Battle Creek Salmon and Steelhead Restoration Project
Final Environmental Impact Statement/ Environmental Impact Report

Volume I: Report

Prepared for:

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Cover
Background photograph: View of North Fork Battle Creek in the fall
Inset photographs, clockwise, starting from the top: Baldwin Creek entering the mainstem of Battle Creek; migrating Chinook salmon; springs near Eagle Canyon Diversion Dam; steelhead pair among spawning gravels; Coleman Diversion Dam and Canal
(Background photograph taken by Kathleen Bishop with the Battle Creek Watershed Conservancy)

Tabs
Background photograph: View of North Fork Battle Creek in the spring
Inset photograph: Natural springs near Eagle Canyon Diversion Dam
(Background photograph taken by Kathleen Bishop with the Battle Creek Watershed Conservancy)

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Acronyms and Abbreviations

AADT	annual average daily traffic
ACHP	Advisory Council on Historic Preservation
ACID	Anderson-Cottonwood Irrigation District
Adaptive Management Plan	Battle Creek Salmon and Steelhead Restoration Project Adaptive Management Plan
ADT	Average Daily Trip
af	acre-feet
af/yr	acre-feet per year
AFRP	Anadromous Fish Restoration Program
AMF	Adaptive Management Fund
AMP	Adaptive Management Plan
AMTT	adaptive management technical team
APE	area of potential effect
APWRA	Altamont Pass Wind Resource Area
ASIP	Action Specific Implementation Plan
BA	biological assessment
Basin Plan	Central Valley Regional Water Quality Control Board's Region 5A/5B (Sacramento and San Joaquin River Basins) Basin Plan
Bay-Delta	San Francisco Bay/Sacramento–San Joaquin Delta
BCWC	Battle Creek Watershed Conservancy
BCWG	Battle Creek Working Group
BLM	U.S. Department of the Interior, Bureau of Land Management
BMPs	best management practices
BO	biological opinion
CAAA	Clean Air Act Amendments of 1990
CAAQS	California Ambient Air Quality Standards

CalEPA	California Environmental Protection Agency
CALFED Program	CALFED Bay-Delta Program
CALFED Programmatic EIS/EIR	CALFED Bay-Delta Program Final Programmatic EIS/EIR
CalPX	California Power Exchange
Caltrans	California Department of Transportation
CAMP	Comprehensive Assessment Monitoring Program
CARB	California Air Resources Board
CBDA	California Bay-Delta Authority
CCR	California Code of Regulations
CDF	California Department of Forestry and Fire Protection
CDP	census designated places
CEC	California Energy Commission
cents/kWh	cents per kilowatt hour
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHRC	California Hydropower Reform Coalition
CIWMB	California Integrated Waste Management Board
CMARP	Comprehensive Monitoring, Assessment, and Research Program
CMP	corrugated metal pipe
CNDDB	California Natural Diversity Database
CNEL	community noise equivalent level
CNFH	Coleman National Fish Hatchery
CNPS	California Native Plant Society
CO	carbon monoxide
Coleman Science Panel	Coleman National Fish Hatchery Science Panel

Communications Protocol	Communications Protocol for Preparing NEPA/CEQA Documents, the FERC License Amendment Application, and Other Related Documents for the Battle Creek Salmon and Steelhead Restoration Project, Battle Creek Hydroelectric Project, FERC Project No. 1121
Corps	U.S. Army Corps of Engineers
CPUC	California Public Utilities Commission
CRHR	California Register of Historical Resources
CT	census tracts
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Regional Water Quality Control Board, Central Valley Region
CWA	Clean Water Act
dB	decibels
dBA	A-weighted sound pressure levels, or decibels
DDT	dichlorodiphenyltrichloroethane
Delta	Sacramento–San Joaquin River Delta
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EIS/EIR	Environmental Impact Statement and Environmental Impact Report
EMT	emergency medical technician
EPA	U.S. Environmental Protection Agency
ERP	Ecosystem Restoration Program
ERPP	Ecosystem Restoration Program Plan
ESA	federal Endangered Species Act
ESU	evolutionarily significant unit
feet msl	feet above mean sea level
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission

FHWA	Federal Highway Administration
FIRMs	Flood Insurance Rate Maps
FPA	Federal Power Act
FPPA	Farmland Protection Policy Act
FR	Federal Register
FWCA	Fish and Wildlife Coordination Act
GBCWWG	Greater Battle Creek Watershed Working Group
GCID	Glenn-Colusa Irrigation District
General Permit	National Pollutant Discharge Elimination System General Permit for Storm Water Discharges Associated with Construction Activities
gpm	gallons per minute
GPS	global positioning system
GWh	Gigawatt hours
HAER	Historic American Engineering Record
Hydroelectric Project	Battle Creek Hydroelectric Project
Hz	cycles per second
IFIM	Instream Flow Incremental Methodology
IHN	infectious hematopoietic necrosis
ISB	CBDA Independent Science Board
ISO	Independent System Operator
k.a.	thousand years ago
KRIS	Klamath Resource information System
kV	kilovolts
kW	kilowatts
kWh	kilowatt-hour
L_{dn}	day-night noise level
L_{eq}	equivalent sound level
L_{max}	maximum noise output level
LOP	Letter of Permission
m.a.	million years ago
MBTA	Migratory Bird Treaty Act
MLTF	Mount Lassen Trout Farm
MOA	memorandum of agreement

MOU	memorandum of understanding
MPR	market price referent
MSCS	Multi-Species Conservation Strategy
MSDS	material safety data sheets
msl	mean sea level
MW	megawatts
MWD	The Metropolitan Water District of Southern California
MWh	megawatt hours
NAAQS	National Ambient Air Quality Standards
NCCP	Natural Community Conservation Plan
NCCPA	California Natural Community Conservation Planning Act
NCCPs	natural community conservation plans
NCPC	Northern California Power Company
NEIC	Northeast Information Center
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NOA	notice of availability
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPV	net-present value
NR	natural resources and recreation zone
NRHP	National Register of Historic Places
NTUs	nephelometric turbidity units
OCAP	Operating Criteria and Plan
OSHA	Occupational Safety and Health Administration

p.u.	power units
PCBs	polychlorinated biphenyls
PG&E	Pacific Gas and Electric Company
PHABSIM	Physical Habitat Simulation
PIT	passive integrated transponder
PL	Public Law
PM10	particulate matter 10 microns in mean diameter or less
PM2.5	particulate matter 2.5 microns in mean diameter or less
PMT	Battle Creek Project Management Team
PPE	personal protective equipment
ppm	parts per million
ppv	peak particle velocity
PRC	Public Resources Code
Programmatic NCCP Determination	DFG's Natural Community Conservation Planning Act Approval of the CALFED Bay-Delta Program Multiple Species Conservation Strategy
psi	pounds per square inch
Qal	Quaternary Alluvium
Qb1	Quaternary Basalt Unit 1
Qb2	Quaternary Basalt Unit 2
Qb3	Quaternary Basalt Unit 3
Qc	Quaternary Colluvium
QCIP	quality control and inspection program
QF	Qualifying Facility
Qrs	Quaternary Reservoir Sediment
RBDD	Red Bluff Diversion Dam
RCC	roller-compacted concrete
Reclamation	U.S. Department of Interior, Bureau of Reclamation
Restoration Project	Battle Salmon and Steelhead Restoration Project
Restoration Project ASIP	Battle Creek Salmon and Steelhead Restoration Project Draft Action Specific Implementation Plan
RM	River Mile
RMR	reliability must run

ROD	Record of Decision
ROG	reactive organic gases
RPS	Renewable Portfolio Standards
RWQCB	Regional Water Quality Control Board
SB	California Senate Bill
SCAQMD	Shasta County Air Quality Management District
SEL	sound exposure level
SGPWRA	San Gorgonio Pass Wind Resource Area
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SNTEMP	stream network temperature model
SO_2	sulfur dioxide
SOP	specific operating procedures
SPCP	Spill Prevention and Countermeasure Plan
SR	State Route
Standards	Reclamation Safety and Health Standards
State Water Board	California State Water Resources Control Board
Summary Report	Biological Survey Summary Report for the Battle Creek Salmon and Steelhead Restoration Project
SVAB	Sacramento Valley Air Basin
SWP	State Water Project
SWPPP	stormwater pollution prevention plan
TAC	Technical Advisory Committee
TCAPCD	Tehama County Air Pollution Control District
TCCA	Tehama-Colusa Canal Authority
TCMs	traffic control measures
TNC	The Nature Conservancy
tpd	tons per day
TPWRA	Tehachapi Pass Wind Resource Area
TPZ	timber preserve zone
TRP	technical review panel
TRP Report	Technical Review Panel Report for the Battle Creek Salmon and Steelhead Restoration Project
TSS	total suspended solids
Ttd	Unit D of the Tuscan formation

UBC	Uniform Building Code
USBM	U.S. Department of this Interior, Bureau of Mines
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VELB	valley elderberry longhorn beetle
WAF	Water Acquisition Fund
WUA	Weighted Usable Area
WY	Water Year
yd^3	cubic yards

Executive Summary

Introduction

The signatories to the 1999 Memorandum of Understanding (MOU) (Appendix A)—the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), the U.S. Fish and Wildlife Service (USFWS), the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries), the California Department of Fish and Game (DFG), and the Pacific Gas and Electric Company (PG&E)—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 ES-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 PG&E to seek a license amendment from FERC.

The Restoration Project is a proactive, cooperative undertaking among the public, interested parties, the Battle Creek Working Group (BCWG) (now the Greater Battle Creek Watershed Working Group [GBCWWG])[1], 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.

Because of the federal and state actions associated with the Restoration Project, compliance with both the National Environmental Policy Act (NEPA) (42 U.S. Code [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 that received funding in 1999 (and may receive additional funding, pursuant to a March 2005 proposal) from the California Bay-Delta Authority (CBDA), which assists with the implementation of the CALFED Bay-Delta Program (CALFED), environmental review of the Final EIS/EIR tiers from the

[1] Since commencement of the Restoration Project, the BCWG has evolved to become the Greater Battle Creek Watershed Working Group; however, it is referred to as the BCWG throughout this document because the referenced activities took place before this change.

CALFED Final Programmatic EIS/EIR (CALFED Bay-Delta Program 2000)[2]. A table summarizing the impacts of the Restoration Project and their levels of significance can be found at the end of this executive summary.

The purpose of the 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.

Reclamation, the lead federal agency, is responsible for ensuring overall NEPA compliance, and 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 amendment requires Clean Water Act (CWA) (33 USC 1251 *et seq.*) Section 401 water quality certification from the California State Water Resources Control Board (State Water Board), the State Water Board is the state lead agency responsible for ensuring compliance with CEQA, the CWA, and other applicable state laws.

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 runs of Chinook salmon and steelhead has resulted in their listing under the federal Endangered Species Act (ESA) and the California Endangered Species Act (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 Central

[2] CBDA, an agency that assists with the implementation of the CALFED Progam, was previously known as the CALFED Bay-Delta Program. Documents published before this name change took place are identified in this Final EIS/EIR as being prepared by the CALFED Bay-Delta Program (CALFED). In addition, the term CALFED is often used to refer to the CALFED Program, also known as the CALFED Plan.

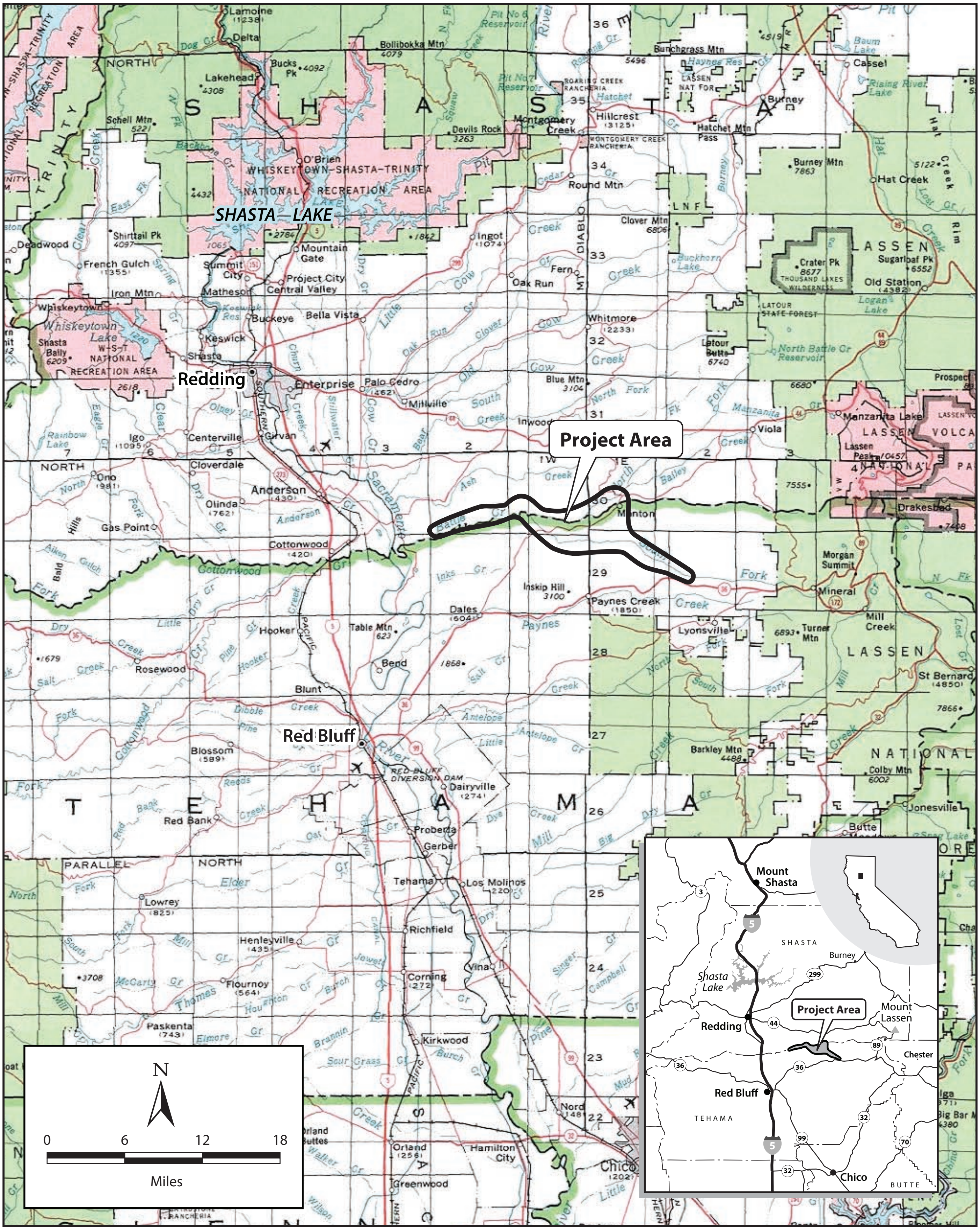

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Figure ES-1
Location of the Battle Creek Salmon and Steelhead Restoration Project

Valley Project Improvement Act (CVPIA), and the Ecosystem Restoration Program (ERP) of the CALFED Bay-Delta Accord.

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, 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 has led to the identification of Battle Creek as a unique opportunity and initiated a partnership to affect a comprehensive restoration project for the watershed.

When compared to other upper Sacramento River tributaries, Battle Creek offers a unique 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. 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.

Other factors that contribute to the unique Battle Creek restoration opportunity include those below.

- Because of the lack of large on-stream storage reservoirs, creek geomorphic processes have not been affected substantially.

- Habitat suitable to support naturally occurring anadromous salmonid species exists in the watershed and will improve with the Restoration Project.
- Private ownership of lands bordering Battle Creek discourages potential human impacts on recovered species.

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. In mid-1999, the parties signed a detailed, formal MOU (Appendix A) in conformance with the Agreement in Principle, allowing the release of $28 million in CBDA, CALFED ERP federal funding for the agencies' responsibilities in the partnership. Since the signing of the MOU in 1999, costs have increased, and additional funds are being requested via a March 2005 proposal to the CALFED ERP[3].

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 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 evaluated along with other action alternatives in this Final EIS/EIR. If an alternative other than the Proposed Action were selected, a new MOU must be negotiated. The ability to negotiate a new agreement for a restoration effort, and the amount of time that would be required to prepare a new MOU, would be uncertain.

Social Context

Various local groups working in the Battle Creek Watershed have provided input on the Restoration Project. The BCWG has served as a catalyst to explore

[3] 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.

various actions to carry forth the Restoration Project. The Battle Creek Watershed Conservancy (BCWC) has also focused on restoration from a watershed approach. Based on a collaborative effort between the project proponents and the community, many of the concerns relating to the Restoration Project have been addressed.

In 2004, the BCWC announced its conditional support of the Restoration Project, pending the appropriate consideration and resolution of four agency issues:

- that USFWS convene and lead an emergency workshop to revisit the steelhead supplementation plan;
- that DFG reconsider the documented record and lead an effort to more clearly identify the goals, objectives, and priorities of the Restoration Project and make sure that those objectives are consistent with existing Restoration Project documentation, with the CALFED Programmatic Record of Decision, and that they are consistent throughout all elements of the final funding request to CBDA;
- that the winter-run recovery team complete the winter-run recovery plan or at least develop a stream-specific strategy for reestablishing a winter-run Chinook salmon population in Battle Creek and that reintroduction strategies are developed for other ESA–listed species (e.g., spring-run Chinook salmon and steelhead) in Battle Creek that can be implemented in anticipation of the Restoration Project Record of Decision; and
- that Reclamation facilitate the development and implementation of an adaptive management plan for Coleman National Fish Hatchery facilities and operations (Battle Creek Watershed Conservancy 2004).

As a result of the progress that has been made on the issues listed above and the ongoing progress concerning other key issues, the BCWC Board now recommends support of the Restoration Project in its current form (Appendix B).

In addition to the Restoration Project, other restoration actions in the watershed include the evaluation of the Coleman National Fish Hatchery's operations to ensure their compatibility with recovery efforts for wild anadromous fish species in Battle Creek upstream of 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 CBDA funding, and the watershed restoration measures identified in the 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

With partnerships coalescing, stakeholders 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, 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.

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.

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 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 *Battle Creek Salmon and Steelhead Restoration Project Adaptive Management Plan* (Adaptive Management Plan) protocols (Terraqua Inc. 2004).

A total of $6 million is budgeted for adaptive management through scheduled use of funds derived from a third party and the Water Acquisition Fund.

Purpose and Need

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 salmon and steelhead, which are dependent on cool water stream habitats. Winter-run Chinook salmon 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 salmon occurs in the mainstem of the Sacramento River below Shasta Dam (Yoshiyama et al. 1998). This section of the river is kept cool by releases from the reservoir. However, periods of extended drought could exhaust Shasta Lake's coldwater reserve, leaving the fish susceptible to reproductive failure. 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 salmon.

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 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 air emissions carbon dioxide, nitrogen oxide, and carbon monoxide and the production of ozone or smog.

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 Final 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 as a result of increased instream flow;
- dedicate water diversion rights for instream purposes at dam removal sites;
- construct tailrace connectors and install failsafe[4] fish screens and fish ladders to increase 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.

As mentioned at the beginning of this executive summary, the Restoration Project is a proactive, cooperative undertaking among the public, interested parties, the BCWG, 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.

[4] The MOU defines failsafe as a level of performance and reliability. Those standards are specified in Sections 2.10 and 2.11 of the MOU (Appendix A).

Proposed Action and Alternatives

The Restoration Project consists of the portion of the Hydroelectric Project below the natural fish barriers (Figure ES-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.

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. A means to access each project site (i.e., an existing or new access road or trail) would be needed during and after construction. Complete descriptions of each site are provided in Chapter 3 of this Final 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; and
- 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.

No Action Alternative

The No Action Alternative is required by NEPA (42 USC 4321–4347) and used as a baseline against which the action alternatives are compared. 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 and maintained according to the conditions set forth in the Hydroelectric Project’s FERC license. It is assumed that fish screens would not be installed in existing diversion canals under 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.

Since 1995, Reclamation has maintained interim flow agreements[5] with PG&E to maintain higher minimum instream flows until such time as 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 to 30 cfs, suspending diversions at Wildcat Diversion Dam, and blocking downstream entrances to the fish passage facilities at Eagle Canyon and Coleman Diversions 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 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 Alternative is the Proposed Action that modifies both facilities and operations to provide water management consistent with the

[5] The Interim Flow Agreement (Agreement 03-20-2554) was developed between Reclamation and PG&E with concurrence from DFG under temporary operation provisions to the existing FERC license. The current agreement will expire in December 2005. For more information, see Chapter 6, “Related Projects,” or Appendix E of this report.

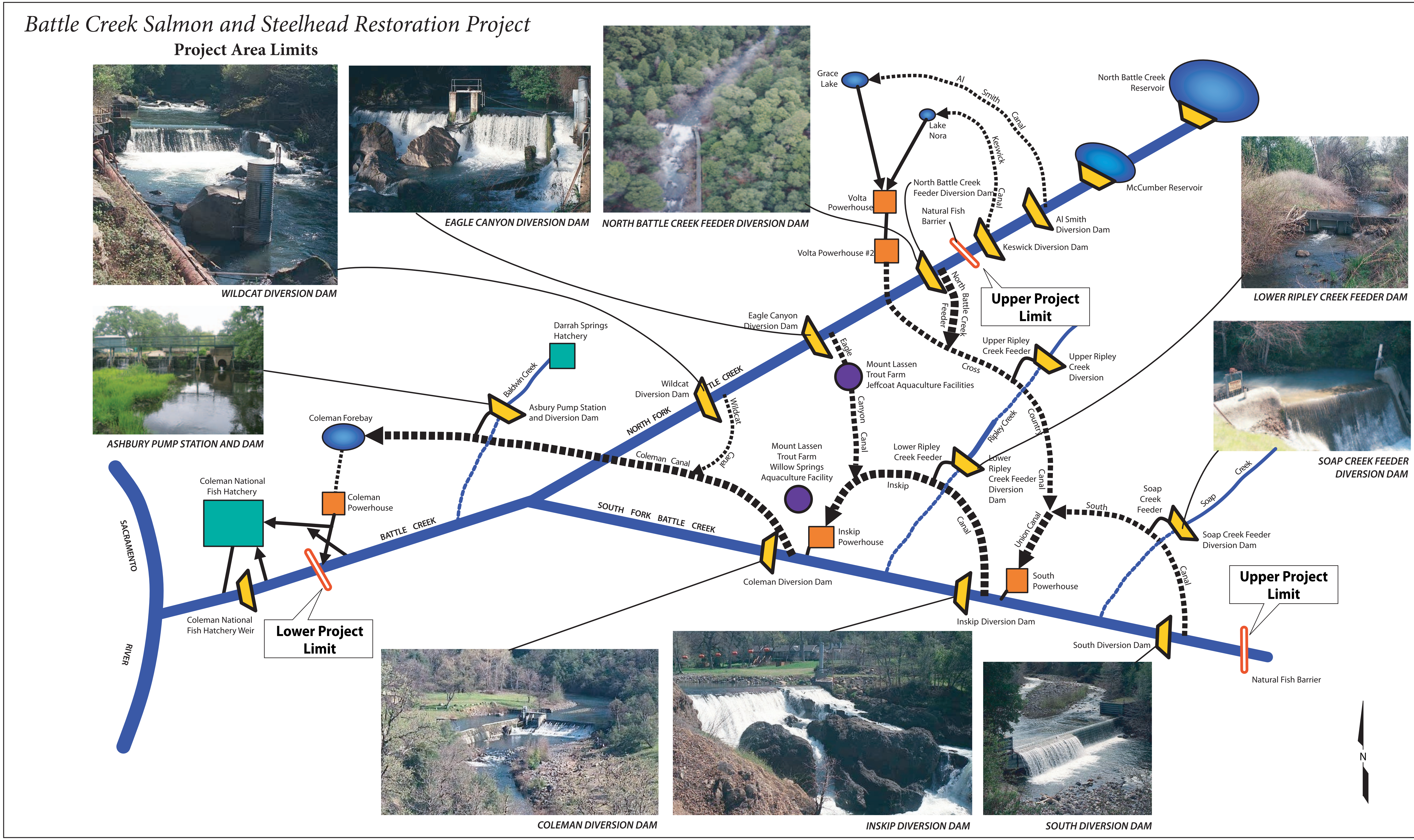

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Figure ES-2
Restoration Project Facilities and Project Area Limits

descriptions in the MOU (Appendix A). Table ES-1 lists the individual components of the Five Dam Removal Alternative.

Table ES-1. Five Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen*
	Fish ladder*
	Minimum instream flow set for North Battle Creek Feeder reach ranges from 47 to 88 cfs
	Access road construction and improvements
Eagle Canyon Diversion Dam	70-cfs fish screen*
	Fish ladder*
	Removal of a segment of the Eagle Canyon Spring Collection Facility
	Minimum instream flow set for Eagle Canyon reach ranges from 35 to 46 cfs
	Improvement of existing access trail
Wildcat Diversion Dam, Pipeline, and Canal	Dam and appurtenant facilities removed
	Improvement of access roads and trail
South Diversion Dam and Canal	Dam and appurtenant facilities removed
	Access road improvements
Soap Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
	Access road improvements
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen*
	Fish ladder*
	Construction of South Powerhouse and Inskip Canal connector (tunnel)
	Minimum instream flow set for Inskip reach ranges from 40 to 86 cfs
	Access road construction and improvements
Lower Ripley Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
	Access road improvements
Coleman Diversion Dam and Inskip Powerhouse	Dam removed
	Construction of Inskip Powerhouse and Coleman Canal connector
	Inskip Powerhouse bypass replaced
	Access road improvements

Site Name	Component
Asbury Pump Station and Diversion Dam	Reoperate
	Creek flow and stage recorder installed
	Minimum instream flow set for Baldwin Creek at 5 cfs

* Reliability and performance standards for fish ladders and fish screens are generally described in the 1999 MOU, Sections 2.10 and 2.11, respectively (Appendix A). More specific information on fish ladders and fish screens is presented in Table 21 and Table 22, respectively, in the Adaptive Management Plan (Terraqua, Inc. 2004)

Under the Five Dam Removal Alternative, Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams would be removed. In addition, fish screens and fish ladders would be installed at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams. At each site, access roads would be constructed or existing roads and trails would be improved to provide access for construction and maintenance activities. Tailrace connectors would be installed to convey water directly from the Inskip and South Powerhouses to downstream canals to meet several fishery restoration goals. A penstock bypass facility would be replaced at the Inskip Powerhouse, as well. Springs along Eagle Canyon, Soap Creek (i.e., Bluff Springs), Ripley Creek, and Darrah Springs areas would release to adjacent stream sections under this alternative. Flow measurement weirs would be installed at Asbury Diversion Dam to ensure a minimum release of 5 cfs in Baldwin Creek.

The new tailrace connectors directing water from Inskip and South Powerhouses to downstream canals would maintain stable stream habitat in Battle Creek, 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. The current bypass facilities at 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.

Construction Schedule

Construction of the Proposed Action is anticipated to begin in spring 2006 and end by summer 2009. The construction schedule for each project site follows:

- North Battle Creek Feeder Diversion Dam—Begin construction in May 2006 and end by August 2007.

- Eagle Canyon Diversion Dam—Begin construction in May 2006 and end by August 2007.
- Wildcat Diversion Dam, Pipeline, and Canal—Begin construction in July 2006 and end by November 2006.
- South Diversion Dam and South Canal—Begin construction in August 2008, complete instream construction by October 2008, and complete decommissioning of the South Canal by January 2009.
- Soap Creek Feeder—Begin construction in August 2008 and end by October 2008.
- Inskip Diversion Dam/South Powerhouse—Begin construction in May 2006 and end by July 2009.
- Lower Ripley Creek Feeder Diversion Dam—Complete construction during July 2007.
- Coleman Diversion Dam/Inskip Powerhouse—Begin construction in May 2006 and end by July 2009.
- Asbury Diversion Dam—Begin construction in May 2007 and end in November 2007.

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 *Battle Creek Salmon and Steelhead Restoration Project Adaptive Management Plan* (Terraqua, Inc. 2004a), which has been developed consistent with relevant CALFED Program guidelines (Chapter 3 in CALFED Bay-Delta Program 1999) 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.

The draft Adaptive Management Plan was revised by the Battle Creek Adaptive Management Team in response to comments received from the CBDA Technical Review Panel, which had reviewed Reclamation's proposal for additional funding presented in February 2003. A copy of the complete report is found on the Restoration Project Web site:

http://www.usbr.gov/mp/battlecreek/docs-adapt_manage.html.

Facility Monitoring 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 draft plan may be found in Appendix B of the Action Specific Implementation Plan (ASIP) (Jones & Stokes 2004) prepared for the Restoration Project. 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 monitoring reports a critical malfunction on the screen, the failsafe feature would shut down the inlet to the canal until the situation has been remedied.
- Recording operation of waste gates, overpours, and spillways during dewatering of the conveyance for maintenance or to release excess water during emergencies.

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

The existing water rights to be transferred from PG&E are listed in Exhibit E of the FERC license. The transfer of these rights to DFG is subject to the condition that the dedications not impair operation of PG&E's remaining diversions. The amount of water to be transferred to DFG and dedicated to the environment will vary seasonally. Water rights transferred for dedication include water from Soap Creek, Lower Ripley Creek, North Fork Battle Creek (at Wildcat and Coleman Diversion Dams), and South Fork Battle Creek (at South and Coleman Diversion Dam). The petition to change the purpose of use will be open to the public for comment and discussion pursuant to the State Water Board's water right process. The purpose of this dedication is to conserve public funds by ensuring that water that was previously diverted by the dams is reserved for instream beneficial use. Dedication of the water rights to the environment by way of a water code 1707 change petition ensures that this benefit is not transitory. The water below the dams is regulated by FERC. No water right transfers or dedications are proposed at dams that remain; however, through the adaptive management process, the availability of flows in the stream reach below these dams could change.

According to Section 1241 of the California State Water Code, water that has not been put to beneficial use for 5 years may be regarded as unappropriated and may be made available for others to appropriate by way of a water rights permit from the State Water Board. If a new water right were approved it would be subject to prior rights and conditions to protect instream beneficial uses. The Restoration Project will go through a further statutory process to prevent abandonment of the water rights at decommissioned dams. Specifically, as described in the Section 6.1 E of the MOU (Appendix A), water rights will be transferred from PG&E to DFG then both parties will jointly file to dedicate the water at decommissioned dams to the environment under Water Code 1707 change petition to formally establish an instream beneficial use and prevent abandonment under Section 1241 et seq. This will ensure that the flow regimes analyzed as part of this effort will be properly dedicated to the Restoration Project and public funds, used to finance this project, will not be wasted.

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 (Appendix A). 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 (Terraqua, Inc. 2004). 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. Table ES-2 provides information on the water rights that would be dedicated to the environment.

Table ES-2. Water Rights Transferred from PG&E to DFG[6]

Identification Number (No.)	Priority or First Use	Diversion Amount (cfs)	Description (Name of Works)	Point of Diversion	Place of Use	Type of Use	Water Class Rights
SWDU No. 837	1910	100	South Battle Creek Canal	South Fork Battle Creek	South, Inskip, and Coleman Powerhouses	Power	Pre-1914
SWDU No. 838	1910	35	Soap Creek Feeder to South Battle Creek Canal	Soap Creek	South, Inskip, and Coleman Powerhouses	Power	Pre-1914
SWDU No. 848	1907	5	Lower Ripley Creek Feeder to Inskip Canal	Ripley Creek	Inskip Powerhouse	Power	Pre-1914
SWDU No. 841	1910	280	Coleman Canal	South Fork Battle Creek	Coleman Powerhouse	Power	Pre-1914
Application No. 2754 License No. 549	1922	18	Wildcat Canal	North Fork Battle Creek	Coleman Powerhouse	Power	License

Notes: SWDU = Statement of water diversion and use.

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 State Water Board 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, and will be administered by the resources agencies, following consultation with appropriate interested parties. Reclamation has committed $3 million of the $28 million in CALFED ERP federal funds (received in 1999) to an account specifically for the Water Acquisition Fund.

[6] As noted in Section 6.1 E of the Restoration Project MOU (see Appendix A), PG&E will transfer water rights to DFG then jointly file for permanent dedication to the environment with the State Water Board under Water Code 1707.

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.

Biological and Environmental Monitoring Fund

In the 1999 MOU, Reclamation, NOAA Fisheries, USFWS, DFG, and PG&E agreed that USFWS and/or DFG, or their designated representatives, will perform biological and environmental monitoring in the Battle Creek watershed and Restoration Project area to address the overall status of anadromous fish populations and related ecosystem health. This monitoring will be performed using available funding from Central Valley fishery restoration funding sources, including CALFED's Comprehensive Monitoring Assessment Research Program, and CVPIA's Comprehensive Assessment and Monitoring Program. Of the $28 million in CALFED ERP federal funds (received in 1999), $1 million was budgeted specifically for monitoring. Pursuant to the 2003 CALFED ERP independent technical review of the Restoration Project, $2.36 million in additional funds for monitoring are being requested as part of the March 2005 proposal to the CALFED ERP. Reclamation, NOAA Fisheries, USFWS, DFG, and PG&E understand and agree that if sufficient funding is not available through the above sources, they will jointly pursue other appropriate funding sources.

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 (Appendix A). 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 and include access road/trail construction or improvements at each project site at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams. The final facility configurations and instream flows for this alternative were derived from the Anadromous Fish Restoration Program (AFRP) (U.S. Fish and Wildlife Service 2001a) and were developed specifically for the restoration of Battle Creek fall- and late fall–run Chinook salmon and steelhead, but not specifically for Battle Creek winter-run or spring-run Chinook salmon. Table ES-3 summarizes the components of the No Dam Removal Alternative.

Table ES-3. No Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 30 to 40 cfs
	Access road construction and improvements
Eagle Canyon Diversion Dam	70-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 30 to 50 cfs
	Improvement of existing access trail
Wildcat Diversion Dam	20-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 30 to 50 cfs
	Improvement of access roads and trail
South Diversion Dam	90-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 20 to 30 cfs
	Access road improvements
Inskip Diversion Dam	220-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 30- 40 cfs
	Access road construction and improvements
Coleman Diversion Dam	340-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 30 to 50 cfs
	Access road improvements
Instream Flows	Minimum instream flows below selected dams would be increased

Note:
cfs = cubic feet per second.

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 Station and Diversion Dam facilities, and no diversion dams would be removed. No powerhouse tailrace connectors or penstock bypass facilities, which prevent mixing of North Fork and South Fork Battle Creek flows, would be constructed. Springs at Eagle Canyon, Soap Creek (i.e., Bluff Springs), Ripley Creek, and Darrah Springs areas would not release to adjacent stream sections under this alternative.

This alternative would also include elements of adaptive management consistent with the overarching principles of adaptive management set forth by the CBDA 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 established in the Five Dam Removal Alternative.

Six Dam Removal Alternative

The Six Dam Removal Alternative would include the facility changes shown in Table ES-4.

Table ES-4. Six Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 47 to 88 cfs
	Access road construction and improvements
Eagle Canyon Diversion Dam	Dam and appurtenant facilities removed
	Improvement of existing access trail
Wildcat Diversion Dam, Pipeline, and Canal	Dam and appurtenant facilities removed
	Improvement of access roads and trail
South Diversion Dam and Canal	Dam and appurtenant facilities removed
	Access road improvements
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 40 to 86 cfs
	Construction of South Powerhouse and Inskip Canal connector (tunnel)
	Access road construction and improvements
Coleman Diversion Dam and Inskip Powerhouse	Dam removed
	Construction of Inskip Powerhouse and Coleman Canal connector
	Inskip Powerhouse bypass replaced
	Access road improvements

Site Name	Component
Lower Ripley Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
	Access road improvements
Soap Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
	Access road improvements
Asbury Pump Station and Diversion Dam	Reoperate
	Creek flow and stage recorder installed
	Minimum instream flow set for Baldwin Creek at 5 cfs

Note:
cfs = cubic feet per second.

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. New tailrace connectors at South and Inskip Powerhouses, and a new bypass facility at the Coleman Diversion Dam/Inskip Powerhouse site would be constructed similar to that described for the Five Dam Removal Alternative to prevent the mixing of North Fork and South Fork Battle Creek flows. Springs at Eagle Canyon, Soap Creek (i.e., Bluff Springs), Ripley Creek, and Darrah Springs areas would release to adjacent stream sections under this alternative. Minimum instream flow requirements are consistent with the 1999 MOU (Appendix A). This alternative would also include elements of adaptive management consistent with the overarching principles of adaptive management set forth by the CBDA Science Program. This alternative does not include a facility monitoring and maintenance plan, dedicated water rights, water acquisition fund, or an adaptive management fund, as established in the Five Dam Removal Alternative.

Three Dam Removal Alternative

The Three Dam Removal Alternative would include the facility changes shown in Table ES-5.

Table ES-5. Three Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 30 to 40 cfs
	Access road construction and improvements

Site Name	Component
Eagle Canyon Diversion Dam	Dam and appurtenant facilities removed
	Improvement of existing trail
Wildcat Diversion Dam, Pipeline, and Canal	Dam and appurtenant facilities removed
	Improvement of access roads and trail
South Diversion Dam	90-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 20 to 30 cfs
	Access road improvements
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen
	Fish ladder
	Monthly minimum flow release ranges from 30 to 40 cfs
	Construction of South Powerhouse and Inskip Canal connector (flow separator channel)
	Access road construction and improvements
Coleman Diversion Dam and Inskip Powerhouse	Dam removed
	Construction of Inskip Powerhouse and Coleman Canal connector
	Inskip Powerhouse Bypass replacement
	Access road improvements
Asbury Pump Station and Diversion Dam	Reoperate
	Creek flow and stage recorder installed
	Minimum instream flow set for Baldwin Creek at 10 cfs

Note:
cfs = cubic feet per second.

The major physical differences between this alternative and the Five Dam Removal Alternative are 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. New tailrace connectors at South and Inskip Powerhouses and a new bypass facility at the Coleman Diversion Dam/Inskip Powerhouse site would be constructed similar to that described for the Five Dam Removal Alternative to prevent the mixing of North Fork and South Fork Battle Creek flows. Springs at Eagle Canyon and Darrah Springs areas would release to adjacent stream sections under this alternative. Minimum instream flow requirements are consistent with AFRP requirements for Battle Creek. This alternative will also include elements of adaptive management consistent with the overarching principles of adaptive management set forth by the CBDA Science Program. This alternative does not include facility monitoring and maintenance plan, dedicated water rights, water acquisition fund, or an adaptive management fund, as described for the Five Dam Removal Alternative.

Summary of Impacts

The following sections present a summary of impacts associated with each Restoration Project alternative. A complete list of impacts associated with each alternative as presented in this Final EIS/EIR is provided in Table ES-6. Chapter 7 in Volume I of this Final EIS/EIR presents a more detailed comparison between the Five Dam Removal Alternative—Proposed Action and each of the action alternatives (including the No Action Alternative) of the relative differences in Chinook salmon and steelhead benefits and significant impacts that would be expected under each alternative.

No Action Alternative

Implementation of the No Action Alternative would not result in new environmental impacts in the Restoration Project study area. This alternative assumes that Hydroelectric Project facilities, including fish ladders, would be operated in accordance with FERC regulations and the existing minimum flows. The existing project operations under the No Action Alternative would continue to limit the recovery of anadromous species in Battle Creek as identified in the Purpose and Need (see Chapter 2 in Volume I of this Final EIS/EIR). Beneficial effects on fish habitat and populations would not occur under this alternative, and construction-related impacts on fish, terrestrial biological resources, wetlands, and historic resources associated with Restoration Project alternatives would not occur in the Battle Creek watershed. Implementing the No Action Alternative would reduce the need to upgrade access roads to hydroelectric facilities and would avoid visual resource effects associated with the South Powerhouse and Inskip Diversion Dam site. No impacts on land use, recreation, local traffic or transportation systems, noise, or air quality would result under this alternative.

Five Dam Removal Alternative—Proposed Action

Implementation of the Proposed Action would result in substantial increases in spawning and rearing habitat and production of fry and juvenile life stages for Chinook salmon and steelhead. For most life stages of steelhead, spring-run Chinook salmon, winter-run Chinook salmon, and late fall–run Chinook salmon, capacity and production indices for the Proposed Action are several times greater than the corresponding indices for the No Action Alternative (Section 4.1, Fish, in Volume I of this Final EIS/EIR). The higher indices indicate the potential for a substantial increase in the number of fry and juvenile fish potentially supported by the higher minimum flow requirements and cooler water temperature conditions.

Additional benefits would result from improvements in fish passage from dam removal and more effective fish ladders and intake screens on remaining dams and diversions. The Proposed Action would also eliminate discharge of North Fork Battle Creek water to South Fork Battle Creek and reduce the number of Hydroelectric Project facilities in the stream channel. The restored hydrologic function would facilitate passage of adult and juvenile anadromous fish and reestablish the natural continuity of habitat use.

Construction of Proposed Action improvements could result in some short-term impacts on habitat and fish survival that would be mitigated with standard construction period mitigation measures. In addition, it was determined that implementation of the Proposed Action could potentially adversely affect fish populations outside of the project area by increasing their risk of exposure to the infectious hematopoietic necrosis (IHN) virus if fish from Mount Lassen Trout Farm's (MLTF's) Jeffcoat and Willow Springs aquaculture facilities, as well as the Darrah Springs State Fish Hatchery, become infected by the IHN virus and later are stocked in California waters. Similarly, implementation of the Proposed Action could potentially adversely affect the beneficial uses of California waters if subsequent third-party actions increase the risk of contamination with the IHN virus. However, mitigation at MLTF's Jeffcoat and Willow Springs aquaculture facilities and the Asbury Diversion Dam site are identified to reduce these impacts to a less-than-significant level.

The Proposed Action would also provide substantial benefits to amphibian habitat by reducing adverse effects of flow fluctuations and by increasing minimum instream flows. Significant construction-related impacts on riparian and wetland habitat would result from Proposed Action improvements that could be reduced by avoiding habitat during construction and replacing temporarily removed habitat on site. Potential habitat disturbances to a number of special-status wildlife species, including valley elderberry longhorn beetle, foothill yellow-legged frog, northwestern pond turtle, yellow-breasted chat, nesting raptors, black rails, and bats, are considered significant. These significant impacts would be reduced to less-than-significant levels by identifying habitat, avoiding occupied habitat areas during construction, and implementing appropriate mitigation measures to minimize impacts when occupied habitat cannot be avoided.

Construction and operation of the Proposed Action associated with South Powerhouse and Inskip Diversion Dam improvements would result in a significant and unavoidable aesthetic impact on the Oasis Springs Lodge. Mitigation measures are identified to partially reduce the aesthetic effect on these facilities. Similarly, recreational use and public access to Battle Creek in the vicinity of construction zones could be affected during the construction period. Mitigation measures are identified to reduce construction-period effects on recreation resources, but not to a less-than-significant level.

Temporary construction nuisances for transportation, noise, and air quality that are considered significant impacts could result at various construction sites during the construction period. Construction area noise-reducing measures and best management practices (BMPs) for emissions controls are identified to reduce these impacts to a less-than-significant level. Potential impacts related to construction area safety have been identified that would be reduced to a less-than-significant level by standard construction area safety precautions.

Wildcat, Eagle Canyon, Coleman, and Inskip Diversion Dams are considered to be historic properties under Section 106 and historical resources for the purposes of CEQA. Under the Proposed Action, Wildcat and Coleman Diversion Dams would be removed, and Eagle Canyon and Inskip Diversion Dams would be modified by installing fish screens and fish ladders. The removal and modifications proposed for these historic properties are considered significant impacts. Reclamation has consulted with the State Historic Preservation Officer (SHPO) with respect to the removal and modification of these facilities, and a memorandum of agreement between Reclamation and the SHPO identifies appropriate measures to implement for these impacts.

Implementation of the Proposed Action would not substantially affect the costs of hydroelectric power generation. The increased annual total and going-forward cost of Hydroelectric Project power, with the 1999 MOU cost-sharing agreement (Appendix A), would be less than the annual power benefits, demonstrating that the Hydroelectric Project would continue to be a low-cost source of electricity.

No Dam Removal Alternative

Implementation of the No Dam Removal Alternative would result in substantial increases in spawning and rearing habitat and production of fry and juvenile life stages for Chinook salmon and steelhead. Fish production would be less than identified for the Proposed Action. For most life stages of steelhead, spring-run Chinook salmon, winter-run Chinook salmon, and late fall–run Chinook salmon, capacity and production indices for the No Dam Removal Alternative are several times greater than the corresponding indices for the No Action Alternative (Section 4.1, Fish, in Volume I of this Final EIS/EIR). The higher indices indicate the potential for a substantial increase in the number of fry and juvenile fish potentially supported by the higher minimum flow requirements and cooler water temperature conditions.

Additional benefits would result from improvements in fish passage from more effective fish ladders and new intake screens at all existing diversion structures. Although the No Dam Removal Alternative would provide substantial benefits relative to the No Action Alternative, the level of benefits would be less than that realized under the Proposed Action (i.e., Five Dam Removal Alternative). The lower benefits could occur in response to:

- lower minimum flow requirements (i.e., AFRP minimum flow requirements under the No Dam Removal Alternative versus MOU minimum flow requirements under the Proposed Action);
- potential impedance of passage associated with movement of adult and juvenile steelhead and Chinook salmon over the dams (i.e., all dams and diversions remain in place); and
- maintenance of unnatural continuity associated with mixing of North Fork Battle Creek flow with South Fork Battle Creek flow that may affect attraction of adult Chinook salmon and an increased potential for adverse warm water temperatures during facility outages.

Some short-term impacts on habitat and fish survival could result from construction of fish ladders and diversion screens, similar to those identified for the Proposed Action. These impacts would be mitigated with standard construction period mitigation measures. Also similar to the Proposed Action, the No Dam Removal Alternative could potentially adversely affect fish populations outside of the project area by increasing their risk of exposure to the IHN virus if fish from MLTF's Jeffcoat and Willow Springs aquaculture facilities, as well as the Darrah Springs State Fish Hatchery, become infected by the IHN virus and later are stocked in California waters. Similarly, implementation of the No Dam Removal Alternative could potentially adversely affect the beneficial uses of California waters if subsequent third-party actions increase the risk of contamination with the IHN virus. However, mitigation at MLTF's Jeffcoat and Willow Springs aquaculture facilities and the Asbury Diversion Dam site are identified to reduce these impacts to a less-than-significant level.

The No Dam Removal Alternative would also provide benefits to amphibian habitat by increasing minimum instream flows. Significant construction-related impacts on riparian and wetland habitat would result from this alternative that could be reduced by avoiding habitat during construction and replacing temporarily removed habitat on site. Potential habitat disturbances to a number of special-status wildlife species, including valley elderberry longhorn beetle, foothill yellow-legged frog, northwestern pond turtle, yellow-breasted chat, nesting raptors, black rail, and bats, are similar to those identified for the Proposed Action and are considered significant. These significant impacts would be reduced to less-than-significant levels by identifying habitat, avoiding occupied habitat areas during construction, and implementing appropriate mitigation measures to minimize impacts when occupied habitat cannot be avoided.

Construction and operation of this alternative associated with the Inskip Diversion Dam fish ladder and diversion improvements would result in a significant and unavoidable aesthetic impact on the Oasis Springs Lodge. Impacts would be slightly less than under the Proposed Action because no powerhouse tailrace connector is proposed under this alternative. Mitigation measures are identified to partially reduce the aesthetic effect of these facilities. Recreational use and public access to Battle Creek in the vicinity of construction zones could be affected in a manner similar to the Proposed Action during the construction period. Mitigation measures are identified to reduce construction-period effects on recreation resources.

Temporary construction nuisances for transportation, noise, and air quality and potential construction site–safety impacts would be similar to those identified for the Proposed Action and would be reduced to a less-than-significant level by implementing mitigation measures similar to those identified for the Proposed Action.

The Wildcat, Eagle Canyon, Coleman, and Inskip Diversion Dams are considered to be historic properties under Section 106, and historical resources for the purposes of CEQA. Under the No Dam Removal Alternative, Wildcat, Eagle Canyon, Inskip, and Coleman Diversion Dams would be modified by installing fish screens and fish ladders. The modifications proposed for these historic properties are considered significant impacts. Reclamation has consulted with the SHPO with respect to the modification of these facilities, and a memorandum of agreement between Reclamation and the SHPO identifies appropriate measure to implement for these impacts.

Implementation of the No Dam Removal Alternative would create an adverse effect on the cost of hydroelectric power generation. The increased annual going-forward cost of Hydroelectric Project power is estimated to be more than the annual power benefits, demonstrating that the Hydroelectric Project would not be a source of low-cost electricity under the No Dam Removal Alternative. In addition, the increased annual total cost of Hydroelectric Project power would be more than annual power benefits (i.e., PG&E would not recover all of its past capital investments).

Six Dam Removal Alternative

Implementation of the Six Dam Removal Alternative would result in substantial increases in spawning and rearing habitat and production of fry and juvenile life stages for Chinook salmon and steelhead. For most life stages of steelhead, spring-run Chinook salmon, winter-run Chinook salmon, and late-fall–run Chinook salmon, capacity and production indices for the Six Dam Removal Alternative are several times greater than the corresponding indices for the No Action Alternative (Section 4.1, Fish, in Volume I of this Final EIS/EIR). The higher indices indicate the potential for a substantial increase in the number of fry and juvenile fish potentially supported by the higher minimum flow requirements and cooler water temperature conditions.

Additional benefits would result from improvements in fish passage from dam removal and more effective fish ladders and new intake screens on remaining dams and diversions. The Six Dam Removal Alternative would also eliminate discharge of North Fork Battle Creek water to South Fork Battle Creek and reduce the number of Hydroelectric Project facilities in the stream channel. The restored hydrologic function would facilitate passage of adult and juvenile anadromous fishes and reestablish the natural continuity of habitat use. These beneficial effects would be similar to those described for the Proposed Action. The most important difference under this alternative would be removal of Eagle Canyon Diversion Dam.

Facility removal and improvements under this alternative could result in some short-term impacts on habitat and fish survival during construction, similar to those identified for the Proposed Action. These impacts would be mitigated with standard construction period mitigation measures. Similar to the Proposed Action, implementation of the Six Dam Removal Alternative could potentially adversely affect fish populations by increasing their risk of exposure to the IHN virus if fish from MLTF's Willow Springs aquaculture facility and the Darrah Springs State Fish Hatchery become infected by the IHN virus and later are stocked in California waters. Similarly, implementation of the Six Dam Removal Alternative could potentially adversely affect the beneficial uses of California waters if subsequent third-party actions increase the risk of contamination with the IHN virus. However, mitigation at MLTF's Willow Springs aquaculture facilities and the Asbury Diversion Dam site are identified to reduce these impacts to a less-than-significant level.

The Six Dam Removal Alternative would also provide benefits to amphibian habitat by reducing adverse effects of flow fluctuations and by increasing minimum instream flows in a manner similar to the Proposed Action. Significant construction-related impacts on riparian and wetland habitat that would result from this alternative could be reduced by avoiding habitat during construction and replacing temporarily removed habitat on site. Potential habitat disturbances to a number of special-status wildlife species, including valley elderberry longhorn beetle, foothill yellow-legged frog, northwestern pond turtle, yellow-breasted chat, nesting raptors, and bats, are similar to those identified for the Proposed Action and are considered significant. These significant impacts would be reduced to less-than-significant levels by identifying habitat, avoiding occupied habitat areas during construction, and implementing appropriate mitigation measures to minimize impacts when occupied habitat cannot be avoided.

Construction and operation of this alternative associated with the South Powerhouse and Inskip Diversion Dam improvements would result in a significant and unavoidable aesthetic impact on the Oasis Springs Lodge in the same manner as the Proposed Action. Similarly, recreational use and public access to Battle Creek in the vicinity of construction zones could be affected during the construction period. Mitigation measures are identified to reduce construction-period effects on recreation resources.

Temporary construction nuisances for transportation, noise, and air quality, and potential construction site–safety impacts would be similar to those identified for the Proposed Action and would be reduced to a less-than-significant level by implementing mitigation measures similar to those identified for the Proposed Action.

The Wildcat, Eagle Canyon, Coleman, and Inskip Diversion Dams are considered to be historic properties under Section 106, and historical resources for the purposes of CEQA. Under the Six Dam Removal Alternative, Wildcat, Eagle Canyon, and Coleman Diversion Dams would be removed, and Inskip Diversion Dam would be modified by installing fish screens and fish ladders. The removal and modifications proposed for these historic properties are considered significant impacts. Reclamation has consulted with the SHPO with respect to the removal and modification of these facilities, and a memorandum of agreement between Reclamation and the SHPO identifies appropriate measure to implement for these impacts.

Implementation of the Six Dam Removal Alternative would create an adverse effect on the cost of hydroelectric power generation. The increased annual going-forward cost of Hydroelectric Project power is estimated to be more than the annual power benefits, demonstrating that the Hydroelectric Project would not be a source of low-cost electricity under the Six Dam Removal Alternative. In addition, the increased annual total cost of Hydroelectric Project power would be more than annual power benefits (i.e., PG&E would not recover all of its past capital investments).

Three Dam Removal Alternative

Implementation of the Three Dam Removal Alternative would result in substantial increases in spawning and rearing habitat and production of fry and juvenile life stages for Chinook salmon and steelhead. For most life stages of steelhead, spring-run Chinook salmon, winter-run Chinook salmon, and late-fall–run Chinook salmon, capacity and production indices for the Three Dam Removal Alternative are several times greater than the corresponding indices for the No Action Alternative (Section 4.1, Fish, in Volume I of this Final EIS/EIR). The higher indices indicate the potential for a substantial increase in the number of fry and juvenile fish potentially supported by the higher minimum flow requirements and cooler water temperature conditions.

Additional benefits would result from improvements in fish passage from dam removal and more effective fish ladders and new intake screens on remaining dams and diversions. The Three Dam Removal Alternative would also eliminate discharge of North Fork Battle Creek water to South Fork Battle Creek and reduce the number of Hydroelectric Project facilities in the stream channel. The restored hydrologic function would facilitate passage of adult and juvenile anadromous fishes and reestablish the natural continuity of habitat use. Although the Three Dam Removal Alternative would provide substantial benefits relative to the No Action Alternative, the level of benefits would be less than those realized under the Proposed Action (i.e., Five Dam Removal Alternative). The lower benefits could occur in response to:

- lower minimum flow requirements (i.e., AFRP minimum flow requirements under the Three Dam Removal Alternative versus MOU minimum flow requirements under the Proposed Action);

- potential impedance of passage associated with movement of adult and juvenile steelhead and Chinook salmon over the dams (i.e., fewer dams and diversions are removed); and
- increased potential for temporary exposure of Chinook salmon and steelhead to variable flow and water temperature conditions during outages at Inskip Powerhouse.

Facility removal and improvements under this alternative could result in some short-term impacts on habitat and fish survival during construction, similar to those identified for the Proposed Action. These impacts would be mitigated with standard construction-period mitigation measures. Similar to the Proposed Action, implementation of the Three Dam Removal Alternative could potentially adversely affect fish populations by increasing their risk of exposure to the IHN virus if fish from MLTF's Willow Springs aquaculture facility and the Darrah Springs State Fish Hatchery become infected by the IHN virus and later are stocked in California waters. Similarly, implementation of the Six Dam Removal Alternative could potentially adversely affect the beneficial uses of California waters if subsequent third-party actions increase the risk of contamination with the IHN virus. However, mitigation at MLTF's Willow Springs aquaculture facility and the Asbury Diversion Dam site are identified to reduce these impacts to a less-than-significant level.

The Three Dam Removal Alternative would also provide substantial benefits to amphibian habitat by reducing adverse effects of flow fluctuations and by increasing minimum instream flows in a manner similar to the Proposed Action. Significant construction-related impacts on riparian and wetland habitat would result from this alternative that could be reduced by avoiding habitat during construction and replacing temporarily removed habitat on site. Potential habitat disturbances to a number of special-status wildlife species, including valley elderberry longhorn beetle, foothill yellow-legged frog, northwestern pond turtle, yellow-breasted chat, nesting raptors, and bats, are similar to those identified for the Proposed Action and are considered significant. These significant impacts would be reduced to less-than-significant levels by identifying habitat, avoiding occupied habitat areas during construction, and implementing appropriate mitigation measures to minimize impacts when occupied habitat cannot be avoided.

Construction and operation of this alternative associated with the South Powerhouse and Inskip Diversion Dam improvements would result in a significant and unavoidable aesthetic impact on the Oasis Springs Lodge in the same manner as the Proposed Action, as well as an additional significant and unavoidable aesthetic impact from the armoring or revetment for the tailrace connector between the South Powerhouse and the Inskip Canal. Similarly, recreational use and public access to Battle Creek in the vicinity of construction zones could be affected during the construction period. Mitigation measures are identified to reduce construction-period effects on recreation resources.

Temporary construction nuisances for transportation, noise, and air quality, and potential construction site–safety impacts would be similar to those identified for the Proposed Action and would be reduced to a less-than-significant level by implementing mitigation measures similar to those identified for the Proposed Action.

The Wildcat, Eagle Canyon, Coleman, and Inskip Diversion Dams are considered to be historic properties under Section 106, and historical resources for the purposes of CEQA. Under the Three Dam Removal Alternative, Wildcat, Eagle Canyon, and Coleman Diversion Dams would be removed, and Inskip Diversion Dam would be modified by installing fish screens and fish ladders. The removal and modifications proposed for these historic properties are considered significant impacts. Reclamation has consulted with the SHPO with respect to the removal and modification of these facilities, and a memorandum of agreement between Reclamation and the SHPO identifies appropriate measure to implement for these impacts.

Implementation of the Three Dam Removal Alternative would create an adverse effect on the cost of hydroelectric power generation. The increased annual going-forward cost of Hydroelectric Project power is estimated to be more than the annual power benefits, demonstrating that the Hydroelectric Project would not be a source of low-cost electricity under the Three Dam Removal Alternative. In addition, the increased annual total cost of Hydroelectric Project power would be more than annual power benefits (i.e., PG&E would not recover all of its past capital investments).

Key Issues and Areas of Potential Controversy

The Restoration Project was developed using a collaborative approach among the federal and state lead agencies, various resource agencies, and the public. Despite this shared approach, several issues have arisen during the development of the Restoration Project and are considered to be potentially controversial. One of these key issues includes the compatibility of the Proposed Action and the other action alternatives with ongoing and planned operations at the Coleman National Fish Hatchery, especially with respect to fish restoration upstream of the hatchery. Other key issues include the focus of the adaptive management process being used for Battle Creek fish restoration, the level of community involvement, long-term impacts on land use as they relate to potential restrictions associated with ESA and CESA compliance, potential effects on trout farming at the MLTF facilities, and the decision not to analyze Alternative 6 and the Eight Dam Removal as action alternatives in this EIS/EIR. Another issue of potential controversy raised by the public is the consideration of other project alternatives. Other issues that have been raised by the public include the cost and effectiveness of the failsafe fish screens and fish ladders, the desire to establish conservation easements on project-related lands, and the need to consolidate public lands along Battle Creek.

Environmentally Preferred Alternative

According to Reclamation's NEPA Handbook, the alternative or alternatives considered to be environmentally preferred should be specified in an EIS. The *environmentally preferred alternative* under NEPA is defined as "the alternative that will promote the national environmental policy as expressed in NEPA's Section 101." Ordinarily, the environmentally preferred alternative refers to the alternative that causes the least damage to the physical environment; it also refers to the alternative that best protects, preserves, and enhances historic, cultural, and natural resources. It is implicit in NEPA that the environmentally preferred alternative is a reasonable and feasible alternative.

Section 15126.6(e) of the State CEQA Guidelines also requires the state lead agency (State Water Board) to identify the environmentally superior alternative. If the No Action Alternative is also the environmentally superior alternative, the EIR will also identify an environmentally superior alternative from among the other alternatives.

In this EIS/EIR for the Restoration Project, the environmentally superior alternative is referred to as the *environmentally preferred* alternative (NEPA terminology).

In addition to the No Action Alternative, four alternatives are considered for the Restoration Project: the Five Dam Removal Alternative (the Proposed Action), No Dam Removal Alternative, Six Dam Removal Alternative, and the Three Dam Removal Alternative. Table ES-7 presents those environmental benefits and impacts that are different among the alternatives. Impacts that are shared by all alternatives are not listed in this table.

Based on the comparison presented in Table ES-7, both the Five Dam Removal (Proposed Action) and Six Dam Removal Alternatives would result in the greatest number of beneficial effects among all the alternatives. The Five Dam and Six Dam Removal Alternatives would have more benefits to fish, amphibians, and riparian species than the other alternatives. In addition, decommissioning South Canal under the Five Dam Removal and Six Dam Removal Alternatives would provide potential habitat in the canal tunnels for special-status bat species. Improvements under both alternatives would substantially improve the reliability and effectiveness of upstream and downstream fish passage. In addition, powerhouse tailrace connectors are proposed under the Five Dam Removal and Six Dam Removal Alternatives. These connectors would prevent North Fork Battle Creek water from mixing with South Fork Battle Creek water, which would prevent false attraction of anadromous fish to South Fork Battle Creek.

The Five Dam Removal (Proposed Action) and Six Dam Removal Alternatives would also result in similar environmental impacts. However, one difference between the two alternatives is that the Five Dam Removal Alternative would include environmental impacts associated with the mitigation that is proposed for the MLTF Jeffcoat mitigation site. Implementing mitigation at the Jeffcoat mitigation site would result in additional significant impacts associated with the potential disturbance to or the loss of habitat for special-status species, including valley elderberry longhorn beetle, foothill yellow-legged frog, northwestern pond turtle, and California black rail. Additionally, mitigation at Jeffcoat would affect waters of the United States and sensitive plant communities and associated wildlife habitats (e.g., riparian forest and scrub plant community). Under the Six Dam Removal Alternative, there would be a greater loss of seasonal wetlands from the closure of the Eagle Canyon Canal that would not occur under the Proposed Action although the loss of these wetlands is considered somewhat speculative. The total loss of waters of the United States, however, would be less under the Six Dam Removal Alternative (approximately 16 acres) compared to the Proposed Action (approximately 18 acres).

Impacts associated with erosion, noise, air quality, and general public health and safely may also occur as a result of implementing the mitigation proposed for the Jeffcoat site. As described in this document, measures will be implemented to mitigate these significant impacts.

With respect to cultural resources, Eagle Canyon Diversion Dam, which was determined to be eligible for inclusion in the NRHP (Section 4.15, Cultural Resources, in Volume I of this Final EIS/EIR), would be removed under the Six Dam Removal Alternative; however, the dam would not be removed under the Five Dam Removal Alternative. Conversely, mitigation activities proposed at the Jeffcoat mitigation site under the Five Dam Removal Alternative could potentially disturb historic-era cultural resources and archeological sites, if these sites are found to be eligible and cannot be avoided.

Both the Five Dam Removal Alternative and the Six Dam Removal Alternative would also require replacing lost hydropower with a renewable resource. The likely renewable resource to replace lost hydropower would be wind power. Environmental impacts typically associated with wind power production include impacts to biological resources (particularly raptors), aesthetics and visual resources, and noise (see Power Generation and Economics in Section 4.16, Other NEPA Analyses, in Volume I of this Final EIS/EIR). Because more hydropower is lost under the Six Dam Removal Alternative compared to the Five Dam Removal Alternative (Table 4.16-9), environmental impacts associated with replacement power under the Six Dam Removal Alternative would also be of greater magnitude than under the Five Dam Removal Alternative. However, these impacts are difficult to quantify because not enough information is known about where the windfarm would be located, how the wind turbines would be designed, and how long the wind turbines would be in operation.

In relation to power generation, the annual power benefits associated with the Five Dam Removal Alternative would be greater than the increased annual total and going-forward cost of Hydroelectric Project power (Section 4.16, Other NEPA Analyses, in Volume I of this Final EIS/EIR). The No Dam Removal, Six Dam Removal, and Three Dam Removal Alternatives would have greater project costs and fewer power generation benefits.

In summary, the Six Dam Removal Alternative and the Five Dam Removal Alternative are nearly equal because they both have the most environmental benefits and a similar number of impacts compared to the other Action Alternatives. The main difference between the Five Dam Removal and Six Dam Removal Alternatives is that the Five Dam Removal Alternative would result in additional potentially significant impacts to the physical environment associated with mitigation at MLTF's Jeffcoat aquaculture facility, although these impacts could be mitigated to a less-than-significant level under the Proposed Action. Although the Six Dam Removal Alternative would result in indirect environmental impacts associated with replacement power at a greater magnitude compared to the Five Dam Removal Alternative, the magnitude of difference between the two alternatives is difficult to quantify. For these reasons, the Six Dam Removal Alternative is identified as the environmentally preferred alternative.

Under NEPA, the federal lead agency is not obligated to select the environmentally preferred alternative as the Proposed Action but must identify it in the Record of Decision and should, if possible, identify it in the final EIS. Similarly, CEQA does not require the state lead agency to select the environmentally superior alternative as the Proposed Action in its EIR, as long as the significant impacts of the proposed project are otherwise avoided or mitigated without implementation of the environmentally superior alternative. No significant impacts associated with the Five Dam Removal Alternative (i.e., the Proposed Action) would in fact be avoided by implementation of the Six Dam Removal Alternative.

Indian Trust Assets

Indian trust assets are legal interests in assets held in trust by the federal government for Indian tribes or individuals. The trust relationship usually stems from a treaty, executive order, or act of Congress. Assets are anything that holds monetary value and can be real property, physical assets, or intangible property rights. Examples of trust assets are lands, minerals, hunting and fishing rights, and water rights. Indian rancherias, reservations, and public domain allotments are frequently placed in trust status.

Reclamation's Indian trust asset policy states that Reclamation will carry out its activities in a manner that protects Indian trust assets and avoids adverse impacts when possible. When Reclamation cannot avoid adverse impacts, it will provide appropriate mitigation or compensation.

A search of the geographical information system coverage for California Indian reservations and public domain allotments failed to show any tribal or Indian lands in the vicinity of the Restoration Project area (Bureau of Reclamation and U.S. Fish and Wildlife Service 1999). Given the absence of Indian lands within or near the Restoration Project area, there will be no impacts on Indian trust assets from the Restoration Project.

Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires each federal agency to identify and address disproportionately high and adverse human health or environmental effects of their actions on minorities and low-income populations and communities. It requires federal agencies to adopt strategies to address environmental justice concerns within the context of agency operations.

The California Government Code (Section 65040.12) defines environmental justice as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations and policies." This statute obligates the State Water Board as state lead agency for CEQA to do the following:

- conduct all programs, policies, and activities in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations of the state;
- promote enforcement of all health and environmental statutes within its jurisdiction in a manner that ensures the fair treatment of all Californians, irrespective of race, culture, and income;
- ensure greater public participation from environmental justice stakeholders in the development, adoption, and implementation of environmental regulations and policies; and
- identify among people of different socioeconomic classifications any differential patterns of consumption of natural resources.

The dams to be removed and the fish screens, ladders, and related water conveyance facilities to be improved as part of the Restoration Project are located on lands managed for grazing, fisheries restoration, and hydropower generation. Construction, operation, and maintenance activities associated with the Restoration Project are not expected to result in substantial changes to, or conflict with, existing land uses or result in substantial change in the socioeconomic characteristics of the study area. The Restoration Project could benefit employment and income in the study area by enhancing the anadromous fishery. Conversely, the Restoration Project could adversely affect employment and income in the study area by reducing or eliminating production from the MLTF, a privately owned fish hatchery with some operations located within the study area.

The Restoration Project study area does not have a high minority or low-income population. Most workers commute outside the study area to their places of employment, and income levels are similar to county averages. Construction, operation, and maintenance of the Restoration Project would not result in a disproportionate effect on a minority and/or low-income communities. In addition, the lead agencies have engaged stakeholders for input at all levels of the project decision-making process to ensure early, accessible, and meaningful participation. By stakeholders' participation in ongoing local watershed efforts, the agencies have included them in the decision-making process and have explored opportunities to address environmental justice within current statutory and regulatory structure (refer to Section 4.16, Other NEPA Analyses, in Volume I of this Final EIS/EIR for additional analysis).

Public and Agency Involvement Process

Public involvement is a vital and required component of the NEPA and CEQA processes. Scoping is a process to gather input from the public, including their issues and concerns and, together with technical input and agency considerations, to define the significant issues to be addressed in the environmental document. NEPA regulations (40 CFR 1500 *et seq.*) define *scoping* as "an early and open process for determining the scope of issues to be addressed, and for identifying the significant issues related to the proposed action." The State CEQA guidelines (Title 14 CCR §§15000 *et seq*.) require scoping meetings under limited circumstances and encourage scoping activities.

Reclamation placed a Notice of Intent to prepare an EIS/EIR and notice of a public scoping meeting in the *Federal Register* on January 12, 2000. A brief description of the proposed Restoration Project and details on the public scoping meeting were included in the notice.

A joint federal and state public scoping meeting was held on January 31, 2000, at the Manton School Gymnasium in Manton, California. During this meeting, the public was presented with an overview of the Restoration Project, including the purpose of and need for the project, a project description, and the current project alternatives. In addition, written and oral comments were received from the public at this meeting.

The State Water Board issued a Notice of Preparation of a draft EIS/EIR for the Restoration Project on April 12, 2000. The notice was circulated through the State Clearinghouse for agency review and comment on April 13, 2000.

The Scoping Report[7], prepared in 2000, provides an overview of the Restoration Project; describes the environmental compliance process associated with the Restoration Project, including the role of public scoping; discusses the public scoping meeting; describes Restoration Project alternatives; and contains comments received throughout the scoping process.

In addition to the public scoping process, public participation has been encouraged and has occurred at Restoration Project meetings. The public input received at Restoration Project meetings, including the GBCWWG, Environmental and Design Technical Team, and Battle Creek Project Management Team (PMT) meetings, was used throughout the development of the EIS/EIR.

[7] The Scoping Report is available on Reclamation's web site at http://www.usbr.gov/mp/battlecreek/.

Preparation of the Restoration Project documents, including the EIS/EIR, Adaptive Management Plan, and Draft FERC license amendment, has also involved active participation by coordinated teams of federal and state agency staff, stakeholders, the public, and interested parties. Members of the teams included Reclamation, USFWS, NOAA Fisheries, FERC, DFG, the State Water Board, California Department of Water Resources, PG&E, BCWG, Battle Creek Watershed Conservancy, The Nature Conservancy, Friends of the River, and others. Most of the teams met monthly; meetings were open to the public.

The release of the Draft EIS/EIR provided the public with an opportunity to provide input on the analysis of the environmental effects of the proposed project and the action alternatives examined in the Draft EIS/EIR. The Draft EIS/EIR was released for a 90-day public review on July 18, 2003. Responses to the comments received during the review of the Draft EIS/EIR are presented in Volume III of this Final EIS/EIR.

After the Draft EIS/EIR was released for public review, Reclamation with participation from the Battle Creek PMT and Technical Team members, conducted two public information workshops in Manton, California, for stakeholders and members of the public (July 23, 2003, and August 12, 2003). On March 15, 2004, Reclamation with participation from the PMT, Technical Team members, and The Nature Conservancy, and CHRC held a public meeting in Red Bluff, California, specifically to address public questions about the incremental benefits between the proposed Restoration Project and the Eight Dam Removal Alternative, which has been eliminated from further consideration. Public comments have been encouraged at all public meetings on the Restoration Project.

After the close of the public comment period for the Draft EIS/EIR, Reclamation and the State Water Board began responding to comments that had been received during public review. As a result of this process, and subsequent reviews that were performed outside the NEPA/CEQA process, it became evident that significant new information would need to be added to the Draft EIS/EIR. Therefore, Reclamation and the State Water Board recirculated portions of the Draft EIS/EIR for public comment in the Draft Supplemental EIS/Revised EIR.

The public comment period for the Draft Supplemental EIS/Revised EIR began on March 1, 2005, with an announcement of the availability of the Draft Supplemental EIS/Revised EIR. The formal public comment period closed on April 29, 2005. Responses to the comments received during the review of the Draft Supplemental EIS/Revised EIR are presented in Volume III of this Final EIS/EIR.

Copies of the Draft Supplemental EIS/Revised EIR were distributed to the public, interested parties, federal and state agencies, local governments, elected officials, and various non-governmental groups. In addition, copies of the Draft Supplemental EIS/Revised EIR were sent to the Tehama County Library, the Shasta County Library, the Susanville Library, and the Natural Resources Library for the Department of the Interior located in Washington, D.C. for public viewing. Notice was placed in the *Federal Register* in compliance with NEPA. Copies were provided to the State Clearinghouse for distribution to state agencies in compliance with CEQA. Pursuant to its issuance, the Draft Supplemental EIS/Revised EIR was provided to others upon their request.

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Table ES-6. Summary of Impacts, Levels of Significance, and Proposed Mitigation Measures for the No Action Alternative, Five Dam Removal Alternative (Proposed Action), No Dam Removal Alternative, Six Dam Removal Alternative, and Three Dam Removal Alternative

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
FISH			
No Action Alternative			
Hydroelectric Project facilities (including fish ladders) and operations would be maintained and operated in accordance with Federal Energy Regulatory Commission (FERC) regulations, and the existing minimum flows would continue to be provided; fish populations would continue to be maintained at levels lower than those targeted by restoration goals.	No change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.1-1. Mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek from an accidental spill of petroleum products and other construction-related materials	Significant	Construction contractor will implement toxic materials control and spill plans; Reclamation will implement a construction-area fish management program.	Less than Significant
Impact 4.1-2. Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species because of increased sedimentation to North Fork and South Fork Battle Creek as a result of construction activities	Significant	Construction contractors will develop and implement a vegetation protection plan and an erosion and sediment plan.	Less than Significant
Impact 4.1-3. Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of removing South, Coleman, and Wildcat Diversion Dams, which would release currently stored fine sediment to the stream channel	Significant	Reclamation will remove diversion dams during low-flow season (July–October) and will construct pilot channels.	Less than Significant
Impact 4.1-4. Disturbed steelhead and Chinook salmon habitat in the stream channel as a result of construction activities	Less than Significant	None	Not Applicable
Impact 4.1-5. Disrupted movement and migration of fish species as a result of dewatering portions of the stream channel and temporarily removing fish ladders during construction	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-6. Compromised feeding efficiency of sight-feeding fish from erosion and the input of fine sediment as a result of construction and demolition activities	Less than Significant	None	Not Applicable
Impact 4.1-7. Vulnerability of all life stages of fish to injury or mortality from percussion-related energy shock waves, operation of equipment, and becoming trapped in isolated pockets of water during construction activities	Less than Significant	None	Not Applicable
Impact 4.1-8. Increased risk of a serious or catastrophic fish disease spreading from Battle Creek to fish communities throughout the state through stocking with MLTF and Darrah Springs State Fish Hatchery fish	Significant	A pipeline would be constructed to bypass the Jeffcoat site to prevent the potential contamination of spring water with the IHN virus. In addition, one of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam.	Less than Significant
Impact 4.1-9. Reduced habitat and range of some resident warmwater species because of cooler water temperatures	Less than Significant	None	Not Applicable
Impact 4.1-10. Decreased rainbow trout abundance in canals as a result of eliminating some diversions and constructing effective fish screens at three dams	Less than Significant	None	Not Applicable
Impact 4.1-11. Increased exposure of rainbow trout to pathogens because of the increase of Chinook salmon and steelhead in Battle Creek	Less than Significant	None	Not Applicable
Impact 4.1-12. Substantially increased capacity indices for spawning and rearing of steelhead and Chinook salmon resulting from increased minimum instream flows	Beneficial	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-13. Substantially increased production indices for fry and juvenile life stages for steelhead and Chinook salmon as a result of cooler water temperatures	Beneficial	None	Not Applicable
Impact 4.1-14. Increased survival of adults and increased spawning success because higher instream flows would improve conditions that facilitate passage of Chinook salmon and steelhead over natural barriers	Beneficial	None	Not Applicable
Impact 4.1-15. Increased survival of adults and increased spawning success because removal of five dams and the construction of more reliable effective fish ladders would facilitate passage of Chinook salmon and steelhead	Beneficial	None	Not Applicable
Impact 4.1-16. Potentially increased spawning success and fry production because separating the powerhouse water discharge from the normal stream channel would facilitate the return of adult Chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek	Beneficial	None	Not Applicable
Impact 4.1-17. Restoration of natural streamflows and processes by ceasing the discharge of North Fork Battle Creek water to South Fork Battle Creek	Beneficial	None	Not Applicable
Impact 4.1-18. Substantially increased survival of juvenile steelhead and Chinook salmon during downstream movement and migration as a result of eliminating some diversions and constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek	Beneficial	None	Not Applicable
Impact 4.1-19. Reduction of predation-related mortality as a result of removing dams and improving fish ladders	Beneficial	None	Not Applicable
Impact 4.1-20. Substantially increased production of food for fish resulting from increased minimum instream flows	Beneficial	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
No Dam Removal Alternative			
Impact 4.1-21. Mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek from an accidental spill of petroleum products and other construction-related materials (similar to Impact 4.1-1)	Significant	Construction contractor will implement toxic materials control and spill plans; Reclamation will implement a construction-area fish management program. (Same mitigation as that identified for Proposed Action, Impact 4.1-1.)	Less than Significant
Impact 4.1-22. Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species because of increased sedimentation to North Fork and South Fork Battle Creek as a result of construction activities (similar to Impact 4.1-2)	Significant	Construction contractors will develop and implement a vegetation protection plan and an erosion and sediment plan. (Same mitigation as that identified for Proposed Action, Impact 4.1-2.)	Less than Significant
Impact 4.1-23. Disturbed steelhead and Chinook salmon habitat in the stream channel as a result of construction activities	Less than Significant	None	Not Applicable
Impact 4.1-24. Disrupted movement and migration of fish species as a result of dewatering portions of the stream channel and temporarily removing fish ladders during construction (similar to Impact 4.1-5)	Less than Significant	None	Not Applicable
Impact 4.1-25. Compromised feeding efficiency of sight-feeding fish from erosion and the input of fine sediment as a result of construction and demolition activities (similar to Impact 4.1-6)	Less than Significant	None	Not Applicable
Impact 4.1-26. Vulnerability of all life stages of fish to injury or mortality from percussion-related energy shock waves, operation of equipment, and becoming trapped in isolated pockets of water during construction activities (similar to Impact 4.1-7)	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-27. Increased risk of a serious or catastrophic fish disease spreading from Battle Creek to fish communities throughout the state through stocking with Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery fish (similar to Impact 4.1-8)	Significant	A pipeline would be constructed to bypass the Jeffcoat site to prevent the potential contamination of spring water with the IHN virus. In addition, one of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant
Impact 4.1-28. Reduced habitat and range of some resident warmwater species because of cooler water temperatures	Less than Significant	None	Not Applicable
Impact 4.1-29. Decreased rainbow trout abundance in canals as a result of eliminating some diversions and constructing effective fish screens at three dams	Less than Significant	None	Not Applicable
Impact 4.1-30. Increased exposure of rainbow trout to pathogens because of the increase of Chinook salmon and steelhead in Battle Creek (similar to Impact 4.1-11)	Less than Significant	None	Not Applicable
Impact 4.1-31. Substantially increased capacity indices for spawning and rearing of steelhead and Chinook salmon resulting from increased minimum instream flows (similar to Impact 4.1-12)	Beneficial	None	Not Applicable
Impact 4.1-32. Substantially increased production indices for fry and juvenile life stages for steelhead and Chinook salmon as a result of cooler water temperatures (similar to Impact 4.1-13)	Beneficial	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-33. Increased survival of adults and increased spawning success because higher instream flows would improve conditions that facilitate passage of Chinook salmon and steelhead over natural barriers (similar to Impact 4.1-14)	Beneficial	None	Not Applicable
Impact 4.1-34. Increased survival of adults and increased spawning success because of the construction of more effective fish ladders on North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams would facilitate passage of Chinook salmon and steelhead	Beneficial	None	Not Applicable
Impact 4.1-35. Substantially increased survival of juvenile steelhead and Chinook salmon during downstream movement and migration as a result of constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek	Beneficial	None	Not Applicable
Impact 4.1-36. Reduction of predation-related mortality as a result of improving fish ladders	Beneficial	None	Not Applicable
Impact 4.1-37. Substantially increased production of food for fish resulting from increased minimum instream flows (similar to Impact 4.1-20)	Beneficial	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.1-38. Mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek from an accidental spill of petroleum products and other construction-related materials (similar to Impact 4.1-1)	Significant	Construction contractor will implement toxic materials control and spill plans; Reclamation will implement a construction-area fish management program. (Same mitigation as that identified for Proposed Action, Impact 4.1-1.)	Less than Significant
Impact 4.1-39. Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species because of increased sedimentation to North Fork and South Fork Battle Creek as a result of construction activities (similar to Impact 4.1-2)	Significant	Construction contractors will develop and implement a vegetation protection plan and an erosion and sediment plan. (Same mitigation as that identified for Proposed Action, Impact 4.1-2.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-40. Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of removing South, Coleman, and Eagle Canyon Diversion Dams, which would release currently stored fine sediment to the stream channel (similar to Impact 4.1-3)	Significant	Reclamation will remove diversion dams during low-flow season (July–October) and construct pilot channels. (Same mitigation as that identified for Proposed Action, Impact 4.1-3.)	Less than Significant
Impact 4.1-41. Disturbed steelhead and Chinook salmon habitat in the stream channel as a result of construction activities (similar to Impact 4.1-4)	Less than Significant	None	Not Applicable
Impact 4.1-42. Disrupted movement and migration of fish species as a result of dewatering portions of the stream channel and temporarily removing fish ladders during construction (similar to Impact 4.1-5)	Less than Significant	None	Not Applicable
Impact 4.1-43. Compromised feeding efficiency of sight-feeding fish from erosion and the input of fine sediment as a result of construction and demolition activities (similar to Impact 4.1-6)	Less than Significant	None	Not Applicable
Impact 4.1-44. Vulnerability of all life stages of fish to injury or mortality from percussion-related energy shock waves, operation of equipment, and becoming trapped in isolated pockets of water during construction activities (similar to Impact 4.1-7)	Less than Significant	None	Not Applicable
Impact 4.1-45. Increased risk of a serious or catastrophic fish disease spreading from Battle Creek to fish communities throughout the state through stocking with Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery fish (similar to Impact 4.1-8)	Significant	One of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-46. Reduced habitat and range of some resident warmwater species because of cooler water temperatures (similar to Impact 4.1-9)	Less than Significant	None	Not Applicable
Impact 4.1-47. Decreased rainbow trout abundance in canals as a result of eliminating some diversions and constructing effective fish screens at three dams (similar to Impact 4.1-10)	Less than Significant	None	Not Applicable
Impact 4.1-48. Increased exposure of rainbow trout to pathogens because of the increase of Chinook salmon and steelhead in Battle Creek	Less than Significant	None	Not Applicable
Impact 4.1-49. Substantially increased capacity indices for spawning and rearing habitat of steelhead and Chinook salmon resulting from increased minimum instream flows (similar to Impact 4.1-12)	Beneficial	None	Not Applicable
Impact 4.1-50. Substantially increased production indices for fry and juvenile life stages for steelhead and Chinook salmon as a result of cooler water temperatures (similar to Impact 4.1-13)	Beneficial	None	Not Applicable
Impact 4.1-51. Increased survival of adults and increased spawning success because higher instream flows would improve conditions that facilitate passage of Chinook salmon and steelhead over natural barriers (similar to Impact 4.1-14)	Beneficial	None	Not Applicable
Impact 4.1-52. Increased survival of adults and increased spawning success because removal of dams and the construction of more effective fish ladders would facilitate passage of Chinook salmon and steelhead (similar to Impact 4.1-15)	Beneficial	None	Not Applicable
Impact 4.1-53. Potentially increased spawning success and fry production because separating the powerhouse water discharge from the normal stream channel would facilitate the return of adult Chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek (similar to Impact 4.1-16)	Beneficial	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-54. Restoration of natural streamflows and processes by ceasing the discharge of North Fork Battle Creek water to South Fork Battle Creek (similar to Impact 4.1-17)	Beneficial	None	Not Applicable
Impact 4.1-55. Substantially increased survival of juvenile steelhead and Chinook salmon during downstream movement and migration as a result of ceasing diversions and constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek (similar to Impact 4.1-18)	Beneficial	None	Not Applicable
Impact 4.1-56. Reduction of predation-related mortality as a result of removing dams and improving fish ladders (similar to Impact 4.1-19)	Beneficial	None	Not Applicable
Impact 4.1-57. Substantially increased production of food for fish resulting from increased minimum instream flows (similar to Impact 4.1-20)	Beneficial	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.1-58. Mortality and lowered growth rates and reproductive success of fish and other aquatic species in Battle Creek from an accidental spill of petroleum products and other construction-related materials (similar to Impact 4.1-1)	Significant	Construction contractor will implement toxic materials control and spill plans; Reclamation will implement a construction-area fish management program. (Same mitigation as that identified for Proposed Action, Impact 4.1-1.)	Less than Significant
Impact 4.1-59. Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species because of increased sedimentation to North Fork and South Fork Battle Creek as a result of construction activities (similar to Impact 4.1-2)	Significant	Construction contractors will develop and implement a vegetation protection plan and an erosion and sediment plan. (Same mitigation as that identified for Proposed Action, Impact 4.1-2.)	Less than Significant
Impact 4.1-60. Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of removing South, Coleman, and Eagle Canyon Diversion Dams, which would release currently stored fine sediment to the stream channel (similar to Impact 4.1-3)	Significant	Reclamation will remove diversion dams during low-flow season (July–October) and construct pilot channels. (Same mitigation as that identified for Proposed Action, Impact 4.1-3.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-61. Disturbed steelhead and Chinook salmon habitat in the stream channel as a result of construction activities (similar to Impact 4.1-4)	Less than Significant	None	Not Applicable
Impact 4.1-62. Disrupted movement and migration of fish species as a result of dewatering portions of the stream channel and temporarily removing fish ladders during construction (similar to Impact 4.1-5)	Less than Significant	None	Not Applicable
Impact 4.1-63. Compromised feeding efficiency of sight-feeding fish from erosion and the input of fine sediment as a result of construction and demolition activities (similar to Impact 4.1-6)	Less than Significant	None	Not Applicable
Impact 4.1-64. Vulnerability of all life stages of fish to injury or mortality from percussion-related energy shock waves, operation of equipment, and becoming trapped in isolated pockets of water during construction activities (similar to Impact 4.1-7)	Less than Significant	None	Not Applicable
Impact 4.1-65. Increased risk of a serious or catastrophic fish disease spreading from Battle Creek to fish communities throughout the state through stocking with MLTF and Darrah Springs State Fish Hatchery fish (similar to Impact 4.1-8)	Significant	One of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant
Impact 4.1-66. Reduced habitat and range of some resident warmwater species because of cooler water temperatures (similar to Impact 4.1-9)	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-67. Decreased rainbow trout abundance in canals as a result of eliminating some diversions and constructing effective fish screens at three dams (similar to Impact 4.1-10)	Less than Significant	None	Not Applicable
Impact 4.1-68. Increased exposure of rainbow trout to pathogens because of the increase of Chinook salmon and steelhead in Battle Creek (similar to Impact 4.1-11)	Less than Significant	None	Not Applicable
Impact 4.1-69. Substantially increased capacity indices for spawning and rearing of steelhead and Chinook salmon resulting from increased minimum instream flows (similar to Impact 4.1-12)	Beneficial	None	Not Applicable
Impact 4.1-70. Substantially increased production indices for fry and juvenile life stages for steelhead and Chinook salmon as a result of cooler water temperatures (similar to Impact 4.1-13)	Beneficial	None	Not Applicable
Impact 4.1-71. Increased survival of adults and increased spawning success because higher instream flows would improve conditions that facilitate passage of Chinook salmon and steelhead over natural barriers (similar to Impact 4.1-14)	Beneficial	None	Not Applicable
Impact 4.1-72. Increased survival of adults and increased spawning success because removal of dams and the construction of more effective fish ladders would facilitate passage of Chinook salmon and steelhead (similar to Impact 4.1-15)	Beneficial	None	Not Applicable
Impact 4.1-73. Potentially increased spawning success and fry production because separating the powerhouse water discharge from the normal stream channel would facilitate the return of adult Chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek (similar to Impact 4.1-16)	Beneficial	None	Not Applicable
Impact 4.1-74. Restoration of natural stream flows and processes by ceasing the discharge of North Fork Battle Creek water to South Fork Battle Creek (similar to Impact 4.1-17)	Beneficial	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.1-75. Substantially increased survival of juvenile steelhead and Chinook salmon during downstream movement and migration as a result of eliminating some diversions and constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek (similar to Impact 4.1-18)	Beneficial	None	Not Applicable
Impact 4.1-76. Reduction of predation-related mortality as a result of removing dams and improving fish ladders (similar to Impact 4.1-19)	Beneficial	None	Not Applicable
Impact 4.1-77. Substantially increased production of food for fish resulting from increased minimum instream flows (similar to Impact 4.1-20)	Beneficial	None	Not Applicable
BOTANICAL, WETLAND, AND WILDLIFE RESOURCES			
No Action Alternative			
Botanical, wildlife, and wetland resources would not be affected under the No Action Alternative; the Hydroelectric Project would continue to operate consistent with the current FERC license.	No Change	None	
Five Dam Removal Alternative (Proposed Action)			
Impact 4.2-1. Potential disturbance or loss of 4.18 acres of woody riparian vegetation and associated wildlife habitat	Significant	Reclamation will avoid and minimize the removal and disturbance of riparian habitat, avoid long-term impacts on woody riparian vegetation and associated habitat, and compensate for the loss of any such habitat.	Less than Significant
Impact 4.2-2. Potential introduction of noxious weeds or spread of existing noxious weeds	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.7-1, Reclamation will educate construction crews, use appropriate eradication techniques, wash all equipment after leaving noxious weed sites, use weed-free materials for revegetation, perform a post-construction weed inventory, and perform routine inspections at construction sites.	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-3. Potential loss or disturbance of 18.86 acres of waters of the United States (including wetlands)	Significant	In addition to mitigation identified for the Proposed Action, Impacts 4.4-1 and 4.7-1, Reclamation will prohibit equipment access or staging in jurisdictional waters adjacent to the construction zone, stake and flag wetland areas for avoidance, routinely inspect protected areas, implement stream bank stabilization measures, compensate for loss of waters of the United States, and revegetate lost habitat.	Less than Significant
Impact 4.2-4. Potential loss or disturbance of common upland woodland and forest communities and associated wildlife habitat	Significant	A qualified biologist will identify the species and number of native trees to be removed or affected to protect those not removed and develop a tree planting plan; in addition, a qualified biologist will monitor all newly planted trees for 5 years and inspect pruned sites prior to, immediately after, and 1 year after construction for regrowth; Reclamation will compensate for the loss of oak and woodland habitat.	Less than Significant
Impact 4.2-5. Potential disturbance to valley elderberry longhorn beetle habitat	Significant	A qualified biologist will identify and mark valley elderberry longhorn beetle habitat for avoidance during construction; Reclamation will minimize impacts during construction through protection measures and replace any lost habitat post construction.	Less than Significant
Impact 4.2-6. Potential disturbance of foothill yellow-legged frogs and their habitat	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-3, a qualified biologist will survey for foothill yellow-legged frogs before construction begins; if frogs are found, a qualified biologist will construct barrier fencing to exclude frogs from the work area and relocate frogs to nearest suitable habitat until after construction.	Less than Significant
Impact 4.2-7. Potential disturbance of northwestern pond turtles and their habitat	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-3, a qualified biologist will survey for northwestern pond turtles before construction begins; if turtles are found, a qualified biologist will construct barrier fencing to exclude turtles from the work area and relocate frogs to nearest suitable habitat until after construction.	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-8. Potential disturbance of breeding habitat for yellow-breasted chat and little willow flycatcher	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-1, a qualified biologist will survey for breeding yellow-breasted chats and little willow flycatchers before construction begins; if breeding chats or little willow flycatchers are found, the construction contractor will limit removal of riparian vegetation and establish a 500-foot no disturbance buffer around all active sites until after construction.	Less than Significant
Impact 4.2-9. Potential disturbance to nesting raptors	Significant	A qualified biologist will perform preconstruction surveys of the project sites to locate active osprey, Cooper's hawk, peregrine falcon, golden eagle, and bald eagle nests; if active nests are found, Reclamation will limit construction activities near the nests to the nonbreeding season (mid-July to late March), establish a 500-foot-radius direct line-of-sight buffer for active nonlisted special-status raptor nests and a 0.5-mile-radius direct line-of-sight buffer for active bald eagle nests, and maintain a 0.5-mile direct line-of-sight helicopter exclusion zone around any active nests.	Less than Significant
Impact 4.2-10. Potential disturbance to nesting California black rails in emergent marsh	Significant	A qualified biologist will conduct a tape-playback survey to determine presence of California black rails in the emergent marsh, and construction activities will be seasonally restricted to avoid disturbance during the rails' nesting season.	Less than Significant
Impact 4.2-11. Potential disturbance of bats in canal tunnels and on rocky cliffs and outcrops along canyon walls	Significant	A qualified biologist will survey construction sites, nearby tunnels, rocky cliffs and outcrops, and other potential bat habitats that could be adversely affected by construction to determine the presence or absence of bats; Reclamation will restrict construction activities to non-use periods or outside the breeding and hibernation periods if sites are found that support maternity colonies or large concentrations of roosting bats; if impacts are unavoidable during any season, Reclamation will implement selected minimizing actions to reduce disturbance of roosting bats; construction scheduling, buffer zones, and other mitigation measures will be developed in consultation with bat specialists, U.S. Fish and Wildlife Service, and the California Department of Fish and Game.	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-12. Possible loss of woody riparian vegetation along PG&E canals	Less than Significant	None	Not Applicable
Impact 4.2-13. Potential disturbance of mixed chaparral habitat	Less than Significant	Reclamation will implement BMPs and environmental commitments described in Chapter 3 (Volume I of this Final EIS/EIR), including compensation for habitat loss, to avoid or minimize temporary effects on mixed chaparral.	Less than Significant
Impact 4.2-14. Potential disturbance of annual grassland habitat	Less than Significant	Reclamation will implement BMPs and environmental commitments described in Chapter 3 (Volume I of this Final EIS/EIR), including compensation for habitat loss, to avoid or minimize temporary effects on annual grassland.	Less than Significant
Impact 4.2-15. Potential disturbance of foraging bald eagles along Battle Creek	Less than Significant	None	Not Applicable
Impact 4.2-16. Reduction of artificial flow fluctuations and increased survival of amphibians	Beneficial	None	Not Applicable
Impact 4.2-17. Increase in quantity of amphibian habitat resulting from increased minimum instream flows	Beneficial	None	Not Applicable
Impact 4.2-18. Substantial increase in quantity of bat roosting habitat in the South Canal tunnels as a result of termination of water flow through the tunnels	Beneficial	None	Not Applicable
No Dam Removal Alternative			
Impact 4.2-19. Potential disturbance or loss of 1.87 acres of woody riparian vegetation and associated wildlife habitat (similar to Impact 4.2-1)	Significant	Reclamation will avoid and minimize the removal and disturbance of riparian habitat, avoid long-term impacts on woody riparian vegetation and associated habitat, and compensate for the loss of any such habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-1.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-20. Potential introduction of noxious weeds or spread of existing noxious weeds (similar to Impact 4.2-2)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.7-1, Reclamation will educate construction crews, use appropriate eradication techniques, wash all equipment after leaving noxious weed sites, use weed-free materials for revegetation, perform a post-construction weed inventory, and perform routine inspections at construction sites. (Same mitigation as identified for the Proposed Action, Impact 4.2-2.)	Less than Significant
Impact 4.2-21. Potential loss or disturbance of 14.57 acres of waters of the United States (including wetlands) (similar to Impact 4.2-3)	Significant	In addition to mitigation identified for the Proposed Action, Impacts 4.4-1 and 4.7-1, Reclamation will prohibit equipment access or staging in jurisdictional waters adjacent to the construction zone, stake and flag wetland areas for avoidance, routinely inspect protected areas, implement stream bank stabilization measures, compensate for loss of waters of the United States, and revegetate lost habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-3.)	Less than Significant
Impact 4.2-22. Potential loss or disturbance of common upland woodland and forest communities and associated wildlife habitat (similar to Impact 4.2-4)	Significant	A qualified biologist will identify the species and number of native trees to be removed or affected to protect those not removed and develop a tree planting plan; in addition, a qualified biologist will monitor all newly planted trees for 5 years and inspect pruned sites prior to, immediately after, and 1 year after construction for regrowth; Reclamation will compensate for the loss of oak and woodland habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-4.)	Less than Significant
Impact 4.2-23. Potential disturbance to valley elderberry longhorn beetle habitat (similar to Impact 4.2-5)	Significant	A qualified biologist will identify and mark valley elderberry longhorn beetle habitat for avoidance during construction; Reclamation will minimize impacts during construction through protection measures and replace any lost habitat post construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-5.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-24. Potential disturbance of foothill yellow-legged frogs and their habitat (similar to Impact 4.2-6)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-3, a qualified biologist will survey for foothill yellow-legged frogs before construction begins; if frogs are found, a qualified biologist will construct barrier fencing to exclude frogs from the work area and relocate frogs to nearest suitable habitat until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-6.)	Less than Significant
Impact 4.2-25. Potential disturbance of northwestern pond turtles and their habitat (similar to Impact 4.2-7)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-3, a qualified biologist will survey for northwestern pond turtles before construction begins; if turtles are found, a qualified biologist will construct barrier fencing to exclude turtles from the work area and relocate frogs to nearest suitable habitat until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-7.)	Less than Significant
Impact 4.2-26. Potential disturbance of breeding habitat for yellow-breasted chat and little willow flycatcher (similar to Impact 4.2-8)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-1, a qualified biologist will survey for breeding yellow-breasted chats and little willow flycatchers before construction begins; if breeding chats or little willow flycatchers are found, the construction contractor will limit removal of riparian vegetation and establish a 500-foot no disturbance buffer around all active sites until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-8.)	Less than Significant
Impact 4.2-27. Potential disturbance to nesting raptors (similar to Impact 4.2-9)	Significant	A qualified biologist will perform preconstruction surveys of the project sites to locate active osprey, Cooper's hawk, peregrine falcon, golden eagle, and bald eagle nests; if active nests are found, Reclamation will limit construction activities near the nests to the nonbreeding season (mid-July to late March), establish a 500-foot-radius direct line-of-sight buffer for active nonlisted special-status raptor nests and a 0.5-mile-radius direct line-of-sight buffer for active bald eagle nests, and maintain a 0.5-mile direct line-of-sight helicopter exclusion zone around any active nests. (Same mitigation as identified for the Proposed Action, Impact 4.2-9.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-28. Potential disturbance to nesting California black rails in emergent marsh (similar to Impact 4.2-10)	Significant	A qualified biologist will conduct a tape-playback survey to determine presence of California black rails in the emergent marsh and construction activities will be seasonally restricted to avoid disturbance during the rails' nesting season. (Same mitigation as identified for the Proposed Action, Impact 4.2-10.)	Less than Significant
Impact 4.2-29. Potential disturbance of bats in canal tunnels and on rocky cliffs and outcrops along canyon walls (similar to Impact 4.2-11)	Significant	A qualified biologist will survey construction sites, nearby tunnels, rocky cliffs and outcrops, and other potential bat habitats that could be adversely affected by construction to determine the presence or absence of bats; Reclamation will restrict construction activities to non-use periods or outside the breeding and hibernation periods if sites are found that support maternity colonies or large concentrations of roosting bats; if impacts are unavoidable during any season, Reclamation will implement selected minimizing actions to reduce disturbance of roosting bats; construction scheduling, buffer zones, and other mitigation measures will be developed in consultation with bat specialists, U.S. Fish and Wildlife Service, and the California Department of Fish and Game. (Same mitigation as identified for the Proposed Action, Impact 4.2-11.)	Less than Significant
Impact 4.2-30. Possible loss of woody riparian vegetation along PG&E Canals (similar to Impact 4.2-12)	Less than Significant	None	Not Applicable
Impact 4.2-31. Potential disturbance of mixed chaparral habitat (similar to Impact 4.2-13)	Less than Significant	Reclamation will implement BMPs and environmental commitments described in Chapter 3 (Volume I of this Final EIS/EIR), including compensation for habitat loss, to avoid or minimize temporary effects on mixed chaparral. (Same mitigation as identified for the Proposed Action, Impact 4.2-13.)	Less than Significant
Impact 4.2-32. Potential disturbance of annual grassland habitat (similar to Impact 4.2-14)	Less than Significant	Reclamation will implement BMPs and environmental commitments described in Ch. 3, including compensation for habitat loss, to avoid or minimize temporary effects on annual grassland. (Same mitigation as identified for the Proposed Action, Impact 4.2-14.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-33. Potential disturbance of foraging bald eagles along Battle Creek	Less than Significant	None	Not Applicable
Impact 4.2-34. Increase in quantity of amphibian habitat resulting from increased minimum instream flows	Beneficial	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.2-35. Potential disturbance or loss of 4.18 acres of woody riparian vegetation and associated wildlife habitat (similar to Impact 4.2-1)	Significant	Reclamation will avoid and minimize the removal and disturbance of riparian habitat, avoid long-term impacts on woody riparian vegetation and associated habitat, and compensate for the loss of any such habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-1.)	Less than Significant
Impact 4.2-36. Potential introduction of noxious weeds or spread of existing noxious weeds (similar to Impact 4.2-2)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.7-1, Reclamation will educate construction crews, use appropriate eradication techniques, wash all equipment after leaving noxious weed sites, use weed-free materials for revegetation, perform a post-construction weed inventory, and perform routine inspections at construction sites. (Same mitigation as identified for the Proposed Action, Impact 4.2-2.)	Less than Significant
Impact 4.2-37. Potential loss or disturbance of 16.4 acres of waters of the United States (including wetlands) (similar to Impact 4.2-3)	Significant	In addition to mitigation identified for the Proposed Action, Impacts 4.4-1 and 4.7-1, Reclamation will prohibit equipment access or staging in jurisdictional waters adjacent to the construction zone, stake and flag wetland areas for avoidance, routinely inspect protected areas, implement stream bank stabilization measures, compensate for loss of waters of the United States, and revegetate lost habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-3.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-38. Potential loss or disturbance of common upland woodland and forest communities and associated wildlife habitat (similar to Impact 4.2-4)	Significant	A qualified biologist will identify the species and number of native trees to be removed or affected to protect those not removed and develop a tree planting plan; in addition, a qualified biologist will monitor all newly planted trees for 5 years and inspect pruned sites prior to, immediately after, and 1 year after construction for regrowth; Reclamation will compensate for loss of oak and woodland habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-4.)	Less than Significant
Impact 4.2-39. Potential disturbance to valley elderberry longhorn beetle habitat (similar to Impact 4.2-5)	Significant	A qualified biologist will identify and mark valley elderberry longhorn beetle habitat for avoidance during construction; Reclamation will minimize impacts during construction through protection measures and replace any lost habitat post construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-5.)	Less than Significant
Impact 4.2-40. Potential disturbance of foothill yellow-legged frogs and their habitat (similar to Impact 4.2-6)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-3, a qualified biologist will survey for foothill yellow-legged frogs before construction begins; if frogs are found, a qualified biologist will construct barrier fencing to exclude frogs from the work area and relocate frogs to nearest suitable habitat until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-6.)	Less than Significant
Impact 4.2-41. Potential disturbance of northwestern pond turtles and their habitat (similar to Impact 4.2-7)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-3, a qualified biologist will survey for northwestern pond turtles before construction begins; if turtles are found, a qualified biologist will construct barrier fencing to exclude turtles from the work area and relocate frogs to nearest suitable habitat until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-7.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-42. Potential disturbance of breeding habitat for yellow-breasted chat and little willow flycatcher (similar to Impact 4.2-8)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-1, a qualified biologist will survey for breeding yellow-breasted chats and little willow flycatchers before construction begins; if breeding chats or little willow flycatchers are found, the construction contractor will limit removal of riparian vegetation and establish a 500-foot no disturbance buffer around all active sites until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-8.)	Less than Significant
Impact 4.2-43. Potential disturbance to nesting raptors (similar to Impact 4.2-9)	Significant	A qualified biologist will perform preconstruction surveys of the project sites to locate active osprey, Cooper's hawk, peregrine falcon, golden eagle, and bald eagle nests; if active nests are found, Reclamation will limit construction activities near the nests to the nonbreeding season (mid-July to late March), establish a 500-foot-radius direct line-of-sight buffer for active nonlisted special-status raptor nests and a 0.5-mile-radius direct line-of-sight buffer for active bald eagle nests, and maintain a 0.5-mile direct line-of-sight helicopter exclusion zone around any active nests. (Same mitigation as identified for the Proposed Action, Impact 4.2-9.)	Less than Significant
Impact 4.2-44. Potential disturbance to nesting California black rails in emergent marsh (similar to Impact 4.2-10)	Significant	A qualified biologist will conduct a tape-playback survey to determine presence of California black rails in the emergent marsh, and construction activities will be seasonally restricted to avoid disturbance during the rails' nesting season. (Same mitigation as identified for the Proposed Action, Impact 4.2-10.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-45. Potential disturbance of bats in canal tunnels and on rocky cliffs and outcrops along canyon walls (similar to Impact 4.2-11)	Significant	A qualified biologist will survey construction sites, nearby tunnels, rocky cliffs and outcrops, and other potential bat habitats that could be adversely affected by construction to determine the presence or absence of bats; Reclamation will restrict construction activities to non-use periods or outside the breeding and hibernation periods if sites are found that support maternity colonies or large concentrations of roosting bats; if impacts are unavoidable during any season, Reclamation will implement selected minimizing actions to reduce disturbance of roosting bats; construction scheduling, buffer zones, and other mitigation measures will be developed in consultation with bat specialists, U.S. Fish and Wildlife Service, and the California Department of Fish and Game. (Same mitigation as identified for the Proposed Action, Impact 4.2-11.)	Less than Significant
Impact 4.2-46. Possible loss of woody riparian vegetation along PG&E canals (similar to Impact 4.2-12)	Less than Significant	None	Not Applicable
Impact 4.2-47. Potential disturbance of mixed chaparral habitat (similar to Impact 4.2-13)	Less than Significant	Reclamation will implement BMPs and environmental commitments described in Ch. 3, including compensation for habitat loss, to avoid or minimize temporary effects on mixed chaparral. (Same mitigation as identified for the Proposed Action, Impact 4.2-13.)	Less than Significant
Impact 4.2-48. Potential disturbance of annual grassland habitat (similar to Impact 4.2-14)	Less than Significant	Reclamation will implement BMPs and environmental commitments described in Chapter 3 (Volume I of this Final EIS/EIR), including compensation for habitat loss, to avoid or minimize temporary effects on annual grassland. (Same mitigation as identified for the Proposed Action, Impact 4.2-14.)	Less than Significant
Impact 4.2-49. Potential disturbance of foraging bald eagles along Battle Creek	Less than Significant	None	Not Applicable
Impact 4.2-50. Reduction in artificial flow fluctuations and increased survival of amphibians	Beneficial	None	Not Applicable
Impact 4.2-51. Increase in the quantity of amphibian habitat resulting from increased minimum instream flows	Beneficial	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-52. Substantial increase in the quantity of bat roosting habitat in the South Canal tunnels as a result of termination of water flow through the tunnels	Beneficial	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.2-53. Potential loss or disturbance of 3.81 acres of woody riparian vegetation and associated wildlife habitat (similar to Impact 4.2-1)	Significant	Reclamation will avoid and minimize the removal and disturbance of riparian habitat, avoid long-term impacts on woody riparian vegetation and associated habitat, and compensate for the loss of any such habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-1.)	Less than Significant
Impact 4.2-54. Potential introduction of noxious weeds or spread of existing noxious weeds (similar to Impact 4.2-2)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.7-1, Reclamation will educate construction crews, use appropriate eradication techniques, wash all equipment after leaving noxious weed sites, use weed-free materials for revegetation, perform a post-construction weed inventory, and perform routine inspections at construction sites. (Same mitigation as identified for the Proposed Action, Impact 4.2-2.)	Less than Significant
Impact 4.2-55. Potential loss or disturbance of 12.07 acres of waters of the United States (including wetlands) (similar to Impact 4.2-3)	Significant	In addition to mitigation identified for the Proposed Action, Impacts 4.4-1 and 4.7-1, Reclamation will prohibit equipment access or staging in jurisdictional waters adjacent to the construction zone, stake and flag wetland areas for avoidance, routinely inspect protected areas, implement stream bank stabilization measures, compensate for loss of waters of the United States, and revegetate lost habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-3.)	Less than Significant
Impact 4.2-56. Potential loss or disturbance of common upland woodland and forest communities and associated wildlife habitat (similar to Impact 4.2-4)	Significant	A qualified biologist will identify the species and number of native trees to be removed or affected to protect those not removed and develop a tree planting plan; in addition, a qualified biologist will monitor all newly planted trees for 5 years and inspect pruned sites prior to, immediately after, and 1 year after construction for regrowth; Reclamation will compensate for loss of oak and woodland habitat. (Same mitigation as identified for the Proposed Action, Impact 4.2-4.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-57. Potential disturbance to valley elderberry longhorn beetle habitat (similar to Impact 4.2-5)	Significant	A qualified biologist will identify and mark valley elderberry longhorn beetle habitat for avoidance during construction; Reclamation will minimize impacts during construction through protection measures and replace any lost habitat post construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-5.)	Less than Significant
Impact 4.2-58. Potential disturbance of foothill yellow-legged frogs and their habitat (similar to Impact 4.2-6)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-3, a qualified biologist will survey for foothill yellow-legged frogs before construction begins; if frogs are found, a qualified biologist will construct barrier fencing to exclude frogs from the work area and relocate frogs to nearest suitable habitat until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-6.)	Less than Significant
Impact 4.2-59. Potential disturbance of northwestern pond turtles and their habitat (similar to Impact 4.2-7)	Significant	In addition to mitigation identified for the Proposed Action, Impact 4.2-3, a qualified biologist will survey for northwestern pond turtles before construction begins; if turtles are found, a qualified biologist will construct barrier fencing to exclude turtles from the work area and relocate frogs to nearest suitable habitat until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-7.)	Less than Significant
Impact 4.2-60. Potential disturbance of breeding habitat for yellow-breasted chat (similar to Impact 4.2-8)	Significant	A qualified biologist will survey for breeding yellow-breasted chats before construction begins; if breeding chats are found, the construction contractor will limit removal of riparian vegetation and establish a 500-foot no disturbance buffer around all active sites until after construction. (Same mitigation as identified for the Proposed Action, Impact 4.2-8.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-61. Potential disturbance to nesting raptors (similar to Impact 4.2-9)	Significant	A qualified biologist will perform preconstruction surveys of the project sites to locate active osprey, Cooper's hawk, peregrine falcon, golden eagle, and bald eagle nests; if active nests are found, Reclamation will limit construction activities near the nests to the nonbreeding season (mid-July to late March), establish a 500-foot-radius direct line-of-sight buffer for active nonlisted special-status raptor nests and a 0.5-mile-radius direct line-of-sight buffer for active bald eagle nests, and maintain a 0.5-mile direct line-of-sight helicopter exclusion zone around any active nests. (Same mitigation as identified for the Proposed Action, Impact 4.2-9.)	Less than Significant
Impact 4.2-62. Potential disturbance to nesting California black rails in emergent marsh (similar to Impact 4.2-10)	Significant	A qualified biologist will conduct a tape-playback survey to determine presence of California black rails in the emergent marsh, and construction activities will be seasonally restricted to avoid disturbance during the rails' nesting season. (Same mitigation as identified for the Proposed Action, Impact 4.2-10.)	Less than Significant
Impact 4.2-63. Potential disturbance of bats in canal tunnels and on rocky cliffs and outcrops along canyon walls (similar to Impact 4.2-11)	Significant	A qualified biologist will survey construction sites, nearby tunnels, rocky cliffs and outcrops, and other potential bat habitats that could be adversely affected by construction to determine the presence or absence of bats; Reclamation will restrict construction activities to non-use periods or outside the breeding and hibernation periods if sites are found that support maternity colonies or large concentrations of roosting bats; if impacts are unavoidable during any season, Reclamation will implement selected minimizing actions to reduce disturbance of roosting bats; construction scheduling, buffer zones, and other mitigation measures will be developed in consultation with bat specialists, U.S. Fish and Wildlife Service, and the California Department of Fish and Game. (Same mitigation as identified for the Proposed Action, Impact 4.2-11.)	Less than Significant
Impact 4.2-64. Possible loss of woody riparian vegetation along PG&E canals (similar to Impact 4.2-12)	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.2-65. Potential disturbance of mixed chaparral habitat (similar to Impact 4.2-13)	Less than Significant	Reclamation will implement BMPs and environmental commitments described in Ch. 3, including compensation for habitat loss, to avoid or minimize temporary effects on mixed chaparral. (Same mitigation as identified for the Proposed Action, Impact 4.2-13.)	Less than Significant
Impact 4.2-66. Potential disturbance of annual grassland habitat (similar to Impact 4.2-14)	Less than Significant	Reclamation will implement BMPs and environmental commitments described in Ch. 3, including compensation for habitat loss, to avoid or minimize temporary effects on annual grassland. (Same mitigation as identified for the Proposed Action, Impact 4.2-14.)	Less than Significant
Impact 4.2-67. Potential disturbance of foraging bald eagles along Battle Creek	Less than Significant	None	Not Applicable
Impact 4.2-68. Reduction of artificial flow fluctuations and increased survival of amphibians	Beneficial	None	Not Applicable
Impact 4.2-69. Substantial increase in the quantity of amphibian habitat resulting from increased minimum instream flows	Beneficial	None	Not Applicable
HYDROLOGY			
No Action Alternative			
Current hydrology would not change; Hydroelectric Project facilities and operations would be maintained and operated in accordance with FERC regulations, and the existing minimum flows would continue to be provided.	No Change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.3-1. In-water construction could result in short-term disruption of streambed and flows	Less than Significant	None	Not Applicable
Impact 4.3-2. Coleman Diversion Dam removal could reduce the 10-, 25-, and 50-year floodwater surface profiles at Inskip Powerhouse	Beneficial	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
No Dam Removal Alternative			
Impact 4.3-3. In-water construction could result in short-term disruption of streambed and flows (similar to Impact 4.3-1)	Less than Significant	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.3-4. Removal of Eagle Canyon Diversion Dam could result in minor, slight increases to downstream bed elevations	Less than Significant	None	Not Applicable
Impact 4.3-5. In-water construction could result in short-term disruption of streambed and flows (similar to Impact 4.3-1)	Less than Significant	None	Not Applicable
Impact 4.3-6. Coleman Diversion Dam removal could reduce the 10-, 25-, and 50-year floodwater surface profiles at Inskip Powerhouse (similar to Impact 4.3-2)	Beneficial	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.3-7. Removal of Eagle Canyon Diversion Dam could result in minor, slight increases to downstream bed elevations	Less than Significant	None	Not Applicable
Impact 4.3-8. In-water construction could result in short-term disruption of streambed and flows (similar to Impact 4.3-1)	Less than Significant	None	Not Applicable
Impact 4.3-9. Coleman Diversion Dam removal could reduce the 10-, 25-, and 50-year floodwater surface profiles at Inskip Powerhouse (similar to Impact 4.3-2)	Beneficial	None	Not Applicable
WATER QUALITY			
No Action Alternative			
The No Action Alternative would not affect water quality. Under the No Action Alternative, the Hydroelectric Project would continue to operate consistent with the current FERC license.	No change		

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Five Dam Removal Alternative (Proposed Action)			
Impact 4.4-1. Increased erosion and subsequent discharge of settleable material and runoff into Battle Creek as a result of removing diversion dams and constructing fish screens and fish ladders	Significant	Reclamation will develop an erosion control plan in coordination with the Central Valley Regional Water Quality Control Board.	Less than Significant
Impact 4.4-2. Potential spills of hazardous materials could occur	Significant	Reclamation will implement measures designed to avoid or minimize hazardous spills.	Less than Significant
Impact 4.4-3. Potential reduction in beneficial uses of waters used at Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery	Significant	A pipeline to bypass the Jeffcoat site would be constructed to prevent the potential contamination of spring water with the IHN virus. In addition, one of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.4-4. Potential reduction in beneficial uses of California waters from the distribution of infected Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery fish	Significant	A pipeline would be constructed to bypass the Jeffcoat site to prevent the potential contamination of spring water with the IHN virus. In addition, one of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant
Impact 4.4-5. Removal of South and Coleman Diversion Dams could cause erosion of minor amounts of sediment from behind the dam	Less than Significant	None	Not Applicable
Impact 4.4-6. Minor amounts of sediment released by the removal of Coleman Diversion Dam would be deposited at the County Road Bridge	Less than Significant	None	Not Applicable
Impact 4.4-7. Short-term increased turbidity and settleable material load on the Coleman National Fish Hatchery water treatment plant as a result of removing Coleman Diversion Dam	Less than Significant	None	Not Applicable
No Dam Removal Alternative			
Impact 4.4-8. Increased erosion and subsequent discharge of settleable material and runoff into Battle Creek as a result of constructing fish screens and fish ladders (similar to Impact 4.4-1)	Significant	Reclamation will develop an erosion control plan in coordination with the Central Valley Regional Water Quality Control Board. (Same mitigation as identified for the Proposed Action, Impact 4.4-1.)	Less than Significant
Impact 4.4-9. Potential spills of hazardous materials could occur (similar to Impact 4.4-2)	Significant	Reclamation will implement measures designed to avoid or minimize hazardous spills. (Same mitigation as identified for the Proposed Action, Impact 4.4-2.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.4-10. Potential reduction in beneficial uses of waters used at Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery (similar to Impact 4.4-3)	Significant	A pipeline would be constructed to bypass the Jeffcoat site to prevent the potential contamination of spring water with the IHN virus. In addition, one of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant
Impact 4.4-11. Potential reduction in beneficial uses of California waters from the distribution of infected Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery fish (similar to Impact 4.4-4)	Significant	A pipeline would be constructed to bypass the Jeffcoat site to prevent the potential contamination of spring water with the IHN virus. In addition, one of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant
Six Dam Removal Alternative			
Impact 4.4-12. Increased erosion and subsequent discharge of settleable material and runoff into Battle Creek as a result of removing diversion dams and constructing fish screens and fish ladders (similar to Impact 4.4-1)	Significant	Reclamation will develop an erosion control plan in coordination with the Central Valley Regional Water Quality Control Board. (Same mitigation as identified for the Proposed Action, Impact 4.4-1.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.4-13. Potential spills of hazardous materials could occur (similar to Impact 4.4-2)	Significant	Reclamation will implement measures designed to avoid or minimize hazardous spills. (Same mitigation as identified for the Proposed Action, Impact 4.4-2.)	Less than Significant
Impact 4.4-14. Potential reduction in beneficial uses of waters used at Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery (similar to Impact 4.4-4)	Significant	One of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant
Impact 4.4-15. Potential reduction in beneficial uses of California waters from the distribution of infected Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery fish (similar to Impact 4.4-4)	Significant	One of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant
Impact 4.4-16. Removal of South and Coleman Diversion Dams could cause erosion of minor amounts of sediment from behind the dam (similar to Impact 4.4-5)	Less than Significant	None	Not Applicable
Impact 4.4-17. Minor amounts of sediment released by the removal of Coleman Diversion Dam would be deposited at the County Road Bridge (similar to Impact 4.4-6)	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.4-18. Short-term increased turbidity and settleable material load on the Coleman National Fish Hatchery water treatment plant as a result of removing Coleman Diversion Dam (similar to Impact 4.4-7)	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.4-19. Increased erosion and subsequent discharge of settleable material and runoff into Battle Creek as a result of removing diversion dams and constructing fish screens and fish ladders (similar to Impact 4.4-1)	Significant	Reclamation will develop an erosion control plan in coordination with the Central Valley Regional Water Quality Control Board. (Same mitigation as identified for the Proposed Action, Impact 4.4-1.)	Less than Significant
Impact 4.4-20. Potential spills of hazardous materials could occur (similar to Impact 4.4-2)	Significant	Reclamation will implement measures designed to avoid or minimize hazardous spills. (Same mitigation as identified for the Proposed Action, Impact 4.4-2.)	Less than Significant
Impact 4.4-21. Potential reduction in beneficial uses of waters used at Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery (similar to Impact 4.4-4)	Significant	One of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.4-22. Potential reduction in beneficial uses of California waters from the distribution of infected Mount Lassen Trout Farm and Darrah Springs State Fish Hatchery fish (similar to Impact 4.4-3)	Significant	One of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. The Asbury Diversion Dam would be modified to prevent fish passage above the dam. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Less than Significant
Impact 4.4-23. Removal of Coleman Diversion Dam could cause erosion of minor amounts of sediment from behind the dam (similar to Impact 4.4-5)	Less than Significant	None	Not Applicable
Impact 4.4-24. Minor amounts of sediment released by the removal of Coleman Diversion Dam would be deposited at the County Road Bridge (similar to Impact 4.4-6)	Less than Significant	None	Not Applicable
Impact 4.4-25. Short-term increased turbidity and settleable material load on the Coleman National Fish Hatchery water treatment plant as a result of removing Coleman Diversion Dam (similar to Impact 4.4-7)	Less than Significant	None	Not Applicable
GROUNDWATER			
No Action Alternative			
Groundwater would not change under the No Action Alternative.	No Change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.5-1. Potential spills of hazardous materials could occur and contaminate the shallow groundwater system	Significant	Reclamation will implement measures designed to avoid or minimize hazardous spills.	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
No Dam Removal Alternative			
Impact 4.5-2. Potential spills of hazardous materials could occur and contaminate the shallow groundwater system (similar to Impact 4.5-1)	Significant	Reclamation will implement measures designed to avoid or minimize hazardous spills. (Same mitigation as identified for the Proposed Action, Impact 4.5-1.)	Less than Significant
Six Dam Removal Alternative			
Impact 4.5-3. Potential spills of hazardous materials could occur and contaminate the shallow groundwater system (similar to Impact 4.5-1)	Significant	Reclamation will implement measures designed to avoid or minimize hazardous spills. (Same mitigation as identified for the Proposed Action, Impact 4.5-1.)	Less than Significant
Three Dam Removal Alternative			
Impact 4.5-4. Potential spills of hazardous materials could occur and contaminate the shallow groundwater system (similar to Impact 4.5-1)	Significant	Reclamation will implement measures designed to avoid or minimize hazardous spills. (Same mitigation as identified for the Proposed Action, Impact 4.5-1.)	Less than Significant
LAND USE			
No Action Alternative			
The No Action Alternative would not impact land use; the No Action Alternative is not expected to conflict with general plans and established land uses, alter existing land uses, displace a large number of people, or convert agricultural land to nonagricultural land.	No Change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.6-1. Conversion of lands disturbed by construction activities from open space to Restoration Project support would substantially conflict with existing land uses	Less than Significant	None	Not Applicable
No Dam Removal Alternative			
Impact 4.6-2. Conversion of lands disturbed by construction activities from open space to Restoration Project support would substantially conflict with existing land uses	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Six Dam Removal Alternative			
Impact 4.6-3. Conversion of lands disturbed by construction activities from open space to Restoration Project support would substantially conflict with existing land uses	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.6-4. Conversion of lands disturbed by construction activities from open space to Restoration Project support would substantially conflict with existing land uses	Less than Significant	None	Not Applicable
GEOLOGY AND SOILS			
No Action Alternative			
Geological and soil resources would not change.	No change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.7-1. Potential accelerated water and wind erosion from construction activities	Significant	The construction contractor will implement an erosion and sediment control plan in addition to implementing best management practices at all construction sites.	Less than Significant
Impact 4.7-2. Construction workers could be exposed to falling rocks	Less than Significant	None	Not Applicable
No Dam Removal Alternative			
Impact 4.7-3. Potential accelerated water and wind erosion from construction activities (similar to Impact 4.7-1)	Significant	The construction contractor will implement an erosion and sediment control plan in addition to implementing best management practices at all construction sites. (Same mitigation as identified for the Proposed Action, Impact 4.7-1.)	Less than Significant
Impact 4.7-4. Construction workers could be exposed to falling rocks (similar to Impact 4.7-2)	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Six Dam Removal Alternative			
Impact 4.7-5. Potential accelerated water and wind erosion from construction activities (similar to Impact 4.7-1)	Significant	The construction contractor will implement an erosion and sediment control plan in addition to implementing best management practices at all construction sites. (Same mitigation as identified for the Proposed Action, Impact 4.7-1.)	Less than Significant
Impact 4.7-6. Construction workers could be exposed to falling rocks (similar to Impact 4.7-2)	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.7-7. Potential accelerated water and wind erosion from construction activities (similar to Impact 4.7-1)	Significant	The construction contractor will implement an erosion and sediment control plan in addition to implementing best management practices at all construction sites. (Same mitigation as identified for the Proposed Action, Impact 4.7-1.)	Less than Significant
Impact 4.7-8. Construction workers could be exposed to falling rocks (similar to Impact 4.7-2)	Less than Significant	None	Not Applicable
AESTHETICS AND VISUAL RESOURCES			
No Action Alternative			
Aesthetics and visual resources would not change under the No Action Alternative; the No Action Alternative would not alter existing views of Hydroelectric Project facilities or affect any scenic vistas.	No Change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.8-1. Construction of tailrace connectors, new fish screens and fish ladders, and associated facilities would reduce scenic quality at the Oasis Springs Lodge	Significant and Unavoidable	Reclamation will implement a revegetation plan and Reclamation will apply an acid wash to the rock face along the proposed access road to break up the appearance of the cut in the hillside.	Significant
Impact 4.8-2. Proposed construction of tailrace connector, bypass chute, and fish screen and fish ladders would alter views from adjacent area	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.8-3. Removal of diversion dams and associated construction would substantially reduce scenic quality from public viewing areas	Less than Significant	None	Not Applicable
Impact 4.8-4. Potential reduction in scenic resources caused by closure of PG&E canals.	Less than Significant	None	Not Applicable
Impact 4.8-5. Temporarily reduced scenic resources along the Eagle Canyon Canal as a result of construction of Eagle Canyon Pipeline	Less than Significant	None	Not Applicable
No Dam Removal Alternative			
Impact 4.8-6. Construction of new fish screens and fish ladders and associated facilities would reduce scenic quality at the Oasis Springs Lodge (similar to Impact 4.8-1)	Significant and Unavoidable	Reclamation will implement a revegetation plan and Reclamation will apply an acid wash to the rock face along the proposed access road to break up the appearance of the cut in the hillside. (Same mitigation as identified for the Proposed Action, Impact 4.8-1.)	Not Applicable
Impact 4.8-7. Proposed construction of fish screen and fish ladders would alter views from adjacent area	Less than Significant	None	Not Applicable
Impact 4.8-8. Construction of fish screens and fish ladders and associated project activities would substantially reduce scenic quality from public viewing areas	Less than Significant	None	Not Applicable
Impact 4.8-9. Potential reduction in scenic resources caused by closure of PG&E canals	Less than Significant	None	Not Applicable
Impact 4.8-10. Temporarily reduced scenic resources along the Eagle Canyon Canal as a result of construction of Eagle Canyon Pipeline (similar to Impact 4.8-5)	Less than Significant	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.8-11. Construction of tailrace connectors, new fish screen and fish ladder and associated facilities would reduce scenic quality at the Oasis Springs Lodge (similar to Impact 4.8-1)	Significant and Unavoidable	Reclamation will implement a revegetation plan and Reclamation will apply an acid wash to the rock face along the proposed access road to break up the appearance of the cut in the hillside. (Same mitigation as identified for the Proposed Action, Impact 4.8-1.)	Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.8-12. Proposed construction of tailrace connector, bypass chute, and fish screen and fish ladders would alter views from adjacent area (similar to Impact 4.8-2)	Less than Significant	None	Not Applicable
Impact 4.8-13. Removal of diversion dams and associated construction would substantially reduce scenic quality from public viewing areas (similar to Impact 4.8-3)	Less than Significant	None	Not Applicable
Impact 4.8-14. Potential reduction in scenic resources caused by closure of PG&E canals (similar to Impact 4.8-4)	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.8-15. Construction of new fish screen and fish ladder and associated facilities would reduce scenic quality at the Oasis Springs Lodge (similar to Impact 4.8-1)	Significant and Unavoidable	Reclamation will implement a revegetation plan and Reclamation will apply an acid wash to the rock face along the proposed access road to break up the appearance of the cut in the hillside. (Same mitigation as identified for the Proposed Action, Impact 4.8-1.)	Significant
Impact 4.8-16. Construction of the channel with armoring or revetment would alter views of the South Fork creek bank	Significant and Unavoidable	None	Significant
Impact 4.8-17. Proposed construction of fish screens and fish ladders would alter views from adjacent area (similar to Impact 4.8-2)	Less than Significant	None	Not Applicable
Impact 4.8-18. Removal of diversion dams and associated construction would substantially reduce scenic quality from public viewing areas	Less than Significant	None	Not Applicable
Impact 4.8-19. Potential reduction in scenic resources caused by closure of PG&E canals (similar to Impact 4.8-4)	Less than Significant	None	Not Applicable
TRANSPORTATION			
No Action Alternative			
The No Action Alternative would not result in the construction of new access roads or improvements to existing roads, other than those already planned as a part of the operation and maintenance plan for the Hydroelectric Project.	No change	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Five Dam Removal Alternative (Proposed Action)			
Impact 4.9-1. Construction and removal activities at the Restoration Project sites would result in increased traffic volumes on state, county, and private roadways	Less than Significant	None	Not Applicable
Impact 4.9-2. Construction traffic could damage county and private roadways	Less than Significant	None	Not Applicable
Impact 4.9-3. Construction traffic or activities could delay emergency vehicle response times	Less than Significant	None	Not Applicable
No Dam Removal Alternative			
Impact 4.9-4. Construction and removal activities at the Restoration Project sites would result in increased traffic volumes on state, county, and private roadways	Less than Significant	None	Not Applicable
Impact 4.9-5. Construction traffic could damage county and private roadways	Less than Significant	None	Not Applicable
Impact 4.9-6. Construction traffic or activities could delay emergency vehicle response times	Less than Significant	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.9-7. Construction and removal activities at the Restoration Project sites would result in increased traffic volumes on state, county, and private roadways	Less than Significant	None	Not Applicable
Impact 4.9-8. Construction traffic could damage county and private roadways	Less than Significant	None	Not Applicable
Impact 4.9-9. Construction traffic or activities could delay emergency vehicle response times	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.9-10. Construction and removal activities at the Restoration Project sites would result in increased traffic volumes on state, county, and private roadways	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.9-11. Construction traffic could damage county and private roadways	Less than Significant	None	Not Applicable
Impact 4.9-12. Construction traffic or activities could delay emergency vehicle response times	Less than Significant	None	Not Applicable
NOISE			
No Action Alternative			
The No Action Alternative would not increase noise levels above existing levels in the vicinity of the Restoration Project or at the locations of nearby sensitive receptors.	No change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.10-1. Exposure of noise-sensitive uses to noise and vibration from blasting	Significant	The construction contractor will implement noise and blast mitigation plan including but not limited to notification of blasting to nearby landowners, pre-blast alarms, continued noise monitoring, and best management practices.	Less than Significant
Impact 4.10-2. Exposure of noise-sensitive land uses to noise from on-site construction activities	Significant	Reclamation will implement noise reducing construction practices.	Less than Significant
Impact 4.10-3. Exposure of noise-sensitive land uses along site access roads to construction-related truck noise	Significant	Reclamation will construct an alternative haul route at least 750 feet from the nearest occupied residences and limit trucking operations to the hours of 7:00 a.m. to 9:00 p.m.	Less than Significant
Impact 4.10-4. Exposure of noise-sensitive land use to noise from operation of the Restoration Project facilities	Less than Significant	None	Not Applicable
No Dam Removal Alternative			
Impact 4.10-5. Exposure of noise-sensitive uses to noise and vibration from blasting (similar to Impact 4.10-1)	Significant	The construction contractor will implement noise and blast mitigation plan including but not limited to notification of blasting to nearby landowners, pre-blast alarms, continued noise monitoring, and best management practices. (Same mitigation as identified for the Proposed Action, Impact 4.10-1.)	Less than Significant
Impact 4.10-6. Exposure of noise-sensitive land uses to noise from on-site construction activities (similar to Impact 4.10-2)	Significant	Reclamation will implement noise reducing construction practices. (Same mitigation as identified for the Proposed Action, Impact 4.10-2.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.10-7. Exposure of noise-sensitive land uses along site access roads to construction-related truck noise (similar to Impact 4.10-3)	Significant	Reclamation will construct an alternative haul route at least 750 feet from the nearest occupied residences and limit trucking operations to the hours of 7:00 a.m. to 9:00 p.m. (Same mitigation as identified for the Proposed Action, Impact 4.10-3.)	Less than Significant
Impact 4.10-8. Exposure of noise-sensitive land use to noise from operation of the Restoration Project facilities	Less than Significant	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.10-9. Exposure of noise-sensitive uses to noise and vibration from blasting (similar to Impact 4.10-1)	Significant	The construction contractor will implement noise and blast mitigation plan including but not limited to notification of blasting to nearby landowners, pre-blast alarms, continued noise monitoring, and best management practices. (Same mitigation as identified for the Proposed Action, Impact 4.10-1.)	Less than Significant
Impact 4.10-10. Exposure of noise-sensitive land uses to noise from on-site construction activities (similar to Impact 4.10-2)	Significant	Reclamation will implement noise reducing construction practices. (Same mitigation as identified for the Proposed Action, Impact 4.10-2.)	Less than Significant
Impact 4.10-11. Exposure of noise-sensitive land uses along site access roads to construction-related truck noise (similar to Impact 4.10-3)	Significant	Reclamation will construct an alternative haul route at least 750 feet from the nearest occupied residences and limit trucking operations to the hours of 7:00 a.m. to 9:00 p.m. (Same mitigation as identified for the Proposed Action, Impact 4.10-3.)	Less than Significant
Impact 4.10-12. Exposure of noise-sensitive land use to noise from operation of the Restoration Project facilities	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.10-13. Exposure of noise-sensitive uses to noise and vibration from blasting (similar to Impact 4.10-1)	Significant	The construction contractor will implement noise and blast mitigation plan including but not limited to notification of blasting to nearby landowners, pre-blast alarms, continued noise monitoring, and best management practices. (Same mitigation as identified for the Proposed Action, Impact 4.10-1.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.10-14. Exposure of noise-sensitive land uses to noise from on-site construction activities (similar to Impact 4.10-2)	Significant	Reclamation will implement noise reducing construction practices. (Same mitigation as identified for the Proposed Action, Impact 4.10-2.)	Less than Significant
Impact 4.10-15. Exposure of noise-sensitive land uses along site access roads to construction-related truck noise (similar to Impact 4.10-3)	Significant	Reclamation will construct an alternative haul route at least 750 feet from the nearest occupied residences and limit trucking operations to the hours of 7:00 a.m. to 9:00 p.m. (Same mitigation as identified for the Proposed Action, Impact 4.10-3.)	Less than Significant
Impact 4.10-16. Exposure of noise-sensitive land use to noise from operation of the Restoration Project facilities	Less than Significant	None	Not Applicable
AIR QUALITY			
No Action Alternative			
Air quality would not change under the No Action Alternative.	No change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.11-1. Construction-related emissions in excess of allowable thresholds	Significant	The construction contractor will comply with best management practices for emissions controls; Reclamation will obtain all applicable permits required by the Shasta County Air Quality Management District and the Tehama County Air Pollution Control District.	Less than Significant
Impact 4.11-2. Increased emissions from operational and maintenance activities would contribute to violation of air quality standards	Less than Significant	None	Not Applicable
No Dam Removal Alternative			
Impact 4.11-3. Construction-related emissions in excess of allowable thresholds (similar to Impact 4.11-1)	Significant	The construction contractor will comply with best management practices for emissions controls; Reclamation will obtain all applicable permits required by the Shasta County Air Quality Management District and the Tehama County Air Pollution Control District. (Same as mitigation identified for the Proposed Action, Impact 4.11-1.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.11-4. Increased emissions from operational and maintenance activities would contribute to violation of air quality standards (similar to Impact 4.11-2)	Less than Significant	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.11-5. Construction-related emissions in excess of allowable thresholds (similar to Impact 4.11-1)	Significant	The construction contractor will comply with best management practices for emissions controls; Reclamation will obtain all applicable permits required by the Shasta County Air Quality Management District and the Tehama County Air Pollution Control District. (Same as mitigation identified for the Proposed Action, Impact 4.11-1.)	Less than Significant
Impact 4.11-6. Increased emissions from operational and maintenance activities would contribute to violation of air quality standards (similar to Impact 4.3-2)	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.11-7. Construction-related emissions in excess of allowable thresholds (similar to Impact 4.11-1)	Significant	The construction contractor will comply with best management practices for emissions controls; Reclamation will obtain all applicable permits required by the Shasta County Air Quality Management District and the Tehama County Air Pollution Control District. (Same as mitigation identified for the Proposed Action, Impact 4.11-1.)	Less than Significant
Impact 4.11-8. Increased emissions from operational and maintenance activities would contribute to violation of air quality standards (similar to Impact 4.11-2)	Less than Significant	None	Not Applicable
PUBLIC HEALTH AND SAFETY			
No Action Alternative			
The No Action Alternative is expected to have no impacts on public health and safety in addition to those already anticipated as part of the current operations at the existing facilities.	No change	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Five Dam Removal Alternative (Proposed Action)			
Impact 4.12-1. Construction workers could be exposed to hazardous or toxic materials disturbed during construction, modification, or removal activities at the Restoration Project sites	Significant	Reclamation will develop and implement a spill prevention, containment, and countermeasure plan; reduce use of hazardous materials at project sites; and evaluate potential hazards at each project site and develop a plan to minimize risk to the public.	Less than Significant
Impact 4.12-2. The public could be exposed to hazardous or toxic materials associated with or disturbed during construction, modification, or removal activities at the Restoration Project sites; public access to construction areas could also increase the potential for exposure to hazardous materials	Significant	Reclamation will clearly mark all construction sites as hazardous and off-limits to the public, backfill or cover excavation areas at each day end, lock access areas to prevent public entry, and notify nearby sensitive receptors and residents of activity schedule.	Less than Significant
Impact 4.12-3. Increased vehicle traffic along private access roads during construction activities could endanger residents and domestic animals	Significant	Reclamation will limit construction vehicle speed to 5 mph on private roads, limit construction vehicle traffic on private roads to daylight hours only, and establish complaint line for residents to notify authorities of excessive vehicle speeds/safety issues.	Less than Significant
Impact 4.12-4. Dewatering activities at the Restoration Project sites could provide breeding grounds for mosquitoes	Significant	Reclamation will maximize public protection with applicable mosquito abatement districts and control agencies, and inform workers to take appropriate precautions to protect health.	Less than Significant
Impact 4.12-5. Helicopter operations at some of the Restoration Project sites could result in worker injury or fire	Less than Significant	None	Not Applicable
No Dam Removal Alternative			
Impact 4.12-6. Construction workers could be exposed to hazardous or toxic materials disturbed during construction, modification, or removal activities at the Restoration Project sites (similar to Impact 4.12-1)	Significant	Reclamation will develop and implement a spill prevention, containment, and countermeasure plan; reduce use of hazardous materials at project sites; and evaluate potential hazards at each project site and develop a plan to minimize risk to the public. (Same mitigation as identified for the Proposed Action, Impact 4.12-1.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.12-7. The public could be exposed to hazardous or toxic materials associated with or disturbed during construction, modification, or removal activities at the Restoration Project sites; public access to construction areas could also increase the potential for exposure to hazardous materials (similar to Impact 4.12-2)	Significant	Reclamation will clearly mark all construction sites as hazardous and off-limits to the public, backfill or cover excavation areas at each day end, lock access areas to prevent public entry, and notify nearby sensitive receptors and residents of activity schedule. (Same mitigation as identified for the Proposed Action, Impact 4.12-2.)	Less than Significant
Impact 4.12-8. Increased vehicle traffic along private access roads during construction activities could endanger residents and domestic animals (similar to Impact 4.12-3)	Significant	Reclamation will limit construction vehicle speed to 5 mph on private roads, limit construction vehicle traffic on private roads to daylight hours only, and establish complaint line for residents to notify authorities of excessive vehicle speeds/safety issues. (Same mitigation as identified for the Proposed Action, Impact 4.12-3.)	Less than Significant
Impact 4.12-9. Dewatering activities at the Restoration Project sites could provide breeding grounds for mosquitoes (similar to Impact 4.12-4)	Significant	Reclamation will maximize public protection with applicable mosquito abatement districts and control agencies, and inform workers to take appropriate precautions to protect health. (Same mitigation as identified for the Proposed Action, Impact 4.12-4.)	Less than Significant
Impact 4.12-10. Helicopter operations at some of the Restoration Project sites could result in worker injury or fire (similar to Impact 4.12-5)	Less than Significant	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.12-11. Construction workers could be exposed to hazardous or toxic materials disturbed during construction, modification, or removal activities at the Restoration Project sites (similar to Impact 4.12-1)	Significant	Reclamation will develop and implement a spill prevention, containment, and countermeasure plan; reduce use of hazardous materials at project sites; and evaluate potential hazards at each project site and develop a plan to minimize risk to the public. (Same mitigation as identified for the Proposed Action, Impact 4.12-1.)	Less than Significant
Impact 4.12-12. The public could be exposed to hazardous or toxic materials associated with or disturbed during construction, modification, or removal activities at the Restoration Project sites; public access to construction areas could also increase the potential for exposure to hazardous materials (similar to Impact 4.12-2)	Significant	Reclamation will clearly mark all construction sites as hazardous and off-limits to the public, backfill or cover excavation areas at each day end, lock access areas to prevent public entry, and notify nearby sensitive receptors and residents of activity schedule. (Same mitigation as identified for the Proposed Action, Impact 4.12-2.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.12-13. Increased vehicle traffic along private access roads during construction activities could endanger residents and domestic animals (similar to Impact 4.12-3)	Significant	Reclamation will limit construction vehicle speed to 5 mph on private roads, limit construction vehicle traffic on private roads to daylight hours only, and establish complaint line for residents to notify authorities of excessive vehicle speeds/safety issues. (Same mitigation as identified for the Proposed Action, Impact 4.12-3.)	Less than Significant
Impact 4.12-14. Dewatering activities at the Restoration Project sites could provide breeding grounds for mosquitoes (similar to Impact 4.12-4)	Significant	Reclamation will maximize public protection with applicable mosquito abatement districts and control agencies, and inform workers to take appropriate precautions to protect health. (Same mitigation as identified for the Proposed Action, Impact 4.12-4.)	Less than Significant
Impact 4.12-15. Helicopter operations at some of the Restoration Project sites could result in worker injury or fire (similar to Impact 4.12-5)	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.12-16. Construction workers could be exposed to hazardous or toxic materials disturbed during construction, modification, or removal activities at the Restoration Project sites (similar to Impact 4.12-1)	Significant	Reclamation will develop and implement a spill prevention, containment, and countermeasure plan; reduce use of hazardous materials at project sites; and evaluate potential hazards at each project site and develop a plan to minimize risk to the public. (Same mitigation as identified for the Proposed Action, Impact 4.12-1.)	Less than Significant
Impact 4.12-17. The public could be exposed to hazardous or toxic materials associated with or disturbed during construction, modification, or removal activities at the Restoration Project sites; public access to construction areas could also increase the potential for exposure to hazardous materials (similar to Impact 4.12-2)	Significant	Reclamation will clearly mark all construction sites as hazardous and off-limits to the public, backfill or cover excavation areas at each day end, lock access areas to prevent public entry, and notify nearby sensitive receptors and residents of activity schedule. (Same mitigation as identified for the Proposed Action, Impact 4.12-2.)	Less than Significant
Impact 4.12-18. Increased vehicle traffic along private access roads during construction activities could endanger residents and domestic animals (similar to Impact 4.12-3)	Significant	Reclamation will limit construction vehicle speed to 5 mph on private roads, limit construction vehicle traffic on private roads to daylight hours only, and establish complaint line for residents to notify authorities of excessive vehicle speeds/safety issues. (Same mitigation as identified for the Proposed Action, Impact 4.12-3.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.12-19. Dewatering activities at the Restoration Project sites could provide breeding grounds for mosquitoes (similar to Impact 4.12-4)	Significant	Reclamation will maximize public protection with applicable mosquito abatement districts and control agencies, and inform workers to take appropriate precautions to protect health. (Same mitigation as identified for the Proposed Action, Impact 4.12-4.)	Less than Significant
Impact 4.12-20. Helicopter operations at some of the Restoration Project sites could result in worker injury or fire (similar to Impact 4.12-5)	Less than Significant	None	Not Applicable
PUBLIC SERVICES AND UTILITIES			
No Action Alternative			
The No Action Alternative would not affect public services and utilities and is not expected to contribute to the increased usage of those public services and utilities described in the document.	No Change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.13-1. Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services	Significant	The construction contractors will implement practicable and conventional precautions to ensure the safety of workers and the general public, use physical barriers and sign postings consistent with standard construction safety management practices, provide notice to county law enforcement and fire protection agencies during proposed activities, and adhere to standard precautions and approaches required by the California Department of Forestry and Protection and Shasta and Tehama County Fire Departments.	Less than Significant
Impact 4.13-2. Proposed activities at the Restoration Project sites may increase demand on solid waste and hazardous waste disposal facilities	Less than Significant	None	Not Applicable
Impact 4.13-3. Relocation or removal of electric transmission facilities could temporarily affect services provided by utilities	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
No Dam Removal Alternative			
Impact 4.13-4. Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services (similar to Impact 4.13-1)	Significant	The construction contractors will implement practicable and conventional precautions to ensure the safety of workers and the general public, use physical barriers and sign postings consistent with standard construction safety management practices, provide notice to county law enforcement and fire protection agencies during proposed activities, and adhere to standard precautions and approaches required by the California Department of Forestry and Protection and Shasta and Tehama County Fire Departments. (Same mitigation as identified for the Proposed Action, Impact 4.13-1.)	Less than Significant
Impact 4.13-5. Proposed activities at the Restoration Project sites may increase demand on solid waste and hazardous waste disposal facilities (similar to Impact 4.13-2)	Less than Significant	None	Not Applicable
Impact 4.13-6. Relocation or removal of electric transmission facilities could temporarily affect services provided by utilities (similar to Impact 4.13-3)	Less than Significant	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.13-7. Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services (similar to Impact 4.13-1)	Significant	The construction contractors will implement practicable and conventional precautions to ensure the safety of workers and the general public, use physical barriers and sign postings consistent with standard construction safety management practices, provide notice to county law enforcement and fire protection agencies during proposed activities, and adhere to standard precautions and approaches required by the California Department of Forestry and Protection and Shasta and Tehama County Fire Departments. (Same mitigation as identified for the Proposed Action, Impact 4.13-1.)	Less than Significant
Impact 4.13-8. Proposed activities at the Restoration Project sites may increase demand on solid waste and hazardous waste disposal facilities (similar to Impact 4.13-2)	Less than Significant	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.13-9. Relocation or removal of electric transmission facilities could temporarily affect services provided by utilities (similar to Impact 4.13-3)	Less than Significant	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.13-10. Significant Proposed activities at the Restoration Project sites may increase demands on fire, police, and emergency medical services (similar to Impact 4.13-1)	Significant	The construction contractors will implement practicable and conventional precautions to ensure the safety of workers and the general public, use physical barriers and sign postings consistent with standard construction safety management practices, provide notice to county law enforcement and fire protection agencies during proposed activities, and adhere to standard precautions and approaches required by the California Department of Forestry and Protection and Shasta and Tehama County Fire Departments. (Same mitigation as identified for the Proposed Action, Impact 4.13-1.)	Less than Significant
Impact 4.13-11. Proposed activities at the Restoration Project sites may increase demand on solid waste and hazardous waste disposal facilities (similar to Impact 4.13-2)	Less than Significant	None	Not Applicable
Impact 4.13-12. Relocation or removal of electric transmission facilities could temporarily affect services provided by utilities (similar to Impact 4.13-3)	Less than Significant	None	Not Applicable
RECREATION			
No Action Alternative			
The No Action Alternative would not result in any changes to the existing recreational resources in and around the Restoration Project.	No change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.14-1. Construction activities at Inskip Diversion Dam could reduce recreational opportunities at the Oasis Springs Lodge	Significant and Unavoidable	Reclamation will notify Oasis Springs Lodge of the construction activity schedule and will consult with lodge operators to identify any additional impacts on recreational opportunities and determine whether any further appropriate mitigation measures are necessary.	Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.14-2. Construction activities could temporarily reduce recreational resources and activities	Significant	Reclamation will notify land and property owners of construction schedule and minimize construction during periods of high recreational activity.	Less than Significant
Impact 4.14-3. Construction activities, including the use of equipment and storage areas, may temporarily impede public access to Battle Creek for kayaking and to private property where landowners may grant public access by selling hunting and fishing rights	Significant	Reclamation will notify nearby land and property owners of construction schedule, post signage notifying recreationists of construction activity and schedule, store heavy equipment alongside access roads and roadways to allow passage of the public, and minimize construction during periods of high recreational activity.	Less than Significant
Impact 4.14-4. Removing canals and installing fish screens to stop movement of fish into the remaining canals would virtually eliminate the resident trout populations and recreational trout fishing in the canals	Less than Significant	None	Not Applicable
Impact 4.14-5. Loss of a recreational fishery at Oasis Springs Lodge	Less than Significant	None	Not Applicable
Impact 4.14-6. Increased flows in North Fork and South Fork Battle Creek could increase the opportunities for kayaking, rafting, and/or fishing activities	Beneficial	None	Not Applicable
No Dam Removal Alternative			
Impact 4.14-7. Construction activities at Inskip Diversion Dam could reduce recreational opportunities at the Oasis Springs Lodge (similar to Impact 4.14-1)	Significant and Unavoidable	Reclamation will notify Oasis Springs Lodge of the construction activity schedule and will consult with lodge operators to identify any additional impacts on recreational opportunities and determine whether any further appropriate mitigation measures are necessary. (Same mitigation as identified for the Proposed Action, Impact 4.14-1.)	Significant
Impact 4.14-8. Construction activities could temporarily reduce recreational resources and activities (similar to Impact 4.14-2)	Significant	Reclamation will notify land and property owners of construction schedule and minimize construction during periods of high recreational activity. (Same mitigation as identified for the Proposed Action, Impact 4.14-2.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.14-9. Construction activities, including the use of equipment and storage areas, may temporarily impede public access to Battle Creek for kayaking and to private property where landowners may grant public access by selling hunting and fishing rights (similar to Impact 4.14-3)	Significant	Reclamation will notify nearby land and property owners of construction schedule, post signage notifying recreationists of construction activity and schedule, store heavy equipment alongside access roads and roadways to allow passage of the public, and minimize construction during periods of high recreational activity. (Same mitigation as identified for the Proposed Action, Impact 4.14-3.)	Less than Significant
Impact 4.14-10. Installing fish screens to stop movement of fish into the canals would virtually eliminate the resident trout populations and recreational trout fishing in the canals (similar to Impact 4.14-4)	Less than Significant	None	Not Applicable
Impact 4.14-11. Loss of a recreational fishery at Oasis Springs Lodge (similar to Impact 4.14-5)	Less than Significant	None	Not Applicable
Impact 4.14-12. Increased flows in North Fork and South Fork Battle Creek could increase the opportunities for kayaking, rafting, and/or fishing activities (similar to Impact 4.14-6)	Beneficial	None	Not Applicable
Six Dam Removal Alternative			
Impact 4.14-13. Construction activities at Inskip Diversion Dam could reduce recreational opportunities at the Oasis Springs Lodge (similar to Impact 4.14-1)	Significant and Unavoidable	Reclamation will notify Oasis Springs Lodge of the construction activity schedule and will consult with lodge operators to identify any additional impacts on recreational opportunities and determine whether any further appropriate mitigation measures are necessary. (Same mitigation as identified for the Proposed Action, Impact 4.14-1.)	Significant
Impact 4.14-14. Construction activities could temporarily reduce recreational resources and activities (similar to Impact 4.14-2)	Significant	Reclamation will notify land and property owners of construction schedule and minimize construction during periods of high recreational activity. (Same mitigation as identified for the Proposed Action, Impact 4.14-2.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.14-15. Construction activities, including the use of equipment and storage areas, may temporarily impede public access to Battle Creek for kayaking and to private property where landowners may grant public access by selling hunting and fishing rights (similar to Impact 4.14-3)	Significant	Reclamation will notify nearby land and property owners of construction schedule, post signage notifying recreationists of construction activity and schedule, store heavy equipment alongside access roads and roadways to allow passage of the public, and minimize construction during periods of high recreational activity. (Same mitigation as identified for the Proposed Action, Impact 4.14-3.)	Less than Significant
Impact 4.14-16. Removing canals and installing fish screens to stop movement of fish into the remaining canals would virtually eliminate the resident trout populations and recreational trout fishing in the canals	Less than Significant	None	Not Applicable
Impact 4.14-17. Loss of a recreational fishery at Oasis Springs Lodge (similar to Impact 4.14-5)	Less than Significant	None	Not Applicable
Impact 4.14-18. Increased flows in North Fork and South Fork Battle Creek could increase the opportunities for kayaking, rafting, and/or fishing activities (similar to Impact 4.14-6)	Beneficial	None	Not Applicable
Three Dam Removal Alternative			
Impact 4.14-19. Construction activities at Inskip Diversion Dam could reduce recreational opportunities at the Oasis Springs Lodge (similar to Impact 4.14-1)	Significant and Unavoidable	Reclamation will notify Oasis Springs Lodge of the construction activity schedule and will consult with lodge operators to identify any additional impacts on recreational opportunities and determine whether any further appropriate mitigation measures are necessary. (Same mitigation as identified for the Proposed Action, Impact 4.14-1.)	Significant
Impact 4.14-20. Construction activities could temporarily reduce recreational resources and activities (similar to Impact 4.14-2)	Significant	Reclamation will notify land and property owners of construction schedule and minimize construction during periods of high recreational activity. (Same mitigation as identified for the Proposed Action, Impact 4.14-2.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.14-21. Construction activities, including the use of equipment and storage areas, may temporarily impede public access to Battle Creek for kayaking and to private property where landowners may grant public access by selling hunting and fishing rights (similar to Impact 4.14-3)	Significant	Reclamation will notify nearby land and property owners of construction schedule, post signage notifying recreationists of construction activity and schedule, store heavy equipment alongside access roads and roadways to allow passage of the public, and minimize construction during periods of high recreational activity. (Same mitigation as identified for the Proposed Action, Impact 4.14-3.)	Less than Significant
Impact 4.14-22. Installing fish screens to stop movement of fish into the canals would virtually eliminate the resident trout populations and recreational trout fishing in the canals	Less than Significant	None	Not Applicable
Impact 4.14-23. Loss of a recreational fishery at Oasis Springs Lodge	Less than Significant	None	Not Applicable
Impact 4.14-24. Increased flows in North Fork and South Fork Battle Creek could increase the opportunities for kayaking, rafting, and/or fishing activities (similar to Impact 4.14-6)	Beneficial	None	Not Applicable
CULTURAL			
No Action Alternative			
No impacts would occur on cultural resources; the diversion dams and canals would continue to be affected by existing use and upgrades.	No Change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Impact 4.15-1. Removal of historic properties	Significant and Unavoidable	HAER documentation will be prepared for all eligible properties, and a CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study will be prepared and distributed to historical societies and other interested parties.	Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.15-2. Historic properties would be adversely affected	Significant	HAER documentation will be prepared for all eligible properties, and a CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study will be prepared and distributed to historical societies and other interested parties. (Same as mitigation identified for the Proposed Action, Impact 4.15-1.)	Less than Significant
Impact 4.15-3. Potential damage to archaeological deposits as a result of vehicular traffic	Significant	Access roads will be flagged during construction, and traffic will be limited to these areas.	Less than Significant
Impact 4.15-4. Potential impact on cultural resources at the Jeffcoat aquaculture facility	Significant	Reclamation will complete a full assessment of the significance of the resources. To comply with Section 106, Reclamation will consult with the SHPO, the Advisory Council on Historic Preservation, and any other consulting parties in the Section 106 review process regarding eligibility of the significant resources. An MOA will be developed among Reclamation, the SHPO, and any identified consulting parties if eligible cultural resources would be adversely affected by the proposed undertaking. The MOA will describe methods for Reclamation to mitigate the adverse effects. Mitigation measures may include data recovery excavations and avoidance through project design. The Section 106 review process described here will be completed before beginning construction of the Restoration Project.	Less than Significant
No Dam Removal Alternative			
Impact 4.15-5. Historic properties would be adversely affected (similar to Impact 4.15-2)	Significant	HAER documentation will be prepared for all eligible properties, and a CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study will be prepared and distributed to historical societies and other interested parties. (Same as mitigation identified for the Proposed Action, Impact 4.15-2.)	Less than Significant
Impact 4.15-6. Potential damage to archaeological deposits as a result of vehicular traffic (similar to Impact 4.15-3)	Significant	Access roads will be flagged during construction, and traffic will be limited to these. (Same as mitigation identified for the Proposed Action, Impact 4.15-3.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Impact 4.15-7. Potential impact on cultural resources at the Jeffcoat aquaculture facility (Similar to Impact 4.15-4)	Significant	Reclamation will complete a full assessment of the significance of the resources. To comply with Section 106, Reclamation will consult with the SHPO, the Advisory Council on Historic Preservation, and any other consulting parties in the Section 106 review process regarding eligibility of the significant resources. An MOA will be developed among Reclamation, the SHPO, and any identified consulting parties if eligible cultural resources would be adversely affected by the proposed undertaking. The MOA will describe methods for Reclamation to mitigate the adverse effects. Mitigation measures may include data recovery excavations and avoidance through project design. The Section 106 review process described here will be completed before beginning construction of the Restoration Project.	Less than Significant
Six Dam Removal Alternative			
Impact 4.15-8. Removal of historical properties (similar to Impact 4.15-1)	Significant and Unavoidable	HAER documentation will be prepared for all eligible properties, and a CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study will be prepared and distributed to historical societies and other interested parties. (Same as mitigation identified for the Proposed Action, Impact 4.15-1.)	Significant
Impact 4.15-9. Historic properties would be adversely affected (similar to Impact 4.15-2)	Significant	HAER documentation will be prepared for all eligible properties, and a CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study will be prepared and distributed to historical societies and other interested parties. (Same as mitigation identified for the Proposed Action, Impact 4.15-2.)	Less than Significant
Impact 4.15-10. Potential damage to archaeological deposits as a result of vehicular traffic (similar to Impact 4.15-3)	Significant	Access roads will be flagged during construction, and traffic will be limited to these areas. (Same as mitigation identified for the Proposed Action, Impact 4.15-3.)	Less than Significant

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Three Dam Removal Alternative			
Impact 4.15-11. Removal of historic properties (similar to Impact 4.15-1)	Significant and Unavoidable	HAER documentation will be prepared for all eligible properties, and a CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study will be prepared and distributed to historical societies and other interested parties. (Same as mitigation identified for the Proposed Action, Impact 4.15-1.)	Significant
Impact 4.15-12. Eligible historic properties would be adversely affected (similar to Impact 4.15-2)	Significant	HAER documentation will be prepared for all eligible properties, and a CD-ROM containing the interviews and summary report of the Battle Creek Watershed Conservancy's study will be prepared and distributed to historical societies and other interested parties. (Same as mitigation identified for the Proposed Action, Impact 4.15-2.)	Less than Significant
Impact 4.15-13. Potential damage to archaeological deposits as a result of vehicular traffic (similar to Impact 4.15-3)	Significant	Access roads will be flagged during construction, and traffic will be limited to these areas. (Same as mitigation identified for the Proposed Action, Impact 4.15-3.)	Less than Significant
OTHER NEPA ANALYSES			
POWER GENERATION AND ECONOMICS			
No Action Alternative			
Ongoing operation, maintenance, and capital expenditures would not change. This alternative would not result in any effects on the cost of power.	No change	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Effect 4.16-1. Increased cost of project power	Not Applicable	None	Not Applicable
No Dam Removal Alternative			
Effect 4.16-2. Increased cost of project power	Not Applicable	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Six Dam Removal Alternative			
Effect 4.16-3. Increased cost of project power	Not Applicable	None	Not Applicable
Three Dam Removal Alternative			
Effect 4.16-4. Increased cost of project power	Not Applicable	None	Not Applicable
SOCIOECONOMICS			
No Action Alternative			
No substantial change in regional or local employment or income levels is expected.	Not Applicable	None	Not Applicable
Five Dam Removal Alternative (Proposed Action)			
Effect 4.16-5. Potential socioeconomic risk to Mount Lasses Trout Farm fish-marketing program	Not Applicable	A pipeline would be constructed to bypass the Jeffcoat site to prevent the potential contamination of spring water with the IHN virus. In addition, one of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Not Applicable
Effect 4.16-6. Potential construction-related loss of revenues at Oasis Springs Lodge.	Not applicable	Reclamation will notify Oasis Springs Lodge of the construction activity schedule and will consult with lodge operators to identify any additional impacts on recreational opportunities and determine whether any further appropriate mitigation measures are necessary. (Same mitigation as that identified for the Proposed Action, Impact 4.14-1.)	Not applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Effect 4.16-7. Potential long-term loss in revenue at Oasis Springs Lodge	Not applicable		Not applicable
Effect 4.16-8. Slight increase of regional sales/receipts during construction	Not Applicable	None	Not Applicable
Effect 4.16-9. Slight increase of construction-related jobs during Restoration Project construction	Not Applicable	None	Not Applicable
No Dam Removal Alternative			
Effect 4.16-10. Potential socioeconomic risk to Mount Lasses Trout Farm fish-marketing program (similar to Effect 4.16-5)	Not Applicable	A pipeline would be constructed to bypass the Jeffcoat site to prevent the potential contamination of spring water with the IHN virus. In addition, one of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Not Applicable
Effect 4.16-11. Potential construction-related loss in revenues at Oasis Springs Lodge (similar to Effect 4.16-6)	Not applicable	Reclamation will notify Oasis Springs Lodge of the construction activity schedule and will consult with lodge operators to identify any additional impacts on recreational opportunities and determine whether any further appropriate mitigation measures are necessary. (Same mitigation as that identified for the Proposed Action, Impact 4.14-1.)	Not applicable
Effect 4.16-12. Potential long-term loss in revenues at Oasis Springs Lodge (similar to Effect 4.16-7)	Not applicable		Not applicable
Effect 4.16-13. Slight increase of regional sales/receipts during construction	Not Applicable	None	Not Applicable
Effect 4.16-14. Slight increase of construction-related jobs during Restoration Project construction	Not Applicable	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Six Dam Removal Alternative			
Effect 4.16-15. Potential socioeconomic risk to Mount Lassen Trout Farm fish-marketing program (similar to Effect 4.16-5)	Not Applicable	One of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Not Applicable
Effect 4.16-16. Potential construction-related loss in revenues at Oasis Springs Lodge (similar to Effect 4.16-6)	Not applicable	Reclamation will notify Oasis Springs Lodge of the construction activity schedule and will consult with lodge operators to identify any additional impacts on recreational opportunities and determine whether any further appropriate mitigation measures are necessary. (Same mitigation as that identified for the Proposed Action, Impact 4.14-1.)	Not applicable
Effect 4.16-17. Potential long-term loss in revenues at Oasis Springs Lodge (similar to Effect 4.16-7)	Not applicable		Not applicable
Effect 4.16-18. Slight increase of regional sales/receipts during construction (similar to Effect 4.16-6)	Not Applicable	None	Not Applicable
Effect 4.16-19. Slight increase of construction-related jobs during Restoration Project construction (similar to Effect 4.16-7)	Not Applicable	None	Not Applicable

Table ES-6. Continued

Impact	Level of Significance	Proposed Mitigation Measure(s)	Level of Significance after Mitigation
Three Dam Removal Alternative			
Effect 4.16-20. Potential socioeconomic risk to Mount Lassen Trout Farm fish-marketing program (similar to Effect 4.16-5)	Not Applicable	One of the following options at the Willow Springs facility would be implemented: ■ Option A—install a disinfection facility, ■ Option B—relocate Willow Springs to raise trout at an equivalent off-site facility, ■ Option C—modify MLTF's operations at the Willow Springs facility, and ■ Option D—acquire Willow Springs. (Same mitigation as that identified for the Proposed Action, Impact 4.1-8.)	Not Applicable
Effect 4.16-21. Potential construction-related loss in revenues at Oasis Springs Lodge (similar to Effect 4.16-6)	Not applicable	Reclamation will notify Oasis Springs Lodge of the construction activity schedule and will consult with lodge operators to identify any additional impacts on recreational opportunities and determine whether any further appropriate mitigation measures are necessary. (Same mitigation as that identified for the Proposed Action, Impact 4.14-1.)	Not applicable
Effect 4.16-22. Potential long-term loss in revenues at Oasis Springs Lodge (similar to Effect 4.16-7)	Not applicable		Not applicable
Effect 4.16-23. Slight increase of regional sales/receipts during construction (similar to Effect 4.16-6)	Not Applicable	None	Not Applicable
Effect 4.16-24. Slight increase of construction-related jobs during Restoration Project construction (similar to Effect 4.16-7)	Not Applicable	None	Not Applicable

Table ES-7. Comparison of Benefits and Impacts Associated with Each Action Alternative[8]

Impact/Effect	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
Section 4.1, Fish				
Increased survival of adults and increased spawning success because removal of five dams and the construction of more reliable, effective fish ladders would facilitate passage of Chinook salmon and steelhead (migration habitat).	Impact 4.1-15 Beneficial		Impact 4.1-52 Beneficial	Impact 4.1-72 Beneficial
Increased survival of adults and increased spawning success because the construction of more effective fish ladders on North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, and Coleman Diversion Dams would facilitate passage of Chinook salmon and steelhead.		Impact 4.1-34 Beneficial		
Potentially increased spawning success and fry production because separating the powerhouse water discharge from the normal stream channel would facilitate the return of adult Chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek (migration and habitat stability).	Impact 4.1-16 Beneficial		Impact 4.1-53 Beneficial	Impact 4.1-73 Beneficial
Substantially increased survival of juvenile steelhead and Chinook salmon during downstream movement and migration as a result of eliminating some diversions and constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek (entrainment).	Impact 4.1-18 Beneficial		Impact 4.1-55 Beneficial	Impact 4.1-75 Beneficial
Substantially increased survival of juvenile steelhead and Chinook salmon during downstream movement and migration as a result of constructing fish screens at the remaining diversions from North Fork and South Fork Battle Creek (entrainment).		Impact 4.1-35 Beneficial		
Reduction of predation-related mortality as a result of removing dams and improving fish ladders (predation, pathogens, and food).	Impact 4.1-19 Beneficial		Impact 4.1-56 Beneficial	Impact 4.1-76 Beneficial

[8] This table lists only those impacts that are different among the alternatives. Impacts that are shared by all alternatives are not listed in this table.

Table ES-7. Continued

Impact/Effect	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
Reduction of predation-related mortality as a result of improving fish ladders (predation, pathogens, and food).		Impact 4.1-36 Beneficial		
Substantially increased production of food for fish resulting from increased minimum instream flows (predation, pathogens, and food).	Impact 4.1-20 Beneficial	Impact 4.1-37 Beneficial	Impact 4.1-57 Beneficial	Impact 4.1-77 Beneficial
Section 4.2, Botanical, Wetland, and Wildlife Resources				
Substantial increase in quantity of bat roosting habitat in the South Canal tunnels as a result of termination of water flow through the tunnels.	Impact 4.2-18 Beneficial		Impact 4.2-52 Beneficial	
Section 4.3, Hydrology				
Coleman Diversion Dam removal could reduce the 10-, 25-, and 50-year floodwater surface profiles at Inskip Powerhouse.	Impact 4.3-2 Beneficial		Impact 4.3-6 Beneficial	Impact 4.3-9 Beneficial
Total number of beneficial impacts from each alternative	**7**	**4**	**7**	**6**

Section 4.1, Fish				
Mortality of fish eggs and larvae and reduced reproductive success of fish and other aquatic species as a result of removing South, Coleman, and Eagle Canyon Diversion Dams, which would release currently stored fine sediment to the stream channel (contaminants).	Impact 4.1-3 Significant *(Coleman and South Diversion Dams)*		Impact 4.1-40 Significant *(Eagle Canyon, Coleman, and South Diversion Dams)*	Impact 4.1-60 Significant *(Eagle Canyon and Coleman Diversion Dams)*

Table ES-7. Continued

Impact/Effect	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
Increased risk of a serious or catastrophic fish disease spreading from Battle Creek to fish communities throughout the state through stocking with MLTF and Darrah Springs State Fish Hatchery fish. *Note: Mitigation at the Jeffcoat mitigation site is not required for the Six Dam Removal and Three Dam Removal Alternatives.*	Impact 4.1-8 Significant *(Jeffcoat, Willow Springs, and Asbury Diversion Dam)*	Impact 4.1-27 Significant *(Jeffcoat, Willow Springs, and Asbury Diversion Dam)*	Impact 4.1-45 Significant *(Willow Springs and Asbury Diversion Dam)*	Impact 4.1-65 Significant *(Willow Springs and Asbury Diversion Dam)*
Section 4.2, Botanical, Wetland, and Wildlife Resources				
Potential disturbance or loss of woody riparian vegetation and associated wildlife habitat.	Impact 4.2-1 Significant *(4.18 acres)*	Impact 4.2-19 Significant *(1.87 acres)*	Impact 4.2-35 Significant *(4.18 acres)*	Impact 4.2-53 Significant *(3.81 acres)*
Potential loss or disturbance of waters of the United States (including wetlands).	Impact 4.2-3 Significant *(18.86 acres)*	Impact 4.2-21 Significant *(14.57 acres)*	Impact 4.2-37 Significant *(16.43 acres)*	Impact 4.2-55 Significant *(12.07 acres)*
Potential disturbance of breeding habitat for yellow-breasted chat and little willow flycatcher. *Note: Breeding habitat for little willow flycatcher would not be affected under the Three Dam Removal Alternative.*	Impact 4.2-8 Significant	Impact 4.2-26 Significant	Impact 4.2-42 Significant	Impact 4.2-60 Significant *(only yellow-breasted chat)*
Possible loss of woody riparian vegetation along PG&E canals.	Impact 4.2-12 Less than significant *(includes Wildcat, South, and a portion of Eagle Canyon Canals)*	Impact 4.2-30 Less than significant *(includes a portion of Eagle Canyon Canal)*	Impact 4.2-46 Less than significant *(includes Wildcat, South, and Eagle Canyon Canals)*	Impact 4.2-64 Less than significant *(includes Wildcat and Eagle Canyon Canals)*
Section 4.3, Hydrology				
Removal of Eagle Canyon Diversion Dam could result in minor increases to downstream bed elevations.			Impact 4.3-4 Less than significant	Impact 4.3-7 Less than significant

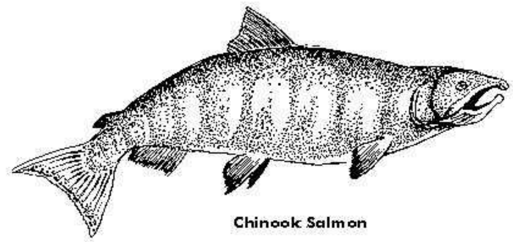
Table ES-7. Continued

Impact/Effect	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
Section 4.4, Water Quality				
Removal of South and Coleman Diversion Dams could cause erosion of minor amounts of sediment from behind the dam.	Impact 4.4-5 Less than significant		Impact 4.4-16 Less than significant	Impact 4.4-23 Less than significant *(only Coleman Diversion Dam)*
Minor amounts of sediment released by the removal of Coleman Diversion Dam would be deposited at the County Road Bridge.	Impact 4.4-6 Less than significant		Impact 4.4-17 Less than significant	Impact 4.4-24 Less than significant
Short-term increased turbidity and settleable material load on the Coleman National Fish Hatchery water treatment plant as a result of removing Coleman Diversion Dam.	Impact 4.4-7 Less than significant		Impact 4.4-18 Less than significant	Impact 4.4-25 Less than significant
Section 4.8, Visual Resources				
Construction of the channel with armoring or revetment would alter views of the South Fork creek bank.				Impact 4.8-16 Significant and unavoidable
Potential reduction in scenic resources visible from canals caused by closure of PG&E canals.	Impact 4.8-4 Less than significant *(Includes Wildcat, South, and a portion of Eagle Canyon Canals)*	Impact 4.8-9 Less than significant *(Includes a portion of Eagle Canyon Canal)*	Impact 4.8-14 Less than significant *(Includes Wildcat, South, and Eagle Canyon Canals)*	Impact 4.8-19 Less than significant *(Includes Wildcat, South, and Eagle Canyon Canals)*
Temporarily reduced scenic resources along the Eagle Canyon Canal as a result of construction of Eagle Canyon pipeline.	Impact 4.8-5 Less than significant	Impact 4.8-10 Less than significant		

Table ES-7. Continued

Impact/Effect	Five Dam Removal Alternative	No Dam Removal Alternative	Six Dam Removal Alternative	Three Dam Removal Alternative
Section 4.15, Cultural Resources				
Removal of historic properties.	Impact 4.15-1 Significant and unavoidable		Impact 4.15-8 Significant and unavoidable	Impact 4.15-11 Significant and unavoidable
Potential impact on cultural resources at the Jeffcoat aquaculture facility.	Impact 4.15-4 Significant	Impact 4.15-7 Significant		
Section 4.16, Other NEPA Analyses				
Power Generation and Economics: Increased cost of project power.	Effect 4.16-1 *($5.0 million)*	Effect 4.16-2 *($12.6 million)*	Effect 4.16-3 *($16.8 million)*	Effect 4.16-4 *(13.7 million)*
Power Generation and Economics: Indirect environmental effects associated with the loss of hydropower and renewable replacement power.	Effect	Effect *(some degree of magnitude less than the Five Dam Removal Alternative)*	Effect *(some degree of magnitude greater than the Five Dam Removal Alternative)*	Effect *(some degree of magnitude less than the Five Dam Removal Alternative)*
Socioeconomics: Potential socioeconomic risk to MLTF fish marketing program.	Effect 4.16-5	Effect 4.16-10	Effect 4.16-15 *(some degree of magnitude less than the Five Dam Removal Alternative)*	Effect 4.16-20 *(some degree of magnitude less than the Five Dam Removal Alternative)*
Total number of impacts under each alternative	**16**	**11**	**15**	**16**

Chapter 1
Introduction, Organization, and Process



Chinook Salmon

The signatories to the 1999 Memorandum of Understanding (MOU) (Appendix A)—the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), the U.S. Fish and Wildlife Service (USFWS), the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries), the California Department of Fish and Game (DFG), and the Pacific Gas and Electric Company (PG&E)—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 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 U.S. Code [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 that received funding in 1999, and may receive additional funding, pursuant to a March 2004 proposal) from the California Bay-Delta Authority (CBDA), environmental review of this EIS/EIR will tier from the CALFED Bay-Delta Program Final Programmatic EIS/EIR (CALFED Programmatic EIS/EIR) (CALFED Bay-Delta Program 2000a).

[1] Pacific Gas & Electric Company (PG&E) is the owner and licensee of the Battle Creek Hydroelectric Project (FERC Project No. 1121).

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. In the event that any new and unforeseen significant impacts, as identified by the lead agencies, occur during the course of implementing the Restoration Project, the lead agencies will conduct the appropriate required environmental review.

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 federal Clean Water Act (CWA) (33 USC 1251 *et seq.*) Section 401 water quality certification from the California State Water Resources Control Board (State Water Board), the State Water Board is the state lead agency responsible for ensuring compliance with CEQA, the CWA, and other applicable state laws.

This document was developed through the contributions and efforts of the public, interested parties, the Battle Creek Working Group (BCWG)[2], the Battle Creek Watershed Conservancy (BCWC), California Bay-Delta Authority (CBDA), State Water Board, FERC, California Department of Water Resources (DWR), and the signatories to the 1999 MOU (Appendix A) including Reclamation, USFWS, NOAA Fisheries, DFG, and PG&E. 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 nine chapters:

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

[2] Since the beginning of the Restoration Project, the BCWG has evolved to become the Greater Battle Creek Watershed Working Group (GBCWWG); however, it is referred to as BCWG throughout this document because the referenced activities took place before this change.

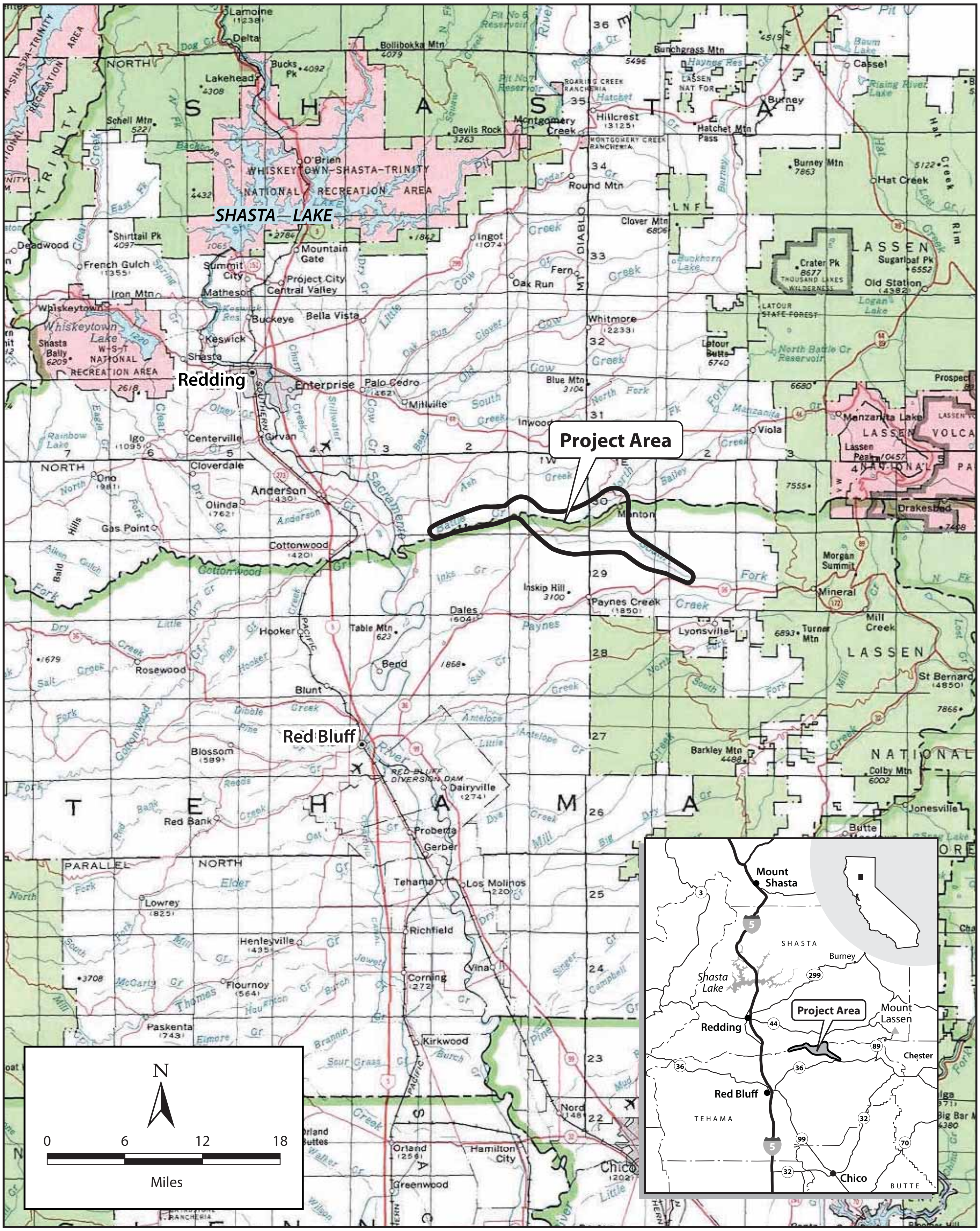


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Figure 1-1
Location of the Battle Creek Salmon and Steelhead Restoration Project

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. In May 2000, PG&E received approval from FERC to use the alternative licensing procedures set forth in 18 CFR § 4.34(i) for its license amendment application. This EIS/EIR serves as part of PG&E's application for a license amendment; it is a substitute for Exhibit E. Section 10(a)(2)(A) of the Federal Power Act, 16 USC Section 803 (a)(2)(A) requires FERC to consider the extent to which a project is consistent with a federal or state comprehensive plan for improving, developing, or conserving a waterway affected by the project. According to a letter prepared by FERC to DFG (Sampson pers. comm.), the following documents qualify as a comprehensive plan under Section 10(a)(2)(A):

- The Resources Agency, State of California, 1989, Upper Sacramento River Fisheries and Riparian Habitat Management Plan;
- DFG, 1990, Central Valley Salmon and Steelhead Restoration and Enhancement Plan;
- DFG, 1993, Restoring Central Valley Streams: A Plan for Action; and
- DFG, 1996, Steelhead Restoration and Management Plan.

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 State Water Board. Accordingly, PG&E will be pursuing a water quality certification for the Restoration Project. Any water quality certification issued by the State Water Board will be based on information in the final EIS/EIR and the administrative record. Implementation of the Restoration Project can begin only after the State Water Board 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 the Restoration Project to the CALFED Bay-Delta Program

The CALFED Bay-Delta Program (CALFED Program) is a cooperative effort of 24 state and federal agencies with regulatory and management responsibilities in the San Francisco Bay/Sacramento–San Joaquin Delta (Bay-Delta) to develop and implement a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The objective of the collaborative planning process is to identify comprehensive solutions to the problem of ecosystem quality, water supply reliability, water quality, and Sacramento–San Joaquin River Delta (Delta) levee and channel integrity.

In July 2000, the CALFED agencies released the Final Programmatic EIS/EIR, which analyzed a range of alternatives to solve Bay-Delta system problems. In August 2000, the CALFED agencies adopted a preferred alternative that included measures to reduce potential conflict between stakeholders and provide an adequate water supply for all beneficial uses of water. The Restoration Project is being proposed as a project to implement a part of the CALFED Program described in the CALFED Programmatic ROD issued August 28, 2000.

The Preferred Program Alternative described in the ROD is a long-term plan that includes a variety of different potential actions over 30 years by numerous public and private entities to improve the health of the Bay-Delta Estuary. Among the potential actions are several that would promote ecosystem restoration throughout the Bay-Delta region.

The goals of the CBDA Ecosystem Restoration Program (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 CBDA 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 Program actions will satisfy the requirements of these three acts.

In the CALFED Programmatic EIS/EIR and the ROD, the CALFED Program set out components of the Preferred Program Alternative. Chapter 2, Decision, Section 2.2, Plan for Action, 2.2.2 Ecosystem Restoration of the ROD calls for the improvement of fish passage through modifications or removal of eight PG&E diversion dams on Battle Creek. In addition, the ROD calls for the improvement of salmon spawning and juvenile survival in upstream tributaries as defined by the ERP and Strategic Plan, by purchasing up to 100,000 acre-feet per year (af/yr) by the end of Stage 1. An important component of the Restoration

Project is the Water Acquisition Fund (WAF), which would establish a ready source of funding that may be needed for any future purchases of additional instream flow releases for fish habitat in Battle Creek as recommended under adaptive management.

More specifically, the ERP Strategic Plan for Ecosystem Restoration (CALFED Bay-Delta Program 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 Programmatic 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 Bay-Delta Program 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.

The Restoration Project is consistent with the implementation approach in the ROD. The Restoration Project has been developed in the context of the overall CALFED Program and meets the policy commitments described in the ROD that each project implementing the program will be subject to the appropriate type of environmental analysis and will evaluate and use the appropriate programmatic mitigation strategies described in the PEIS/EIR and the ROD. (CALFED Bay-Delta Program ROD, pp. 29–30, 32–35, and Appendix A.)

Relationship to the CALFED Bay-Delta Programmatic Environmental Impact Statement/ Environmental Impact Report

The CALFED Programmatic EIS/EIR provides a very broad, programmatic analysis of the general effects of implementing the multiple components of the CALFED Program over a 30-year period, across two-thirds of the state. The impacts analysis in the Programmatic EIS/EIR was not intended to address any site-specific environmental effects of individual projects. Accordingly, the CALFED Programmatic EIS/EIR's direct, indirect, and cumulative impacts analysis is not sufficiently detailed for purposes of this Restoration Project document, which focuses on a specific project and specific affected geographic areas over a different time frame. The CALFED Programmatic EIS/EIR was therefore used only to develop background information (Council on Environmental Quality [CEQ] NEPA Regulations Part 1500, Section 1502.20; CEQA Guidelines Section 15168 [a–d]). This Restoration Project EIS/EIR stands alone and includes an independently developed analysis of the impacts of the Restoration Project, including direct, indirect, and cumulative impacts, alternatives, and avoidance/mitigation measures (CEQA Guidelines Section 15161).

Readers who desire more information about the CALFED Program, the CALFED Programmatic EIS/EIR, the Programmatic ROD, or the new CBDA may wish to review the documents and web resources listed below, which are available from the CBDA at 650 Capitol Mall, 5th Floor, Sacramento, CA 95814, (916) 445-5511:

- Final Programmatic Environmental Impact Statement/Environmental Impact Report (July 2000), including technical appendices;
- Programmatic Record of Decision, Volumes 1–3, (August 28, 2000); and
- <http://calwater.ca.gov>.

Chapter 2

Purpose and Need, Project Description, and Project Background

This chapter discusses the geographic scope of the Restoration Project, 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 the geographic scope, a timeline and summary of events leading to the development of the Restoration Project, discussion of the significance of Battle Creek, development of an MOU, and discussion of the ecological restoration and energy production considerations associated with the Restoration Project.

Geographic Scope

Battle Creek is a tributary to the upper Sacramento River Basin (Figure 2-1). The Battle Creek watershed is situated on the volcanic slopes of Mt. Lassen in southeastern Shasta and northeastern Tehama Counties.

The Restoration Project area is located on the North Fork and South Fork of Battle Creek in southern Shasta and northern Tehama Counties on lands south of Shingletown and State Route (SR) 44 and north of Paynes Creek and SR 36 (Figure 1-1). The Restoration Project includes 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 with South Fork Battle Creek. The upper project limit on South Fork Battle Creek is the natural fish barrier named Angel Falls, located approximately 6 miles above

South Diversion Dam. The lower project limit is the confluence of the Coleman Powerhouse tailrace channel and the mainstem of Battle Creek.

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 salmon and steelhead, which are dependent on cool water stream habitats. Winter-run Chinook salmon 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 salmon occurs in the mainstem of the Sacramento River below Shasta Dam (Yoshiyama et al. 1998). This section is kept cool by releases from the reservoir. However, periods of extended drought could exhaust its coldwater reserve, leaving the fish susceptible to reproductive failure. 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 salmon.

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 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

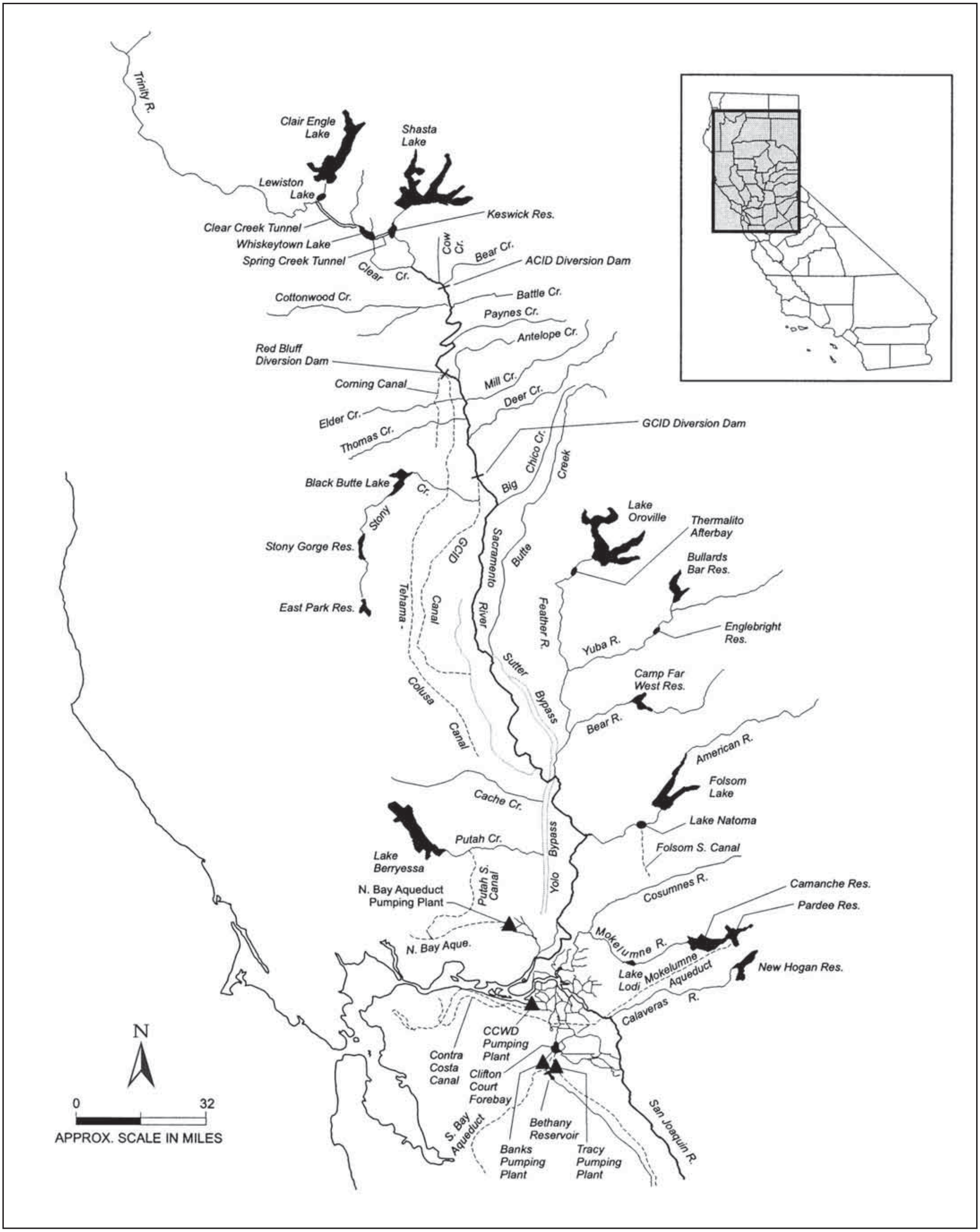

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Figure 2-1
Sacramento River Basin

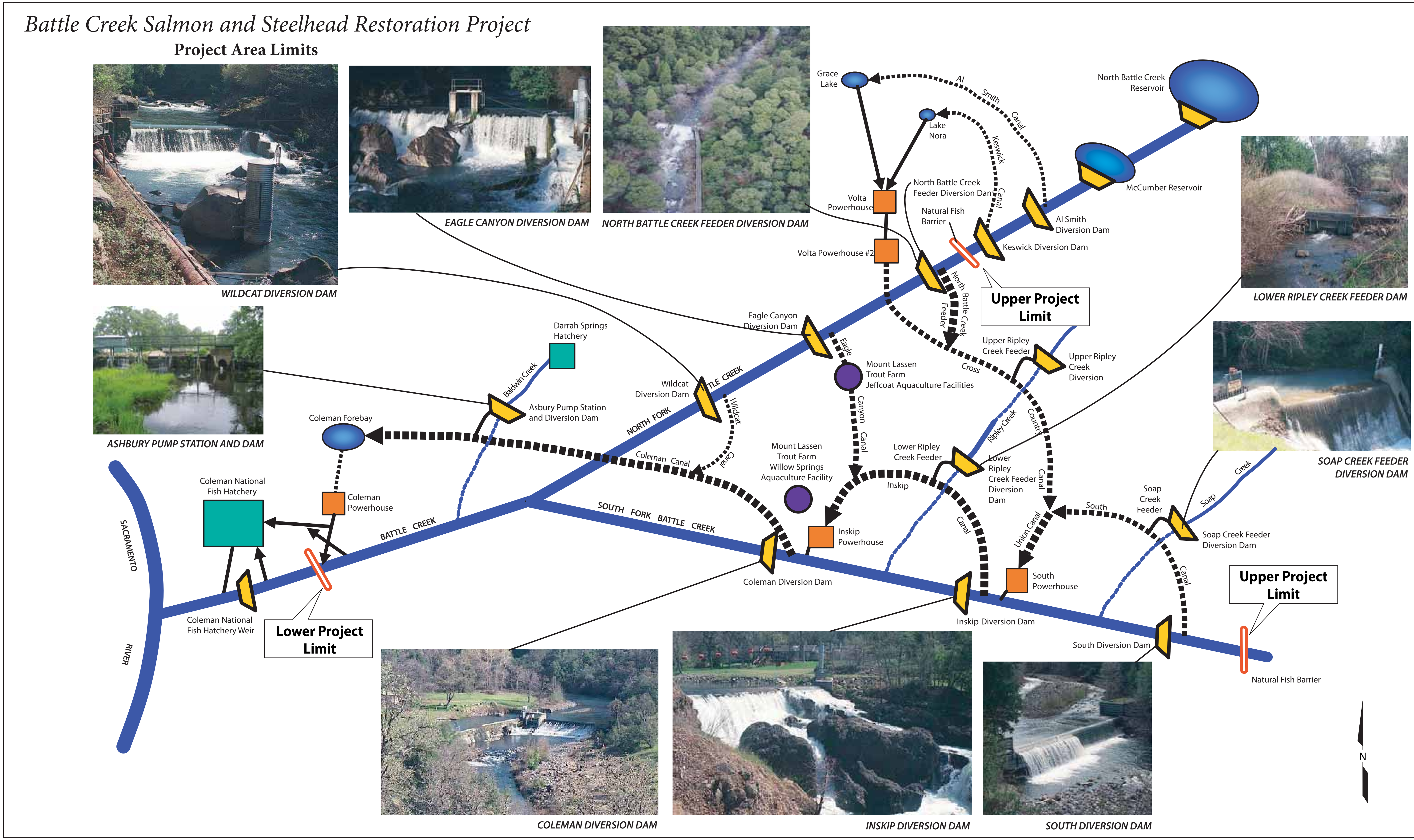

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Figure 2-2
Restoration Project Facilities and Project Area Limits

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 air emissions carbon dioxide, nitrogen oxide, and carbon monoxide and the production of ozone and smog.

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 as a result of increased instream flow;
- dedicate water diversion rights for instream purposes at dam removal sites;
- construct tailrace connectors and install failsafe[1] fish screens and fish ladders to increase 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

[1] The MOU defines failsafe as a level of performance and reliability. Those standards are specified in Sections 2.10 and 2.11 of the MOU (Appendix A).

- avoid impacts on other established water users/third parties.

The Restoration Project is a proactive, cooperative undertaking among the public, interested parties, the BCWG, 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 (AFRP).
- California State Salmon, Steelhead Trout, and Anadromous Fisheries Program Act (California Senate Bill [SB] 2261, 1990).

- CALFED Bay-Delta Ecosystem Restoration Program Plan (CALFED Bay-Delta Program 2000b).
- Upper Sacramento River Fisheries and Riparian Habitat Management Plan (SB 1086, 1989).*
- Central Valley Salmon and Steelhead Restoration and Enhancement Plan, prepared by DFG (1990a).*
- Steelhead Restoration Plan and Management Plan for California, prepared by DFG (1990b).*
- Restoring Central Valley Streams: A Plan for Action, prepared by 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 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

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

1962

Federal fisheries agency salmon planning effort recommends restoring natural streamflows throughout the Battle Creek system, primarily to meet the requirements for spring-run and winter-run chinook salmon.

1965

California Department of Fish and Game (DFG) statewide fisheries planning effort recommends restoration and utilization of natural salmon spawning area in Battle Creek.

1969

Pacific Gas and Electric Company (PG&E) applies for a new license for the existing Battle Creek Hydroelectric Project (FERC License No. 1121).

1970 – 1971

Resource Agency communications at this time reflected, among other things, the beliefs that:

- License flows below Hydroelectric Project diversion dams maintained, but did not enhance, aquatic life (Resource Agency 1971).
- Canal intakes were not screened to avoid loss of resident trout fishery in the canals (Coots and Healey 1966).
- Adequate protection of the anadromous fishery resource was met by reconstruction of the fish ladder at the Coleman Diversion Dam. Further reconstruction of the fish ladders at the other five Hydroelectric Project diversion dams did not appear to be warranted because maintenance of the anadromous fishery was met by eventually reconstructing two-thirds of the fish ladders with steel liners.

1976

Federal Energy Regulatory Commission issues new Hydroelectric Project License, which contains license article 33 allowing short-term drainages in releases below dam for fishery management and requires the Licensee to maintain the following minimum flow releases:

- 150 cfs downstream of Coleman Powerhouse
- 5 cfs in South Fork Battle Creek below the South, Inskip, and Coleman diversions.
- 3 cfs in North Fork Battle Creek below diversions into Al Smith, Keswick, Wildcat, Eagle Canyon, and Cross Country Canals.
- 0.3 cfs from North Battle Creek Reservoir into North Battle Creek Feeder, and from McCumber Reservoir into North Fork Battle Creek.

1979

The U.S. Army Corps of Engineers completed a flood control project on the lower 5 miles of Battle Creek below the Coleman National Fish Hatchery. Much of the spawning gravel was removed from the streambed by pushing the gravel into levee-like piles on the bank (O'Brien 1970).

1987 – 1988

USFWS, PG&E, and DFG cooperate in field trials to assess the potential success of fall-run Chinook salmon spawning in the North Fork, South Fork, and mainstem of Battle Creek. PG&E increased flows during spawning period.

1988

California Advisory Committee on Salmon and Steelhead Trout (legislatively authorized in 1970) recommends restoring Battle Creek system.

The DFG prepares a draft fisheries restoration action item for the Upper Sacramento River Fisheries and Riparian Habitat Management Plan (Senate Bill 1086 Plan) recognizing hatchery operation and hydroelectric power development as combining to drastically reduce natural spawning of Battle Creek salmon and steelhead trout. Short- and long-term solutions recommended by CDFG included continued releases of salmon to Battle Creek upstream of the Coleman National Fish Hatchery, flow augmentations, fisheries studies, development of a Battle Creek anadromous fish restoration plan with the U.S. Fish and Wildlife Service (USFWS), increased diversion bypass flow releases, fish screens at diversions, and improved gravel management.

1989

The California Legislature passes Senate Bill 1086, Upper Sacramento River Fisheries and Riparian Habitat Management Plan, acknowledging that operations of the Coleman National Fish Hatchery and hydroelectric power facilities had contributed to the declining runs of naturally occurring salmon and steelhead (Nielsen 1989).

The Upper Sacramento River Fisheries and Riparian Habitat Advisory Council (Senate Bill 1086) called for increased instream flows and screens at Hydroelectric Project diversions and increased release of salmon and steelhead upstream of Coleman National Fish Hatchery while managing disease risks at the hatchery (Nielsen 1989).

1989 – 1998

Battle Creek Fish Passage is identified as a priority in seven restoration plans.

1990

The DFG Central Valley basin planning effort for salmon and steelhead (Senate Bill 2261) makes recommendations to restore Battle Creek consistent with those in the 1989 Senate Bill 1086 process.

The Battle Creek Spawning Restoration Project, funded by Proposition 70, protected against bank erosion and channel migration threatening important spawning riffles in lower Battle Creek.

1993

The Inland Fisheries Division of CDFG reported on the successful use of streambank stabilization, gravel loosening, and the replacement of armoring cobbles with clean spawning-sized gravels to improve Battle Creek spawning habitat. CDFG, USFWS, and the National Marine Fisheries Service (NOAA Fisheries) met to develop a conceptual long-term fisheries management plan for Battle Creek upstream of the Coleman National Fish Hatchery.

DFG Central Valley fisheries restoration "Plan for Action" (advisory to the federal Central Valley Project Improvement Act of 1992 [CVPIA]) makes detailed recommendations to restore Battle Creek consistent with past recommendations on flow and passage.

1995 – 1996

The U.S. Bureau of Reclamation (Reclamation), USFWS, DFG, and PG&E enter into two interim agreements for immediate anadromous fish habitat improvement (Patterson 1996). The key provisions of these agreements include:

- Instream releases at Eagle Canyon and Coleman Diversion Dams increased to 30 cfs, 5 cfs, target flows or as subsequently modified by mutual agreement.
- Diversion to Wildcat Canal suspended.
- Partial compensation to the Licensee (PG&E) by Reclamation in the form of a water purchase based on value of the forgone energy production. Licensee bears initial loss of 12.5 cfs at Eagle Canyon and Coleman Diversion Dams; Wildcat Canal loss is shared equally.
- Blocking the downstream entrances to the fish passage facilities at Eagle Canyon and Coleman Diversion Dams.

Technical teams from state and federal agencies develop advisory reports for CVPIA program restoration actions that include detailed recommendations to restore Battle Creek that are consistent with past recommendations on flow and passage.

This partnership between PG&E, state and federal fisheries agencies, and restoration funding sources (CVPIA and Category III) allows interim increases in flows at one-half of the hydroelectric diversions affecting salmon and steelhead while a permanent or long-term arrangement can be reached. The basis for this agreement is an article in the FERC license allowing short- term changes to the license for fishery management upon mutual agreement between PG&E and DFG.

1996

The DFG Steelhead Restoration Plan – advisory to the CVPIA of 1992 – recommends increasing the instream flow at Hydroelectric Project diversions and allowing steelhead to ascend above Coleman National Fish Hatchery.

The Pacific Fisheries Management Council passes a resolution to examine the feasibility of reintroducing winter-run chinook salmon into Battle Creek.

Discussions between PG&E and resource agencies begin regarding long-term fisheries restoration in Battle Creek.

1997

Formation of the Greater Battle Creek Working Group, composed of stakeholder representatives from the state and federal resource agencies and fishery, environmental, local, agricultural, power, and urban stakeholder communities and established by interested and affected parties associated with implementation of the CVPIA to develop an implementation plan for Battle Creek that is effective and has community acceptance.

NOAA Fisheries Proposed Recovery Plan for the Winter-Run Chinook Salmon recommends conducting a feasibility analysis of reestablishing winter-run salmon populations in Battle Creek.

The USFWS AFRP revised plan for implementing the CVPIA recommends more detailed actions to restore Battle Creek that are consistent with past recommendations on flow and passage.

CALFED awards a Category III contract to Battle Creek Working Group agencies for the development of a comprehensive technical plan to guide implementation and to receive advice from interested and affected parties.

CALFED and CVPIA award a contract to foster the development of a Battle Creek Watershed Conservancy through the joint efforts of the Western Shasta and Tehama Resource Conservation Districts.

The Battle Creek Watershed Conservancy is formed and a newsletter is initiated.

USFWS is awarded CALFED Ecosystem Restoration Project funding for the monitoring of adult and juvenile spring- and winter-run chinook salmon in Battle Creek. Funding is continued in 1998.

The California Department of Water Resources (DWR) receives CALFED Category III funding for studying spawning gravel replacement in the lower reaches of Battle Creek.

1998

The Greater Battle Creek Working Group becomes a technical advisory committee for the technical plan developed under the CALFED Category III grant. Working Group Subcommittees are convened to focus on biology, power loss, and regulatory issues. Presentations are developed on alternative methods of providing flow and passage.

CALFED awards Ecosystem Restoration Program contract with DWR to perform an engineering investigation of anadromous fish passage in upper Battle Creek.

Reclamation is awarded an Ecosystem Restoration Program Grant to investigate costs associated with removing Wildcat, Eagle Canyon, and Coleman Diversion Dams.

Efforts by USFWS to develop a disease-free water supply at Coleman National Fish Hatchery enter final construction phases.

Reclamation prepared and circulated a Draft Environmental Assessment for the continuance of the temporary flow agreement augmenting streamflow in the lower half of Battle Creek.

The Battle Creek Watershed Conservancy receives CALFED Ecosystem Restoration Program funding for improved Battle Creek watershed stewardship activities.

1999

Completion of the Battle Creek Salmon and Steelhead Restoration Plan—the technical basis for the Battle Creek Salmon and Steelhead Restoration Project.

Reclamation, NOAA Fisheries, USFWS, CDFG, and PG&E sign Agreement in Principle to pursue a restoration project on Battle Creek involving modifications to the Hydroelectric Project.

Reclamation, NOAA Fisheries, USFWS, CDFG, and PG&E sign a Memorandum of Understanding for the Battle Creek Salmon and Steelhead Restoration Project.

Reclamation submits proposal and approves $28 million in directed funding for the Battle Creek Salmon and Steelhead Restoration Project, contingent upon the development of a detailed, formal memorandum of understanding between parties in conformance with the Agreement in Principle and terms of the CALFED funding.

USFWS receives CALFED Ecosystem Restoration Program funding for improving the upstream ladder and barrier weir at the Coleman National Fish Hatchery.

2001

A Four Agency Letter is prepared by Reclamation, USFWS, NOAA Fisheries, and DFG (Four Agency Letter, September 20, 2001) in response to the Battle Creek Watershed Conservancy's concerns over activities of the agencies in the Battle Creek Watershed (Appendix B).

Under the Interim Flow Agreement, USFWS, NOAA Fisheries, and DFG (Letter to PG&E, May 14, 2001) direct PG&E to reduce diversions and close the fish ladders at Eagle Canyon and Coleman Diversion Dams for the 2001 season (Appendix E).

2002

Under the Interim Flow Agreement, USFWS, NOAA Fisheries, and DFG (Letter to PG&E, March 21, 2002) direct PG&E to reduce diversions and close the fish ladders at Eagle Canyon and Coleman Diversion Dams for the 2002 season (Appendix E).

A Four Agency Letter prepared by Reclamation, USFWS, NOAA Fisheries, and DFG (Four Agency Statement, October 31, 2002) allows for a process of passing adult steelhead above the Coleman National Fish Hatchery barrier weir (Appendix E).

2003

A new Interim Flow Agreement is signed to continue the flow agreements that augment streamflow in the lower half of Battle Creek until December 2004 or the start of instream construction.

2004

April—Completion of the Draft Action Specific Implementation Plan

May—Proposal Solicitation Package (PSP) submitted to California Bay Delta Authority (CBDA) Ecosystem Restoration Program (ERP) to seek additional funding for the Restoration Project.

2005

The Battle Creek Watershed Conservancy (BCWC) supports the Restoration Project (Appendix B).

March—Revisions to May 2004 PSP submitted to CBDA ERP to seek additional funding for the Restoration Project.

March—Public review of the Restoration Project Draft Supplemental EIS/Revised EIR

Summer—Completion of the Restoration Project Biological Opinions by USFWS and NOAA Fisheries

Summer—Completion of Restoration Project Final EIS/EIR and issuance of NEPA ROD and CEQA findings

2006

Start of construction

2009

Completion of construction

03035.03 FEIS/EIR

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

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.

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 affect 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.

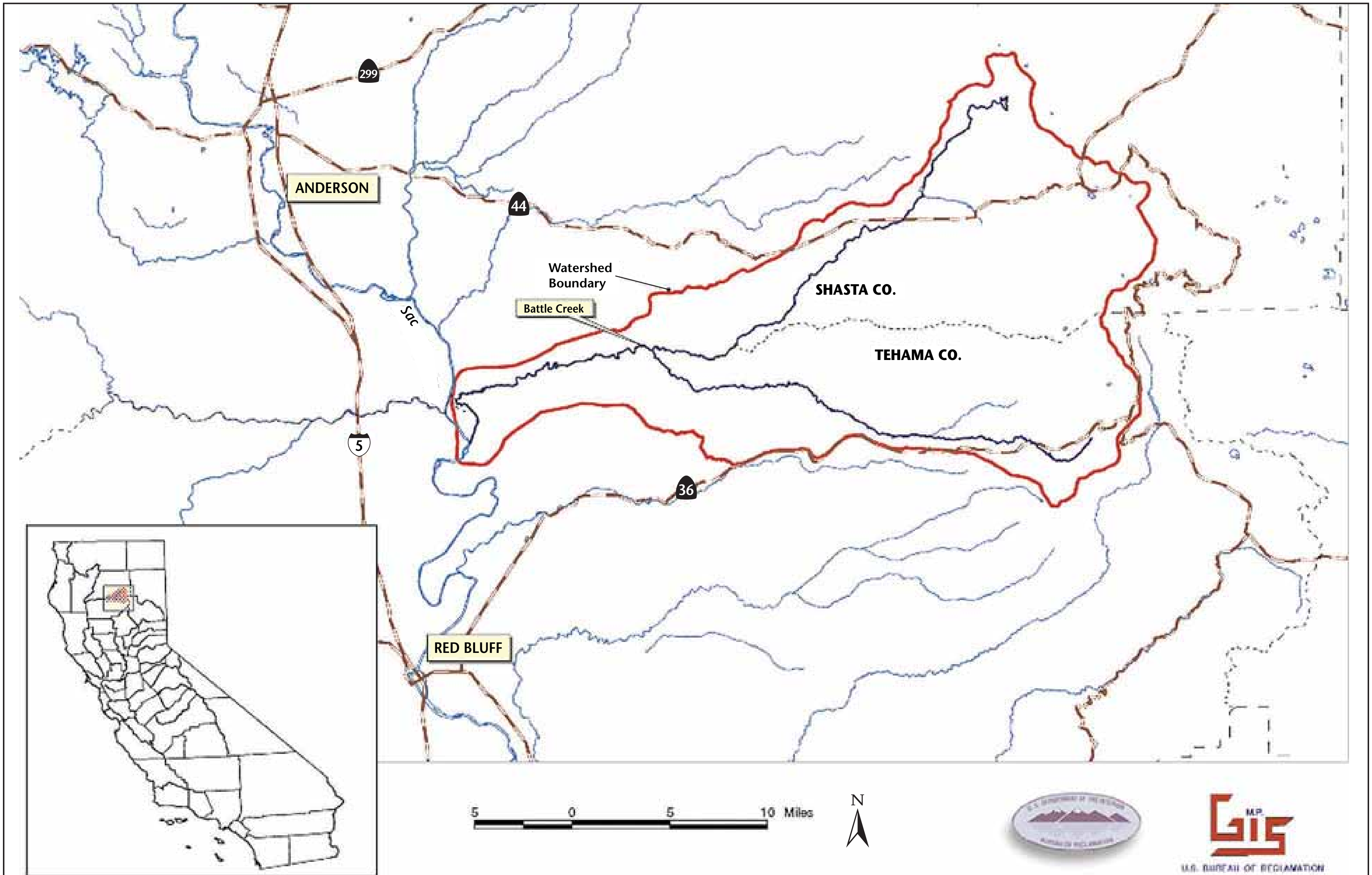
The demonstrated persistence of the various anadromous species inhabiting Battle Creek is a key factor in concluding that wild populations could again flourish if habitat improvements are made to better support the various fish life stages. Establishment of an assemblage of several recovered species 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. In mid-1999, the parties signed a detailed, formal MOU (Appendix A) in conformance with the Agreement in Principle, allowing the release of $28 million in CBDA (CALFED ERP) federal funding for the agencies' responsibilities in the partnership. Since the signing of the MOU in



Source: Reclamation 1999a.

03035.03 FEIS/EIR

Figure 2-4
Battle Creek Watershed

1999, costs have increased, and additional funds are being requested via a March 2005 proposal to the CALFED ERP.[2]

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 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. If an alternative other than the Proposed Action were selected, a new MOU must be negotiated. The ability to negotiate a new agreement for a restoration effort prior to the expiration of the FERC license in 2026 would be uncertain, as would the amount of time that would be required to prepare a new MOU.

Decision-Making Process

As described in the MOU (Appendix A), planning, permitting, and construction of the Restoration Project will be implemented through a cooperative effort of the Project Management Team (PMT), Project Manager, and Technical Teams. The PMT is a management-level group that makes all final decisions through a consensus process. In addition to technical aspects, the PMT takes into account input and concerns from landowners, stakeholders, and the public in reaching decisions. All decisions and decision-making are subject to the discretionary authority of each participating agency of the PMT.

Social Context

Various local groups working in the Battle Creek Watershed have provided input on the Restoration Project. The BCWG[3] has served as a catalyst to explore various actions to carry forth the Restoration Project. The Battle Creek Watershed Conservancy (BCWC) has also focused on restoration from a watershed approach. Based on a collaborative effort between the project proponents and the community, many of the concerns relating to the Restoration Project have been addressed. 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. In

[2] 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.

[3] Since commencement of the Restoration Project, the BCWG has evolved to become the Greater Battle Creek Watershed Working Group; however, it is referred to as the BCWG throughout this document because the referenced activities took place before this change.

2004, the BCWC announced its conditional support of the Restoration Project, pending the appropriate consideration and resolution of four agency issues:

- that USFWS convene and lead an emergency workshop to revisit the steelhead supplementation plan;
- that DFG reconsider the documented record and lead an effort to more clearly identify the goals, objectives, and priorities of the Restoration Project and make sure that those objectives are consistent with existing Restoration Project documentation, with the CALFED Programmatic Record of Decision, and that they are consistent throughout all elements of the final funding request to CBDA;
- that the winter-run recovery team complete the winter-run recovery plan or at least develop a stream-specific strategy for reestablishing a winter-run Chinook salmon population in Battle Creek and that reintroduction strategies are developed for other ESA–listed species (e.g., spring-run Chinook salmon and steelhead) in Battle Creek that can be implemented in anticipation of the Restoration Project Record of Decision; and
- that Reclamation facilitate the development and implementation of an adaptive management plan for Coleman National Fish Hatchery facilities and operations (Battle Creek Watershed Conservancy 2004).

As a result of the progress that has been made on the issues listed above and the ongoing progress concerning other key issues, the BCWC Board now recommends support of the Restoration Project in its current form (Appendix B).

In addition to the Restoration Project, other 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 CBDA funding; and the watershed restoration measures identified in the 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 CBDA 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 (U.S. Fish and Wildlife Service 1997c). 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 (U.S. Fish and Wildlife Service 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.

Since 1995, Reclamation has had interim flow agreements with PG&E to maintain higher minimum instream flows until a long-term restoration project can be implemented on Battle Creek. 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. Increased flow releases are made below the Eagle Canyon and Coleman Diversion Dams.

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 (U.S. Fish and Wildlife Service 1997c). In response, the biological technical team analyzed water temperature using the SNTEMP Model applied initially by Thomas R. Payne and Associates then refined by PG&E (Pacific Gas and Electric Company 2001). 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, it may be appropriate to consider actions such as modifying a new barrier or adjusting instream flows to improve passage.

To maximize the effectiveness of fish passage facilities at the diversion dams under favorable operating conditions, the BCWG fish passage technical team determined that these facilities would be designed as failsafe installations, incorporating resource agency design criteria/guidelines for ladders and screens and geometrics known to provide reliable performance (Kier Associates 1999a). A failsafe fish ladder incorporates features to ensure continued operation of the structure to facilitate the safe passage of fish under the same performance criteria as designed under anticipated sources of failure. A failsafe fish screen is designed to shut off the water diversion whenever the fish screen fails to meet design or performance criteria until the fish screen is functioning again. 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 South Fork 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 in 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 magnitude of effects on stream function is greater the farther upstream 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 final Adaptive Management Plan (AMP) (Appendix C) 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 AMP). 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 CBDA 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 McCumber), 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 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 an elevation of 3,650 feet. The Keswick Canal also has a capacity of 64 cfs and ends at Lake Nora at an elevation of 3,430 feet, 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 ¾ 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 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. The original Hydroelectric Project has been modified over the years as technology improved and original equipment became obsolete. One major change was the replacement of the original four powerhouses (Volta, South, Inskip, and Coleman Powerhouses) in the late 1970s with modern structures and generating equipment that allowed the plants to operate unattended (Reynolds and Scott 1980).

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 D.

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 rediverted 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 (AMF) to accommodate modifications to hydroelectric production facilities or the acquisition of additional water for increased instream flow determined by the AMP protocols. A total of $6 million is budgeted for adaptive management through scheduled use of funds derived from a third party and the Water Acquisition Fund.

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 on 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 pass through 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 Dan and Canal

North Battle Creek Feeder Diversion Dam and Canal were constructed around 1910 to divert 55 cfs 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 2,082.4. A 5-foot-wide hydraulic pass through 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. 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 pass through 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 cfs 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 1,430.2. 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 pass through 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 pass through 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 cfs. 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 3,000 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 cfs 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-feet-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. Cattle fencing is present at a few locations along the corridor of the canal.

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, Pipeline, and Canal
(North Fork Battle Creek)

Wildcat Diversion Dam and Pipeline

Wildcat Diversion Dam, Pipeline, and Canal were constructed in 1912 to divert around 20 cfs 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 1,074.7. 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 along 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. Cattle fencing is present at a few locations along the corridor of 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 generally have no vehicle access, except at the transition structure. However, two primitive roads exist that have been used infrequently by PG&E in the past to access the pipeline at two points along the south canyon. The pipeline is usually 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 and Canal
(South Fork Battle Creek)

South Diversion Dam

South Diversion Dam and Canal were constructed in 1910 to divert up to 100 cfs 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 2,028.2. 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 pass through 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 pass through 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 pass through 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 pass through 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 Feeder 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 Feeder 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 South Fork Battle Creek. The dam consists of a concrete gravity structure 10 feet in height, with an overall length of 41 feet at 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 Feeder 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 South Fork 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 cfs 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 pass through gate is set near the right abutment to allow the sluicing of sediments that periodically accumulate behind the dam. The radial pass through 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 pass through 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 Feeder Diversion Dam

Lower Ripley Creek Feeder 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 5 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 Coleman Canal

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 South Fork Battle Creek approximately 900 feet upstream of Coleman Diversion Dam. The powerhouse receives up to about 293 cfs 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 North Fork 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 cfs.

Coleman Diversion Dam diverts up to 340 cfs from South Fork 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 1,006.1. 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 pass through 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 pass through gate and weir help prevent sediments from blocking the fish ladder and canal entrance. The fish ladder located between the radial pass through 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 Station and Diversion Dam
(Baldwin Creek, Tributary to Mainstem Battle Creek)

Asbury Diversion Dam on Baldwin Creek

Asbury Pump Station and 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 Darrah Springs facility is a key hatchery of the DFG inland fisheries program and raises catchable trout for sport fisheries. Baldwin Creek has been identified as one of seven tributaries to Battle Creek capable of providing suitable habitat for steelhead.

Asbury Diversion Dam was constructed around 1920. The 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 gallons per minute (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 Station and 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 Fish Hatchery. From Wildcat Road, a lightly paved/dirt road heads in a westerly direction approximately 1.3 miles past the hatchery facility to the dam and pump station area. The east (left) side of the dam can be reached by footpath off of this road. The dirt road continues over a railroad bridge, which crosses Baldwin Creek to a parking area adjacent to the pumphouse. The west (right) side of the dam can be reached by footpath from this parking area.

Description of Project Alternatives

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;
- CBDA ERP;
- Upper Sacramento River Fisheries and Riparian Habitat Management Plan (SB 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 (Bernard et al. 1996).

Each of the Action Alternatives[1] 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, and
- Three Dam Removal Alternative.

These names were chosen because they can easily be differentiated, and they focus on one water management strategy—dam removal[2]—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.

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.

[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. Public Scoping Alternative 6, which includes removing all diversion dams on North Fork and South Fork Battle Creek below the natural fish barriers, was removed from further consideration as discussed at the end of this chapter.

[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.

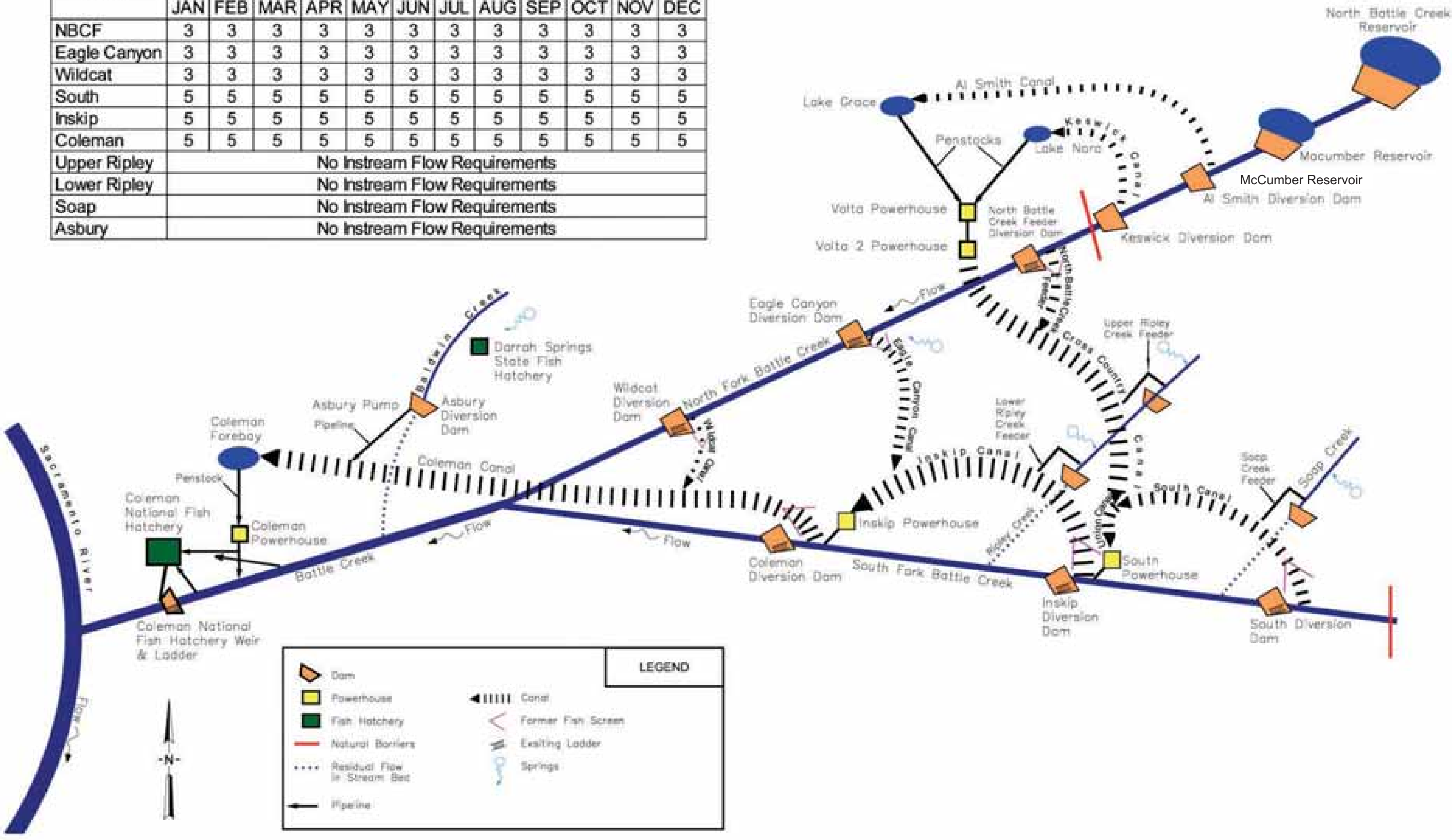
No Action Alternative

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 and maintained 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 an Interim Flow Agreement[3] with PG&E to maintain higher minimum instream flows until a long-term restoration project can be implemented on Battle Creek. The terms of this agreement 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 Diversions 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 Agreement represents 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 Agreement are not included as part of the No Action Alternative. The resource conditions include 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.

[3] The Interim Flow Agreement (Agreement 03-20-2554) was developed between Reclamation and PG&E with concurrence from DFG under temporary operation provisions to the existing FERC license. The current agreement will expire in December 2005. For more information, see Chapter 6, "Related Projects," or Appendix E of this report.

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 Manton, California

Battle Creek Schematic

Revision Date: June 26, 2001

DRAWING : Battle Creek
Sheet of

03035.03 FEIS/EIR

Figure 3-1
No Action Alternative

Five Dam Removal Alternative—Proposed Action

The Five Dam Removal Alternative 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 on 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 numbers and measurements presented in the description of the activities proposed under this alternative are approximate and will be finalized when final designs and construction specifications are completed. The description of this alternative includes the general plan for construction; however, it is possible that some changes may be made in the field. These changes will be within the conditions of the required permits and approvals.

The instream flows are an integral component of the Five Dam Removal Project. The BCWG Biological Technical Team collaboratively developed a detailed minimum flow release schedule for each dam. The Biological Technical Team included biologists from government fishery agencies and 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

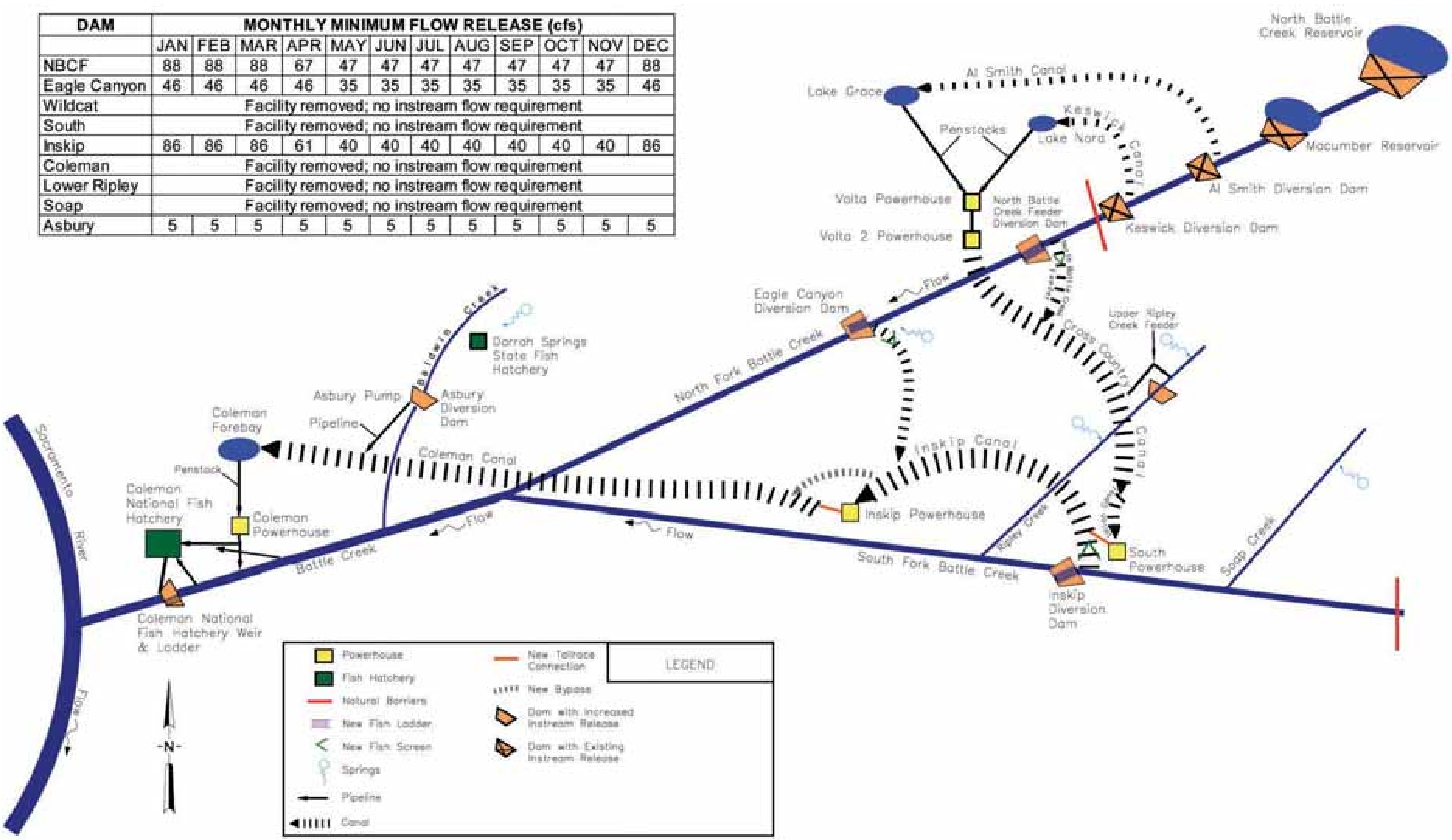
Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen*
	Fish ladder*
	Minimum instream flow set for North Battle Creek Feeder reach ranges from 47–88 cfs
	Access road construction and improvements
Eagle Canyon Diversion Dam	70-cfs fish screen*
	Fish ladder*
	Removal of a segment of the Eagle Canyon Spring Collection Facility
	Minimum instream flow set for Eagle Canyon reach ranges from 35–46 cfs
	Improvement of existing access trail

Site Name	Component
Wildcat Diversion Dam, Pipeline, and Canal	Dam and appurtenant facilities removed
	Improvement of access roads and trail
South Diversion Dam and Canal	Dam and appurtenant facilities removed
	Access road improvements
Soap Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
	Access road improvements
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen*
	Fish ladder*
	Construction of South Powerhouse and Inskip Canal connector (tunnel)
	Minimum instream flow set for Inskip reach ranges from 40–86 cfs
	Access road construction and improvements
Lower Ripley Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
	Access road improvements
Coleman Diversion Dam and Inskip Powerhouse	Dam removed
	Construction of Inskip Powerhouse and Coleman Canal connector
	Inskip Powerhouse bypass replaced
	Access road improvements
Asbury Pump Station and Diversion Dam	Reoperate
	Creek flow and stage recorder installed
	Minimum instream flow set for Baldwin Creek at 5 cfs

* Reliability and performance standards for fish ladders and fish screens are generally described in the 1999 MOU, Sections 2.10 and 2.11, respectively (Appendix A). More specific information on fish ladders and fish screens is presented in Table 21 and Table 22, respectively, in the Adaptive Management Plan (Terraqua, Inc. 2004a).

The following sections describe the construction schedule and activities proposed under the Five Dam Removal Alternative at North Battle Creek Feeder, Eagle Canyon, Wildcat, South, Inskip, Coleman, Lower Ripley Creek, Soap Creek Feeder, and Asbury Diversion Dam sites. The sections describe the most reasonably foreseeable proposed activities available at the time the Final EIS/EIR was produced. Minor project modifications or adjustments are not expected to result in any new or more significant impacts but, should that be the case, the lead agencies would complete the required environmental review of those changes before proceeding.

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 Manton, California

Battle Creek Schematic

Revision Date: June 26, 2001

DRAWING : Battle Creek
Sheet of

Figure 3-2
Five Dam Removal Alternative

The Restoration Project involves abandoning some 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 described only to the level of detail known at this time. Additionally, the acquisition of permanent and temporary easements is in preparation, and these easements are described only to the level of detail known at this time.

Construction Schedule

The following schedule may be modified on an as-needed basis as a result of a variety of factors, including season and precipitation. This schedule modification would be addressed on a case-by-case basis with the appropriate resource agencies. Construction of the Proposed Action is anticipated to begin in spring 2006 and end by summer 2009. The construction schedule for each project site follows.

- North Battle Creek Feeder Diversion Dam—Begin construction in May 2006 and end by August 2007.
- Eagle Canyon Diversion Dam—Begin construction in May 2006 and end by August 2007.
- Wildcat Diversion Dam, Pipeline, and Canal—Begin construction in July 2006 and end by November 2006.
- South Diversion Dam and South Canal—Begin construction in August 2008, complete instream construction by October 2008, and complete decommissioning of the South Canal by January 2009.
- Soap Creek Feeder—Begin construction in August 2008 and end by October 2008.
- Inskip Diversion Dam/South Powerhouse—Begin construction in May 2006 and end by July 2009.
- Lower Ripley Creek Feeder Diversion Dam—Complete construction during July 2007.
- Coleman Diversion Dam/Inskip Powerhouse—Begin construction in May 2006 and end by July 2009.
- Asbury Diversion Dam—Begin construction in May 2007 and end in November 2007.

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. The proposed construction area and project elements at North Battle Creek Feeder Diversion Dam are shown on Figure F-1 of Appendix F.

Fish Ladder

Under this alternative, a new pool and chute fish ladder would be constructed near the center of the existing dam, requiring removing the steel portion of the Steeppass fish ladder, plugging the west section in the dam, and removing the pass through 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 pass through 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 (in this case, 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 would spread across the ladder walls and could be positioned as needed along the wall to allow workers to make gate adjustments or remove debris. A catwalk would be provided along the left wall for access. The proposed ladder is about 17 feet wide (outer wall to outer wall). A new pass through 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 into 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-plate 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 replaced 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

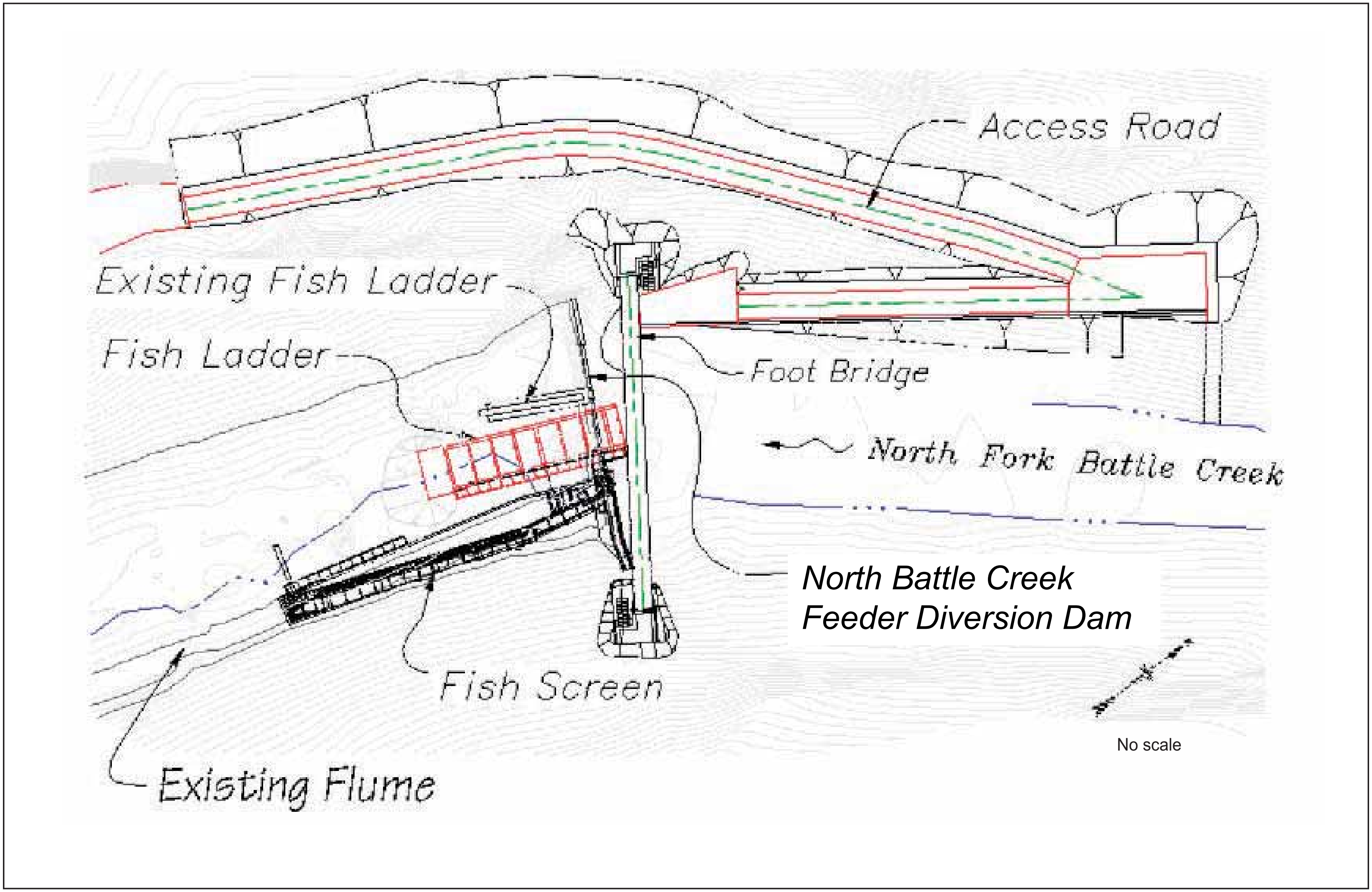


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Figure 3-2a
Proposed Facilities for the North Battle Creek Feeder Diversion Dam
Five Dam Removal Alternative

of the dam and would vary in width from about 5 feet to about 15 feet. A 3-foot-wide working platform would be included along the screen for maintenance purposes. A jib crane would 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 would include a 7.5-cfs fish bypass. This bypass feature would consist of a 15-inch-wide weir, drop box, and an 18-inch-diameter seamless smooth wall pipe. The fish bypass flow would drop 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 would 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 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 Feeder 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 preconstruction 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 22,000 square feet.
- **Staging area near the sediment trap and along the access road.** This area located between the existing access road and the new temporary access road would be used for contractor staging and disposal of excavated earth materials resulting from construction of the new access road and fish facilities at this site. The areas used for contract staging would be cleared and graded, and the surface would be graveled as required to facilitate use. The area to be used for disposal would be cleared of vegetation. Disposal piles will be graded to prevent ponding and reseeded to promote revegetation and to control sediment runoff. The total affected area would be 121,000 square feet.
- **Temporary access road and staging area.** 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 Feeder Diversion Dam. This staging area would be used to deploy trucked-in equipment and supplies by helicopter down to the worksite. Clearing vegetation, grading the site, and adding gravel surfacing would be necessary. The total area affected would be approximately 48,000 square feet.
- **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 2,700 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 Feeder 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 Feeder 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 Feeder 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 20,000 square feet.
- **Use of helicopters.** The dam site is in a remote area with constrained road 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.
- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

All areas temporarily disturbed by construction would be restored to their preconstruction 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:

- stabilize south canyon face to prevent rockfall hazards to construction work and final facilities;
- construct new access road and landing area;
- build cofferdams and temporary water bypass structures to allow continued required instream flow releases and power generation at downstream powerhouses while construction of the fish screen and ladder proceeds;
- prepare site by demolition of existing facilities, including pass through 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 temporary water bypass structures and complete site restoration.

Construction at this site would occur over a 17-month period. Construction is anticipated to begin in May 2006 and end by August 2007. Water diversions into the feeder canal would be continued during construction.

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. The proposed construction area and project elements at Eagle Canyon Diversion Dam are shown on Figure F-2 of Appendix F.

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 9-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 line would be moved out of the way to prevent interference with the helicopter and may be rerouted. 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. An elevated metal walkway would be constructed to avoid impacts on the wetlands at this site. 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. Springs emerge from the cliff near the Eagle Canyon Diversion Dam and along the Eagle Canyon Canal near the Mount Lassen Trout Farms (MLTF) Jeffcoat aquaculture facilities. Under the Five Dam Removal Alternative, the Jeffcoat springs would continue to flow into the Eagle Canyon Canal and be conveyed to Inskip Powerhouse. The springs emerging from the

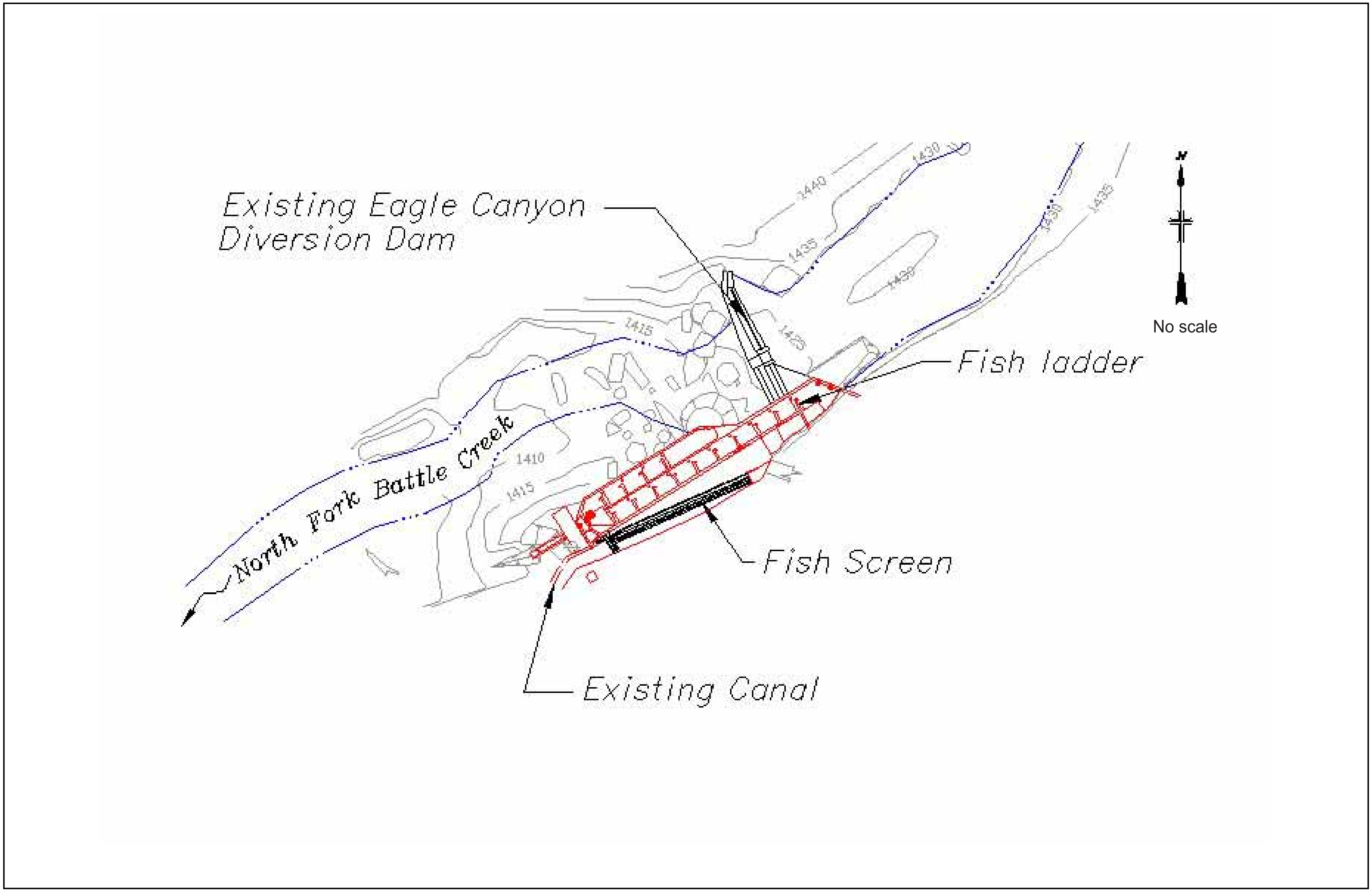

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Figure 3-2b
Proposed Facilities for the Eagle Canyon Diversion Dam
Five Dam Removal Alternative

cliffs near Eagle Canyon Diversion Dam are diverted around the collection system and returned to the North Fork Battle Creek under the terms of an interim flow agreement (see Chapter 6, "Related Projects"). Under the Five Dam Removal Alternative, broken and abandoned pipe collection facilities would be removed and other collection features would be modified to facilitate drainage along the trail and ensure that spring water continues to flow into North Fork Battle 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 20-foot-wide, 5,220-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. In addition, the primary access road would be improved by adding temporary turnouts at several points along the road to facilitate construction vehicle egress. The total area affected would be approximately 104,400 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, approximately 2,900 feet. 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 42,840 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.** Debris from construction and dam removal activities would be removed from the stream channel and deposited off site. Debris would be removed to the extent that it would not affect conditions supporting upstream migration of adult steelhead and Chinook salmon at minimum flow releases from upstream dams and would not adversely modify spawning (e.g., armoring) or rearing habitat. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions. Common excavation composed of sediments would be temporarily stockpiled in the work zone and then reused as backfill.

- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

All areas temporarily disturbed by construction would be restored to their preconstruction 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 to allow continued required instream flow releases and power generation at downstream powerhouses while construction of the fish screen and ladder proceeds;
- 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 17-month period. Construction is anticipated to begin in May 2006 and end by August 2007. Water diversions into the canal would be continued during construction.

Wildcat Diversion Dam, Pipeline, and Canal

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.

The proposed construction areas and project elements at Wildcat Diversion Dam, Wildcat Pipeline, and Wildcat Canal area are shown on Figure F-3 of Appendix F.

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. Natural stream floodflow would distribute the material throughout the downstream river system. The streambed would be restored to preconstruction 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 selected 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, removed from the stream channel, and deposited off site. There are 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 removed and deposited off site. Debris would be removed to the extent that it would not affect conditions supporting upstream migration of adult steelhead and Chinook salmon at minimum flow releases from upstream dams and would not adversely modify spawning (e.g., armoring) or rearing habitat. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions.

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 pass through 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 removed to the extent that it would not affect conditions supporting upstream migration of adult steelhead and Chinook salmon at minimum flow releases from upstream dams and would not adversely modify spawning (e.g., armoring) or rearing habitat. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions.

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 and the stream gage below the dam would also be left in place.

Approximately 5,390 feet of the 24-inch-diameter 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 metal work would remain. All other concrete piers along the pipeline alignment would also remain, except those that are unstable and pose a safety hazard and those that are designated for removal pursuant to landowner discussions. All timber and steel supports would 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 pipeline, the structure is anchored into the canyon wall. All anchor bolts supporting the pipe would be cut off at the rock surface and the ends removed.

Wildcat Canal could 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 108 feet. Downstream of this point, the canal begins collecting a large amount of drainage from the Wildcat Road drain ditch and a ranch drain ditch. 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 440 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.
- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

All areas temporarily disturbed by construction would be restored to their preconstruction 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 4-month period. Construction is anticipated to begin in July 2006 and end in November 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.

The proposed construction area for the South Diversion Dam is shown in Figure F-4 of Appendix F. The area affected by decommissioning South Canal is presented on Figures F-6a and F-6b in Appendix F.

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 300-foot distance. The material would be placed along and within the creek channel in a manner that would not hinder flows or fish passage. 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 pass through 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, some footings that are visible from South Fork Battle Creek would be 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.

Pursuant to landowner discussions, the tunnel sections along South Canal would be abandoned through sealing, filling in, and/or installing of angle iron gates in a manner that would allow the tunnels to serve as bat habitat but prevent people from entering. Tunnel sections that would not be useful as bat habitat (because they are small and short in length) may be caved in (or collapsed) for safety reasons. It may be decided to cave in smaller sections of tunnel because they are not useful as habitat. 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 debris from dam removal located within 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 brushes 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. Decommissioning of the canal is anticipated to begin in August 2008 and end by January 2009.

Cattle fencing is present at a few locations along the corridor of the canal. Initial discussions with affected landowners disclosed that the canal has served as a barrier to cattle. Pursuant to the landowner discussions, new cattle fencing to offset the loss of the barrier that the canal poses to cattle may be installed.

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 Diversion 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 500 feet upstream of the dam site to facilitate sediment flushing during high water events and to ensure that fish passage is adequate. The pilot channel would have a bottom width of approximately 4 feet and side slopes of approximately 2:1. Excavated sediments from the pilot channel would be placed on banks in the creek channel upstream and downstream of the removed dam. The size and location of the bank deposits would be designed to allow the materials to be distributed by floodflows and to avoid hindering fish passage at all flows. The sediment would be placed so that riparian vegetation zones along the edges of the creek would not be affected. The height of the banks would extend above the ordinary high water mark but would be similar to gravel bars that naturally occur in the creek channel.

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. The total area affected would be approximately 96,000 square feet.
- **Area along the south 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 1,690,000 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.

- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

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 preconstruction 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 5-month period. Construction is anticipated to begin in August 2008 and end by January 2009.

Soap Creek Feeder

Project Elements

Proposed elements for the Soap Creek Feeder site include:

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

The proposed construction area and project elements at Soap Creek Feeder Diversion Dam are shown on Figure F-5 of Appendix F.

Soap Creek Feeder Diversion Dam Removal

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 may 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. The total area affected would be approximately 40,000 square feet.
- **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 4,000 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 5,300 square feet.
- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

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 preconstruction 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 pass through 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 August 2008–October 2008.

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 dike,
- 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. The proposed construction areas and project elements at Inskip Diversion Dam/South Powerhouse are shown on Figure F-7 of Appendix F.

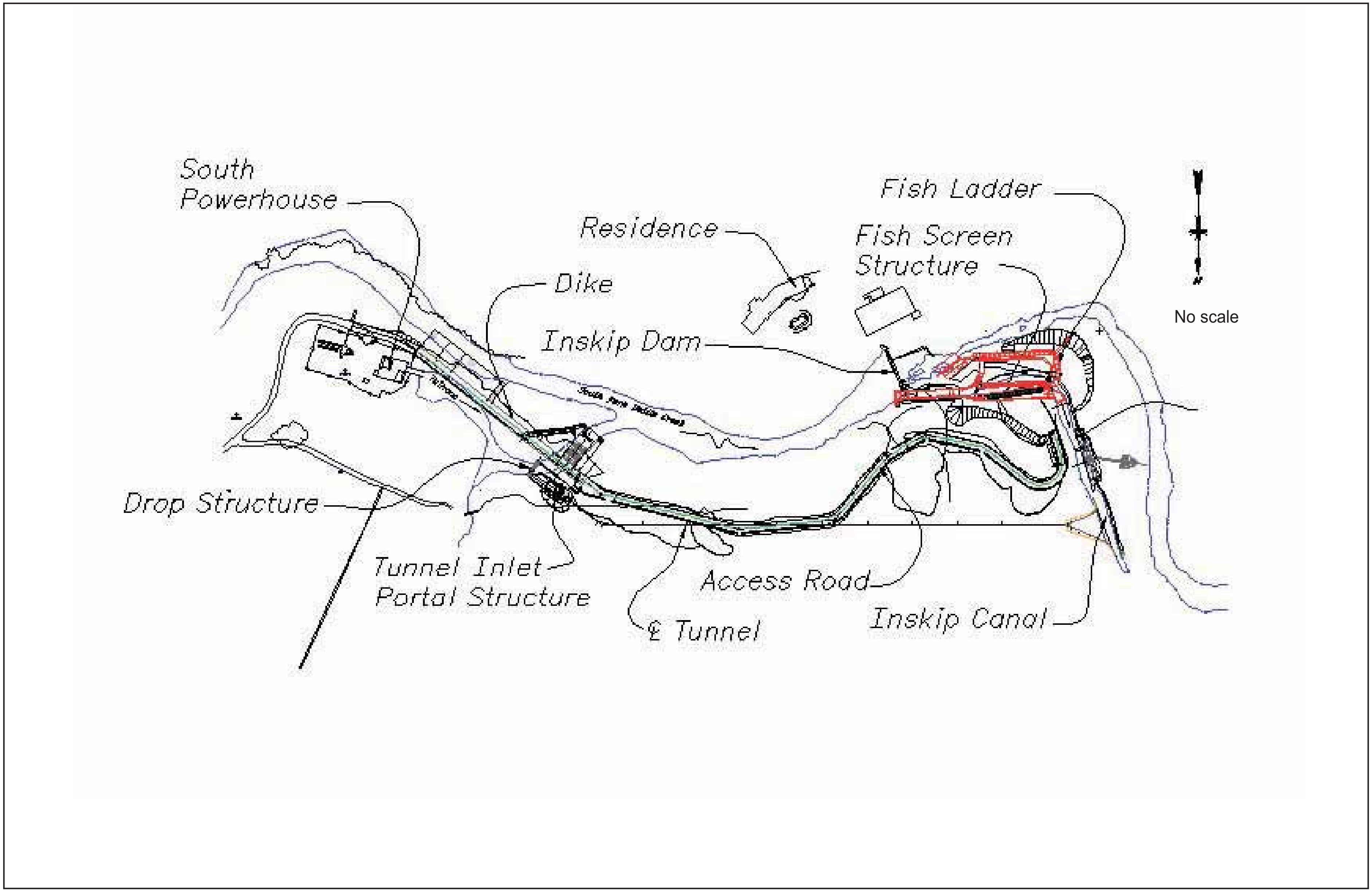

Figure 3-2c
Proposed Facilities for the Inskip Diversion Dam/South Powerhouse
Five Dam Removal Alternative

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 construction, operation, and maintenance of the fish ladder and screen. The new 12-foot-wide road would originate at a new staging/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 abutment 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 unlined 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 tailrace dike and spillway,
- construction of a temporary tailrace construction cofferdam,
- construction of a permanent tailrace box culvert, and
- construction of a tailrace access ramp.

Tailrace dike. A tailrace 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 1,460, 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 1,458. 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 tailrace 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 tailrace 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 South Fork 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 at the Inskip Diversion Dam/South Powerhouse site. Access on top of the plateau (near South Powerhouse) that avoids the residential area would be required for construction, and an existing foot trail between South Powerhouse and Inskip Diversion Dam would need to be improved to allow vehicular access to the dam. The road that provides access from the top of the plateau down the slope to the powerhouse is considered sufficient for construction and long-term operation and maintenance purposes.

New Site Access via Old Ranch Road. 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 width would be 15 feet wide over most of its length. Pullouts would be developed at a few locations selected to facilitate traffic and minimize impacts to vegetation. 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 residential area.

Proposed New Access Road between South Powerhouse and Inskip Diversion Dam. 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 use the tailrace 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 Fork Battle Creek. The proposed road alignment is shown on Figure 3-2c.

After crossing the tailrace channel via the tailrace 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 12-foot-wide cut with the upslope side of the road cut at a slope of 1½:1. The maximum cut in the slope would be 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 bypass tunnel outlet portal area.

The proposed road would be 12 feet wide, with two turnouts (at the hill crest and curve) and 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 3-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 its current location; the new site would be chosen to avoid impacts on trees and facilitate any needed rewiring.

Access Road Options Eliminated from Further Consideration. Two additional alignments were also considered to provide access to the Inskip Diversion Dam site. The first option is essentially the same as the proposed alignment described above except that it would cut into the saddle at the western end of the proposed alignment and would, therefore, partially obscure the view of the road from Oasis Springs Lodge. Based on field surveys and engineering design work, it was determined that selection of this option would result in the need for a higher cut slope and significantly more excavation, which could lead to a higher risk of erosion and the need for disposal of more excavated materials and, therefore, potentially greater environmental impacts. In addition, the cost of this road was estimated to be approximately $200,000 more than the cost of the proposed alignment. For these reasons, this option was eliminated from further consideration.

The second option, identified as the western alignment, was considered but also eliminated from further consideration because of the relatively higher costs of construction and substantially greater environmental impacts. Under the western alignment, the portion of proposed access road that crosses the peninsula area would remain the same as under the proposed alignment; however, the segment between the tunnel inlet portal and the fish screen and fish ladder facility would not be constructed. Instead, access to the fish facility parking area near Inskip Diversion Dam would be via a new road that would climb out of the canyon in a westerly direction approximately 4,000 feet to the top of the plateau. The new road would connect with an existing primitive road that follows the edge of the plateau and currently provides access between the South Powerhouse/Inskip Diversion Dam project site and the Lower Ripley Creek Diversion Dam project site.

The western alignment would ascend from the parking area at the new fish facilities at a steep grade to avoid interfering with the outlet portal of the new bypass tunnel. The terrain that would be encountered in the first 2,000 feet of the western alignment is extremely rugged. Tall cliffs of competent rock and three major gullies in this reach would require that at least three bridges be constructed. Because of the irregular and steep nature of this initial terrain, significant excavation would be required to straighten the alignment enough to allow sufficient turning radius for maintenance vehicles and equipment. The remaining alignment passes through more gentle terrain but would still require rock excavation.

Similar to the proposed alignment, the western alignment would consist primarily of excavation with no fill. Excavated materials would be disposed of at locations on the plateau. The material would be placed in spoilbanks in piles shaped to minimize environmental impacts and to comply with landowner requirements.

The western alignment access road would be paved to allow all-weather access to the fish facility. Approximately 5,000 feet of the existing access road along the plateau would require grading and additional gravel to allow all-weather access to the fish facility.

In addition to greater construction requirements, the western alignment could potentially result in the following environmental impacts. These impacts are based on field observations performed by a Reclamation biologist during a site visit on September 15, 2004. Potential impacts include:

- disturbance of ephemeral, intermittent, and perennial drainages;
- more extensive removal of woody shrubs and trees, including oaks, than the proposed access alignment and the first alignment option described above;
- a larger construction footprint because of both steeper slope (i.e., wider footprint) and longer road length (i.e., longer footprint) compared to the proposed road alignment, resulting in greater effects on:
  - hydrology (i.e., the new western road alignment would intercept rainfall and subsurface water moving down the hill slope, which then would concentrate flow and divert drainage from flow paths it would normally take if the western alignment were not present),
  - site productivity (i.e., removing and disturbing topsoil, altering soil properties, changing microclimate, and accelerating erosion as a result of constructing the western alignment would disrupt biological communities),

- water quality (i.e., increased road surface runoff), and
- air quality (i.e., increased dust and emissions);

- increased habitat fragmentation and edge effects (i.e., the western alignment would increase barriers, adding to the dispersal of small mammals and predator access, and increase the potential to spread tree disease and invasive plant species, such as brown-headed cowbird brood parasitism); and
- increased nutrient input and road surface runoff into South Fork Battle Creek resulting from a steeper slope and greater water runoff velocity.

In addition to the potential environmental impacts listed above, the western alignment would be much more expensive to construct than the proposed alignment or the first alignment option described above. For these reasons, the western alignment was eliminated from further consideration at this site.

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. The 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 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. To the extent feasible, waste and borrow areas would be restricted to annual grasslands.

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. 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, 25-foot-wide corridor would be cleared of vegetation to reduce fire hazard. The total area cleared would be approximately 205,000 square feet.
  - A 15-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 small diameter culvert or a low-water style crossing composed of gravel would be constructed at a low spot in the existing road approximately 2,000 feet south of Hazen Road.
  - Two existing gates would be widened and possibly relocated within the 25-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.** Area A is a small, relatively open, gently sloped area on the east side of the South Powerhouse access road, located about 600 feet northeast of the powerhouse building. 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 26,000 square feet.
- **Contractor use area.** The contractor use area is adjacent to and on the east side of the South Powerhouse access road, located 200 feet east of the powerhouse building. 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 dike, creek-side riprap armoring, temporary small cofferdams in the creek and tailrace, an access ramp into the tailrace, large-diameter culverts through the peninsula, and associated riprap downstream of the culverts and tailrace dike. 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. The total area affected would be approximately 115,000 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 142,000 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.

- **Disposal areas**. Several areas would be used for disposal of excess excavated materials. The total area affected would be approximately 606,000 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.
- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

All areas temporarily disturbed by construction would be restored to their preconstruction 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 road and intersection;
- construct peninsula area features, including creek side riprap armoring, tailrace channel dike, box culvert bypass, overflow spillway, and temporary cofferdam upstream of tunnel inlet portal;
- construct access road to fish facility and tunnel outlet area;
- construct tunnel;
- construct fish screen and ladder headworks modification upstream of dam;
- construct lower portion of fish ladder;

- construct upper portion of fish ladder and fish screen;
- 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 33-month period. Construction is anticipated to begin in May 2006 and end by July 2009.

Water diversions into Cross Country and South Canals that supply water to South Powerhouse would be continued during construction. Water diversions into Inskip Canal would also be continued during construction. In addition, South Powerhouse would be shutdown for brief periods to allow construction of the South Powerhouse tailrace to be performed.

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.

The proposed construction area and project elements at Lower Ripley Creek Feeder are shown on Figure F-8 of Appendix F.

Lower Ripley Creek Feeder Diversion Dam Removal

Under this alternative, Lower Ripley Creek Feeder 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 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 Feeder 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 Creek Feeder Diversion Dam is 16,300 feet. This 15-foot-wide road continues to the west of Lower Ripley Creek Feeder 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 5 cfs) for up to several months. The flows diverted from the Cross Country Canal would be diverted at Lower Ripley Creek Feeder 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 Creek Feeder Diversion Dam would be approximately 16,100 feet. The distance from Lower Ripley Creek Feeder 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 Feeder Diversion Dam.** Removal of Lower Ripley Creek Feeder 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 16,000 square feet.
- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto

adjacent lands. The locations of temporary fences will be coordinated with landowners.

All areas temporarily disturbed by construction would be restored to their preconstruction 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 1 month. Construction is anticipated to occur during July 2007.

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. The proposed construction areas and project elements at Coleman Diversion Dam/Inskip Powerhouse are shown on Figure F-9 of Appendix F.

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, preventing 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. The two crossings would be built at locations along the chute to allow animals access to both sides of the structure.

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

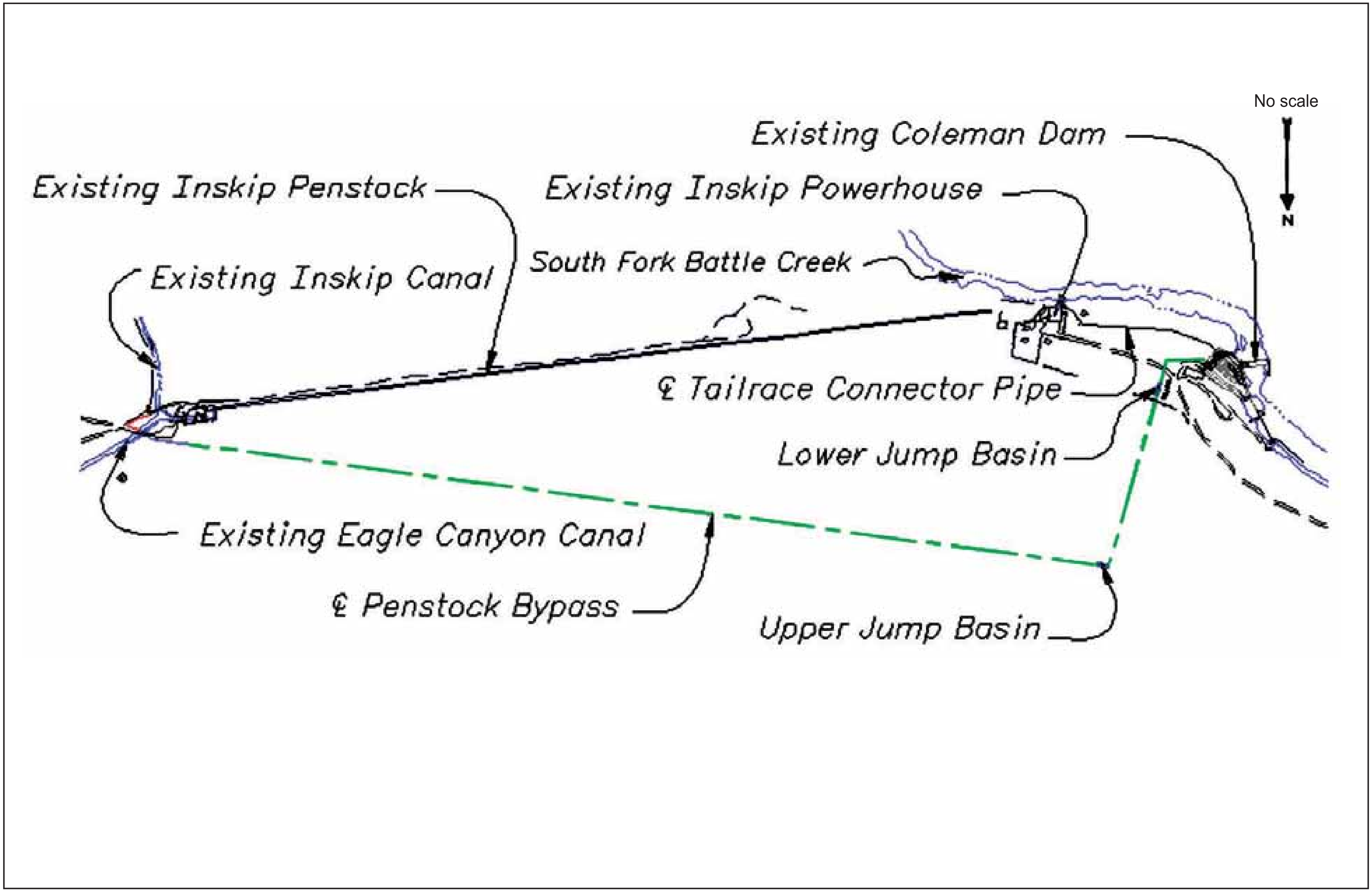

Figure 3-2d
Proposed Facilities for the Coleman Diversion Dam/Inskip Powerhouse
Five Dam Removal Alternative

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 concrete overlay would be removed. The dam construction incorporates rock cobbles embedded in a mortar matrix; it would be removed from the site to the extent that it would not affect conditions supporting upstream migration of adult steelhead and Chinook salmon at minimum flow releases from upstream dams and would not adversely modify spawning (e.g., armoring) or rearing habitat. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions.

The following appurtenant structures would also be removed:

- radial pass through 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. Excavated sediments from the pilot channel would be placed on banks in the creek channel upstream and downstream of the removed dam. The size and location of the bank deposits would be designed to allow the materials to be distributed by floodflows and to avoid hindering fish passage at all flows. The sediment would be placed so that riparian vegetation zones along the edges of the creek would not be affected. The height of the banks would extend above the ordinary high water mark but would be similar to gravel bars that naturally occur in the creek channel. 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.
- **Access road.** A new access road would be constructed from Manton Road to the planned 85-foot-wide corridor of the new penstock bypass. This new road would be constructed to allow all-weather access for heavy construction equipment. A new intersection area would be created to provide a paved turnoff lane and a paved apron setback off Manton Road. The total area affected for the intersection and new road would be approximately 34,800 square feet. Two staging areas would be established along this alignment. The total affected area from the staging area would be approximately 85,800 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 276,200 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 184,000 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.
- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

All areas temporarily disturbed by construction would be restored to their preconstruction 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 raise 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 39 months and is anticipated to begin May 2006 and end by July 2009.

Water diversions into Eagle Canyon and Inskip Canals that supply water to Inskip Powerhouse would be continued during construction. Water diversions into Coleman Canal would also be continued during construction. Also Inskip Powerhouse would be shutdown for brief periods to allow cut over of the tailrace connector. 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 Station and Diversion Dam

Asbury Pump Station and Diversion Dam are located on Baldwin Creek approximately 0.7 mile upstream of its confluence with Battle Creek. Baldwin Creek has been identified as a source of cold water. The nature of the habitat in Baldwin Creek is limited such that it is expected only to provide habitat for small numbers of steelhead without any notable use by Chinook salmon. Releasing water at Asbury Diversion Dam delivers cold water from Darrah Springs to the mainstem of Battle Creek via Baldwin Creek to improve the summer holding conditions in that reach of the stream for the target species.

Asbury Diversion Dam has a maximum height of approximately 7 feet above the streambed. Although the dam does not have a fish ladder, fish such as steelhead are expected to pass over the dam during high streamflows because of its low height. Although fish could potentially pass above Asbury Diversion Dam, this condition has not been monitored, even when steelhead have been released from the Coleman National Fish Hatchery. During the type of high-flow events that are expected to facilitate passage of steelhead at the waterfall near the terminus of Baldwin Creek and at Asbury Diversion Dam, fast-moving, turbid water in Baldwin Creek makes it impossible to observe or capture fish.

Project Elements

Under this alternative, proposed restoration actions in Baldwin Creek include a minimum instream release of 5 cfs from Asbury Diversion Dam, as required by the 1999 MOU (Appendix A). 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 at the diversion dam during all operations to verify compliance with applicable provisions under the FERC license.

The instream release would be accomplished by fitting at least three existing bays with flow-measurement weirs, which would replace the flashboard weirs mounted on the crest of the dam. This arrangement will force water to overflow over a greater length across the dam, which will avoid a concentrated flow. This dispersed flow will minimize fish attraction and will result in a shallow water depth, which will help prevent launching areas for migrating fish. To ensure that the minimum flow of 5 cfs is released over the flashboards, PG&E's Asbury Pump Station would continuously monitor the reservoir water level behind the dam. The pump station has an electronic controller that receives input from water-level sensors that transmit the water surface elevation of Asbury Pond behind Asbury Diversion Dam. The pump station then maintains the pond water surface elevation by discharging the correct amount of water. This ensures a constant release rate over the flashboards. Under flood conditions, the extra water that cannot be pumped simply spills over the flashboards and results in an increased release over the 5 cfs required.

Once the flow measurement weirs have been installed and are operational, PG&E would visit the site regularly to maintain the weir structures, including removing any debris that may be blocking the weir, and to ensure that flows required under the FERC license amendment are maintained. The elevation of the pond impounded behind Asbury Diversion Dam should not fall below a level that would ensure that a minimum flow of 5 cfs is released to Baldwin Creek. The elevation of the pond behind Asbury Diversion Dam would be continuously monitored and telemetered using the Pit 3 Switching Center, which is staffed 24 hours per day.

Asbury Diversion Dam impounds water to an approximate average depth of 3 feet near the dam. Under current operating conditions, there is a 36-inch slide gate and a six-foot opening at the dam. Historically, flashboards covering the six-foot wide opening have periodically been removed to assist in passing sediments through the pond area and back into the creek. Under the Proposed Action, the flashboards would no longer be removed to address concerns about fish passage above the dam; however under future conditions, the 36-inch slide gate operations may continue.

Construction Considerations and Sequencing

Construction activities near Asbury Diversion Dam would include the following:

- **Flow measurement weirs.** The flow measurement weirs that would be constructed on Baldwin Creek would allow the 5-cfs instream flow release to be made in a distributed fashion at the top of the Asbury Diversion Dam. There would be no fewer than three flow measurement weirs at the dam that would eliminate a concentrated discharge from the dam to reduce the chance of false attraction for fish. The flow measurement weirs would skim water at the top of the Asbury Diversion Dam, and the water level would be held constant by a controller to provide a steady instream flow release unless high-water conditions exist. Under high-water conditions, the entire dam would act as an flow measurement weir and release water in addition to the required instream flow release.

- **Construction of a temporary cofferdam and modifications at Asbury Diversion Dam.** A cofferdam consisting of gravel and plastic sheeting may be constructed upstream of the present masonry and concrete dam to isolate the work area from creek flows. The total area that would be temporarily affected by construction of the cofferdam would be 15,200 square feet of the reservoir area formed by the diversion dam. To accomplish the required 5-cfs release, the existing flashboards in at least three bays would be replaced with flow measurement weirs.
- **Site access.** Construction equipment and materials would reach the work areas from the left (south) side of the dam. Two ramps for accessing the downstream side of the dam would be excavated into the left creek bank, one ramp immediately downstream of the dam and a second ramp further downstream near the end of the pipe extension. The ramp size and location would be selected to minimize disturbance to environmentally sensitive areas. A third ramp may be excavated on the upstream left bank to allow construction of the upstream cofferdam. Upon completion of construction, the disturbed areas would be restored to preproject contours and replanted. Construction equipment expected to be used includes excavating equipment, such as dozers and hydraulic excavators; hoisting and lifting equipment, such as cranes delivering and erecting structural steel and pipe; concrete trucks and other large trucks; and other support equipment. The total area affected would be 85,300 square feet.

Construction activities would occur May–November 2007.

Environmental Commitments

The following environmental commitments will be implemented where applicable before and/or during any construction activities related to the Five Dam Removal Alternative. These measures are consistent with broader measures adopted in the CALFED ROD (CALFED Bay-Delta Program 2000c).

Develop and Implement a Worker Environmental Education Program

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

Obtain and Implement the Conditions of the Environmental Permits

Reclamation will obtain the required state and federal permits for the Five Dam Removal Alternative and comply with all conditions included in those permits. Where appropriate, the permit conditions will be incorporated into the project engineering plans and specifications. These permits will include, but may not be limited to, the following:

- Section 404 of the Clean Water Act,
- Section 402 of the Clean Water Act, National Pollutant Discharge Elimination System permit,
- Section 401 of the Clean Water Act, Water Quality Certification,
- Section 7 of the federal Endangered Species Act,
- Section 1602, Streambed Alteration Agreement, and
- Section 106 of the National Historic Preservation Act.

Designate Work and Exclusion Zones

Reclamation and/or the construction contractor will ensure that construction equipment and associated activities will be confined to the designated work zone in areas that support sensitive resources and that cattle will be excluded from the work zone. Construction equipment will be confined to a designated work zone (including access roads) at each project site. Before construction, the work zone will be fenced to clearly delineate the zone as well as keep cattle from entering the site during construction.

Exclusion zones will be delineated in the field by a qualified biologist using global positioning system (GPS) units to measure distances from sensitive resources. These zones will be demarcated by orange construction fencing or along access roads with stakes and ropes. All fences will have signs attached that identify each area as an *Environmentally Sensitive Area*. The fencing will be installed before construction activities begin and will be maintained throughout the construction period. The following paragraph will be included in the construction specifications for environmentally sensitive areas:

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

During the environmental education program, construction personnel will be informed about the importance of avoiding ground-disturbing activities outside the designated work zone. During construction, the construction monitors and resource monitors will ensure that construction equipment and associated activities avoid any disturbance of sensitive resources outside the designated work zones (e.g., riparian zones, including root zones under drip lines, wetlands, springs, and seeps). Construction personnel will avoid all marked environmentally sensitive locations and cultural resources locations within and outside the contractor use area limits. Construction personnel will also avoid the root zone of individual oak woodland trees, which will be marked by flagging off the dripline of each tree. Environmental monitors will conduct surveys as appropriate for threatened and endangered species and special-status species. The following measures will also be employed:

- Use and storage of construction equipment will be confined to within the designated contractor use area limits.
- Existing roads and access points will be used to the extent possible to minimize disturbance to wildlife and their habitats.
- Excavating, filling, and other earth-moving within the contractor use areas will be done gradually to allow wildlife to escape in advance of machinery and moving soils.
- Staging areas, borrow material sites, parking locations, stockpile areas, and storage areas will be located outside of environmentally sensitive locations and will be clearly marked and monitored. To the extent feasible, these facilities will be located in annual grassland habitat.

Anadromous Fish Spawning Exclusion

A qualified fish biologist, designated by Reclamation in consultation with NOAA Fisheries and DFG, will identify spawning gravels in the stream channel area that has the potential to be directly disturbed by construction and dam removal activities at Wildcat, Eagle Canyon, and Coleman Diversion Dams (i.e., downstream of the existing blocked fish ladders on Coleman and Eagle Canyon Diversion Dams). The need for temporary armoring to exclude spawning at construction locations will be determined by a qualified fish biologist prior to any construction activity. The spawning gravel will be armored with temporary mats or other armoring devices that will prevent spawning by Chinook salmon and steelhead. The gravels will be armored at least 2 months before construction and demolition activities that could kill or injure eggs and larvae of steelhead and Chinook salmon in the gravel. The armoring materials will be installed in areas where heavy equipment may be operated within the stream channel or in the vicinity of potential blasting. The temporary mats or other armoring devices will be removed after instream construction and blasting have been completed.

Implement a Fish Rescue Operation

Stream channel segments may be isolated from the streamflow during construction. Reclamation, in consultation with NOAA Fisheries and DFG, will ensure that a fish biologist is on site to implement a fish rescue operation in isolated pools that may harbor stranded fish. Fish will be removed from isolated pools by seining or electroshocking. Reclamation, in consultation with NOAA Fisheries and DFG, will also ensure that the electroshocking or seining team includes at least one person with a 4-year college degree in fisheries or biology, or a related degree. The person must also have at least 2 years of professional experience in fisheries field surveys and the use of electroshocking equipment. Fish collection assumes a 2- to 4-person team per electroshocker or seine to facilitate safe and efficient collection and transport. Up to two electroshocking or seining teams may be used to facilitate efficient fish removal, particularly in reaches where the average width of the channel is more than 20 feet or where an abundance of instream cover makes fish capture difficult. The electroshocking team will complete a minimum of three passes through each isolated pool. The number of electroshocking passes may exceed three if necessary remove most fish. Captured fish will be placed in 5-gallon buckets. At the end of each pass, captured fish will be transferred into buckets with aerated water or into in-river holding tanks (e.g., buckets with small holes or other similar containers). Water temperature in holding buckets will be monitored and river water will be added or replaced as needed to maintain fish in good condition.

Fish will be counted and recorded by species. All fish will be released in the live channel upstream of the construction area unless it is determined these fish are downstream migrants that should be released downstream of the affected areas. The number of Chinook salmon and steelhead captured and the number of Chinook salmon and steelhead accidentally killed before release will be reported by email to NOAA Fisheries within 5 working days. All dead Chinook salmon and steelhead will be frozen and retained until NOAA Fisheries provides direction for disposition or until 6 months following fish capture.

Debris Removal

Construction activities would occur at North Battle Creek Feeder, Eagle Canyon, Wildcat, Coleman, Lower Ripley Creek Feeder, Inskip, Soap Creek Feeder, and South Diversion Dams. Wildcat, Coleman, South, Lower Ripley Creek Feeder, and Soap Creek Feeder Diversion Dams will be removed. Debris in the stream channel resulting from construction and dam removal activities will be removed by Reclamation and/or the construction contractor and deposited off site. Debris will be removed to the extent practicable that it will not affect conditions supporting upstream migration of adult steelhead and Chinook salmon at minimum flow releases from upstream dams and will not adversely modify spawning (e.g., armoring) or rearing habitat. Any material left in the stream will not impair flows or fish passage. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions.

Implement Environmental Timeframes

Reclamation and/or the construction contractor will complete all activities in a timely manner to minimize the duration and impacts resulting from construction. In addition, all activities will occur during the times of the year that are least detrimental to the environment. Instream work will be conducted during periods of low streamflow (May–October). In addition, construction activities that could adversely affect nesting birds and their habitat will be limited to the nonbreeding period, and construction activities that could adversely affect bat colonies and their habitat will be limited to the nonhibernation, nonmaternity colony period (August–October).

Develop an Environmental Implementation Plan

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

- stormwater pollution prevention plan (SWPPP) (including specific erosion control and site reclamation measures),
- spill prevention and countermeasure plan,
- habitat compensation plan,
- wetland and riparian mitigation and monitoring plan,
- Migratory Bird Treaty Act (MBTA) compliance program, and
- environmental compliance monitoring program.

General information describing each plan is provided in the following sections.

Stormwater Pollution Prevention Plan

Reclamation and/or the construction contractor will prepare and implement a SWPPP as part of the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activities (General Permit). The SWPPP will include measures to minimize erosion and sediment transport to Battle Creek. It will include:

- best management practices (BMPs) (e.g., sediment containment devices, protection of construction spoils, proper installation of cofferdams);
- site restoration;
- postconstruction monitoring of the effectiveness of BMPs;
- contingency measures;
- details about contractor responsibilities;
- a list of responsible parties; and
- a list of agency contacts.

Measures in the plan will include, at a minimum:

- avoiding work or equipment operation in flowing water during in-channel activities by constructing cofferdams and diverting all flows around construction sites;
- conducting all construction work according to site-specific construction plans that minimize the potential for sediment input to the aquatic system, including constructing silt barriers immediately downstream of the construction site and minimizing disruption of the streambed at and adjacent to the construction site;
- using sedimentation fences, hay bales certified as weed-free, sandbags, water bars, and baffles as additional sources of protection for waters, ditches, and wetlands;
- identifying all areas requiring clearing, grading, revegetation, and recontouring and minimizing the areas to be cleared, graded, and recontoured;
- storing construction spoils out of the stream (above the ordinary high-water mark) and protecting receiving waters from these erosion source areas with sedimentation fences or other effective sediment control devices;
- grading spoil sites to minimize surface erosion; and
- covering bare areas with mulch and revegetating all cleared areas with appropriate native, noninvasive species.

The Central Valley Regional Water Quality Control Board (CVRWQCB) will monitor compliance with the NPDES General Permit. An application for a waste discharge permit will be filed with the CVRWQCB, and compliance with the monitoring and reporting requirements for project construction is necessary.

The measures listed above will also be incorporated into the project design as conditions of a DFG Section 1600 streambed alteration agreement. Specific requirements for reducing impacts on stream habitat will be coordinated with DFG during the agreement process.

Spill Prevention and Countermeasure Plan

Before construction begins, Reclamation and/or the construction contractor will prepare a spill prevention and countermeasure plan (SPCP) that includes strict on-site handling rules to keep construction and maintenance materials out of drainages and the waterway. Goals of this plan will be to:

- prevent contamination of streamside soil and the watercourse from cement; concrete or concrete washing; asphalt, paint, or other coating materials; oil or other petroleum products; and hazardous materials;
- clean up spills immediately and notify DFG immediately of any spill and cleanup procedures;
- prepare, prior to construction, a spill control and response plan and restrict the volume of petroleum products allowed on site to the volume that can be addressed by the spill control and response measures included in the plan;
- provide staging and storage areas outside the stream zone for equipment, construction materials, fuels, lubricants, solvents, and other possible contaminants;
- store hazardous substances in staging areas at least 100 feet from stream and other water surfaces;
- perform refueling and vehicle maintenance at least 100 feet from receiving waters;
- minimize equipment operations in flowing water and remove vehicles from the normal high-water area before refueling and lubricating; and
- inspect equipment to ensure that seals prevent any fuel, engine oil, or other fluids from leaking.

The measures listed above will be implemented to prevent contamination, clean up spills, provide staging and storing areas, and minimize equipment operations in flowing water. The State Water Board will monitor compliance with these measures and the SPCP.

The measures listed above will also be incorporated into the project design as conditions of the DFG Section 1600 streambed alteration agreement. Specific requirements for reducing impacts on stream habitat will be coordinated with DFG during the agreement process.

Habitat Compensation Approach

Reclamation, in consultation with USFWS and DFG, will mitigate temporary habitat impacts associated with the Restoration Project on site through appropriate habitat restoration. Permanent impacts associated with the Restoration Project will be compensated for with a program view of ERP actions within the watershed. The mitigation approach for permanent impacts presented herein includes consideration of a CBDA–funded conservation easement in the Battle Creek watershed for offsetting compensation needs for riparian and upland habitats.

The MSCS guidelines and programmatic conservation measures reconcile effects of multiple ERP projects in a single watershed, in this case the Battle Creek watershed, into a balanced compensation approach. The MSCS states:

> ERP actions to restore or enhance habitats that are implemented concurrently and in proximity to one another will be considered together for purposes of assessing their impacts on species and habitats and imposing compensatory measures. If the restoration and enhancement actions culminate in an increase or improvement in a particular NCCP community, compensatory measures may not be required even if there is a temporary or limited adverse modification of the community or habitat type. Ultimately, the need for compensatory conservation measures for CALFED restoration and enhancement actions will depend on the type, location, timing, and success of the related actions (CALFED Bay-Delta Program 2000b).

The Restoration Project clearly meets those criteria, as it makes extensive efforts to avoid and minimize adverse effects and mitigates the loss of habitat on site to the extent possible. Therefore, the use of a CBDA–funded conservation easement within the project area has been proposed. Following implementation of Restoration Project avoidance, minimization, and restoration measures, the remaining environmental compensation needs of the Restoration Project could be considered offset by the environmental benefits of the CBDA–funded Burton Ranch easement along the mainstem of Battle Creek. Habitat credit comes from preservation, in perpetuity, of riparian and upland habitat that is under threat of future impacts attributable to human land use/development. This conservation easement would provide the in-kind benefits needed to offset habitat values lost during implementation of the Restoration Project. For more details on the conservation easement approach, see Appendix F of the 2004 Action Specific Implementation Plan (ASIP), "Habitat Compensation Approach for the Battle Creek Salmon and Steelhead Restoration Project: A Program View" (Jones & Stokes 2004a). The executive summary for the 2004 ASIP is presented in Appendix G of this report.

Wetland and Riparian Mitigation and Monitoring Plan

Reclamation, in consultation with NOAA Fisheries and DFG, is preparing a wetland and riparian mitigation plan to mitigate impacts on wetlands subject to U.S. Army Corps of Engineers (Corps) jurisdiction in the Restoration Project area. The plan is intended to provide the Corps and USFWS with sufficient information to determine the adequacy of the proposed mitigation and to issue a Section 404 permit. The Corps will approve the plan prior to project construction activities that affect the Corps jurisdictional areas in the project area.

The plan will be prepared to meet or exceed the specifications and mitigation requirements pertaining to Corps jurisdictional areas specified in the Draft Fish and Wildlife Coordination Act (FWCA) report prepared for the project (U.S. Fish and Wildlife Service 2005). The plan will also be provided to the State Water Board to determine the adequacy of the proposed mitigation with respect to water quality and to issue a Section 401 water quality certification for the project.

The goal of the mitigation effort is to avoid and minimize adverse effects on wetland and riparian habitat, as well as replace the acreage and function and values of wetlands and riparian habitat permanently affected by the project. To support this goal, the wetland and riparian mitigation plan will meet the following objectives:

- provide compensatory mitigation for permanent impacts in the form of habitat creation, restoration, preservation, or enhancement of wetland habitats in the Restoration Project area (i.e., Battle Creek watershed);
- to the extent practicable, provide in-kind mitigation and design the habitats so that they will have equal or better function and value and quality than the wetlands that will be affected by the project;
- immediately restore habitats that have been temporarily affected by Restoration Project construction to predisturbance conditions;
- integrate concerns for special-status species (e.g., valley elderberry longhorn beetle) into the mitigation design to the maximum degree practicable; and
- design the mitigation wetlands so that, once established, they will require no maintenance.

Reclamation will submit a performance monitoring report to the Corps at the end of each monitoring year. The report will summarize monitoring methods, results, progress toward meeting the final performance standards, and corrective actions taken.

Migratory Bird Treaty Act Compliance Program

Reclamation and/or the construction contractor will implement the following mitigation measures as applicable for all project construction:

1. Known or potential nesting and roosting sites, such as live trees with cavities and all snags and stumps, will be protected to the extent practicable year-round.
2. Nests of raptors or any other bird will not be removed from their locations.
3. To the extent possible, construction activities that could adversely affect nesting birds and rearing of young through take of nests, impacts on nesting habitat, or disturbance from noise or human activity, will be limited to the period between September 1 and February 1 to avoid the bird breeding season.
4. Any habitat providing nesting cover for birds, such as grassland, mixed chaparral, live oak woodland, blue oak woodland, gray pine/oak woodland, and westside ponderosa pine, that must be removed for construction purposes, will be removed between September 1 and February 1 prior to construction.
5. Construction sites will be monitored for bird nesting activity during the breeding season to the extent possible.
6. If raptors or any other birds appear at or near a construction site and attempt to nest, typical levels of construction noise and activity that will occur at the

site during the breeding season will be sustained, such that the birds can accept or reject the site based on their assessment of the disturbance. Unless it is known that the nest site will be physically disturbed, the birds will be allowed to nest if they choose under the assumption that they will be able to tolerate construction noise and activity.

7. If disturbance of a nest with eggs or young appears unavoidable, or nesting activity such as incubation or feeding of young may be affected, a project contact at USFWS and DFG will be consulted before disturbance occurs.
8. If potential nesting habitat must be affected during the breeding season, a project contact at USFWS and DFG will be consulted before disturbance occurs.
9. If a project site meets buffer zone criteria for an active nest during the breeding season, disturbance probably can be assumed insignificant, but USFWS and DFG still will be contacted for known occurrences of these species on the project area.

Environmental Compliance Monitoring Program

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

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

The roles and responsibilities of the resource monitors and other individuals on the project, compliance documentation, and other elements of the environmental compliance monitoring program will be clearly outlined in the implementation plan.

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 *Battle Creek Salmon and Steelhead Restoration Project Adaptive Management Plan* (Terraqua, Inc. 2004a), which has been developed consistent with relevant CALFED Program guidelines (Chapter 3 in CALFED Bay-Delta Program 1999) and the MOU (Appendix A). The Water Acquisition Fund and AMF, which are elements of adaptive management, would provide funding for potential changes to Restoration Project actions that result from the application of the AMP.

The draft AMP was revised by the Battle Creek Adaptive Management Team in response to comments received from the CBDA Technical Review Panel, which had reviewed Reclamation's proposal for additional funding presented in February 2003. The executive summary of the revised AMP is presented in Appendix C. A copy of the complete report is found on the Restoration Project Web site:

http://www.usbr.gov/mp/battlecreek/docs-adapt_manage.html.

Facility Monitoring 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 draft plan may be found in Appendix B of the ASIP prepared for the Restoration Project (Jones & Stokes 2004a). (Appendix G of this report presents the executive summary for 2004 ASIP.) 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.
- Recording operation of waste gates, overpours, and spillways during dewatering of the conveyance for maintenance or to release excess water during emergencies.

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

The existing water rights to be transferred from PG&E are listed in Exhibit E of the FERC license. The transfer of these rights to DFG is subject to the condition that the dedications not impair operation of PG&E's remaining diversions. The amount of water to be transferred to DFG and dedicated to the environment will vary seasonally. Water rights transferred for dedication include water from Soap Creek, Lower Ripley Creek, North Fork Battle Creek (at Wildcat and Coleman Diversion Dams), and South Fork Battle Creek (at South and Coleman Diversion Dams). The petition to change the purpose of use will be open to the public for comment and discussion pursuant to the State Water Resources Control Board's water right process. The purpose of this dedication is to conserve public funds by ensuring that water that was previously diverted by the dams is reserved for instream beneficial use. Dedication of the water rights to the environment by way of a water code 1707 change petition ensures that this benefit is not transitory. The water below the dams is regulated by FERC. No water right transfers or dedications are proposed at dams that remain; however, through the adaptive management process, the availability of flows in the stream reach below these dams could change.

According to Section 1241 of the California State Water Code, water that has not been put to beneficial use for 5 years may be regarded as unappropriated and may be made available for others to appropriate by way of a water rights permit from the State Water Board. If a new water right were approved, it would be subject to prior rights and conditions to protect instream beneficial uses. The Restoration Project would go through a further statutory process to prevent abandonment of the water rights at decommissioned dams. Specifically, as described in Section 6.1 E of the MOU, water rights would be transferred from PG&E to DFG, and then both parties would jointly file to dedicate the water at decommissioned dams to the environment under the Water Code 1707 change petition to formally establish an instream beneficial use and prevent abandonment under Section 1241 et seq. This process would ensure that the flow regimes analyzed as part of this effort would be properly dedicated to the Restoration Project and public funds used to finance this project would not be wasted.

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 AMP (Terraqua, Inc. 2004a). 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. Table 3-2 provides information on the water rights that would be dedicated to the environment.

Table 3-2. Water Rights Transferred from PG&E to DFG[4]

Identification Number (No.)	Priority or First Use	Diversion Amount (cfs)	Description (Name of Works)	Point of Diversion	Place of Use	Type of Use	Water Class Rights
SWDU No. 837	1910	100	South Battle Creek Canal	South Fork Battle Creek	South, Inskip, and Coleman Powerhouses	Power	Pre-1914
SWDU No. 838	1910	35	Soap Creek Feeder to South Battle Creek Canal	Soap Creek	South, Inskip, and Coleman Powerhouses	Power	Pre-1914
SWDU No. 848	1907	5	Lower Ripley Creek Feeder to Inskip Canal	Ripley Creek	Inskip Powerhouse	Power	Pre-1914
SWDU No. 841	1910	280	Coleman Canal	South Fork Battle Creek	Coleman Powerhouse	Power	Pre-1914
Application No. 2754 License No. 549	1922	18	Wildcat Canal	North Fork Battle Creek	Coleman Powerhouse	Power	License

Notes: SWDU = Statement of water diversion and use.

In this alternative, PG&E agrees that it would 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 AMP. PG&E agrees that any deed transferring such riparian land or rights will contain this restriction.

[4] As noted in Section 6.1 E of the Restoration Project MOU (see Appendix A), PG&E will transfer water rights to DFG then jointly file for permanent dedication to the environment with the State Water Board under Water Code 1707.

PG&E and DFG would jointly file a petition with the State Water Board 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 AMP 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, and will be administered by the resources agencies, following consultation with appropriate interested parties. Reclamation has committed $3 million of the $28 million in CALFED ERP federal funds (received in 1999) to an account specifically 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 AMP. 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.

Biological and Environmental Monitoring Fund

In the 1999 MOU, Reclamation, NOAA Fisheries, USFWS, DFG, and PG&E agreed that USFWS and/or DFG, or their designated representatives, will perform biological and environmental monitoring in the Battle Creek watershed and Restoration Project area to address the overall status of anadromous fish populations and related ecosystem health. This monitoring will be performed using available funding from Central Valley fishery restoration funding sources, including CBDA's Comprehensive Monitoring Assessment Research Program, and CVPIA's Comprehensive Assessment and Monitoring Program. Of the $28 million in CALFED ERP federal funds (received in 1999), $1 million was budgeted specifically for monitoring. Pursuant to the 2003 CALFED ERP independent technical review of the Restoration Project, $2.36 million in additional funds for monitoring are being requested, as part of the March 2005 proposal to the CALFED ERP. Reclamation, NOAA Fisheries, USFWS, DFG, and PG&E understand and agree that if sufficient funding is not available through the above sources, they will jointly pursue other appropriate funding sources.

Adaptive Management Fund

The Adaptive Management Fund would implement actions developed under the AMP. 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 AMP. 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 AMP 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 and include access road/trail construction or improvements to each project site 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 2001a). Table 3-3 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 on 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 3-3. No Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 30–40 cfs
	Access road construction and improvements
Eagle Canyon Diversion Dam	70-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 30–50 cfs
	Improvement of existing access trail
Wildcat Diversion Dam	20-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 30–50 cfs
	Improvement of access roads and trail
South Diversion Dam	90-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 20–30 cfs
	Access road improvements
Inskip Diversion Dam	220-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 30-40 cfs
	Access road construction and improvements
Coleman Diversion Dam	340-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 30–50 cfs
	Access road improvements
Instream Flows	Minimum instream flows below selected dams would be increased

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											

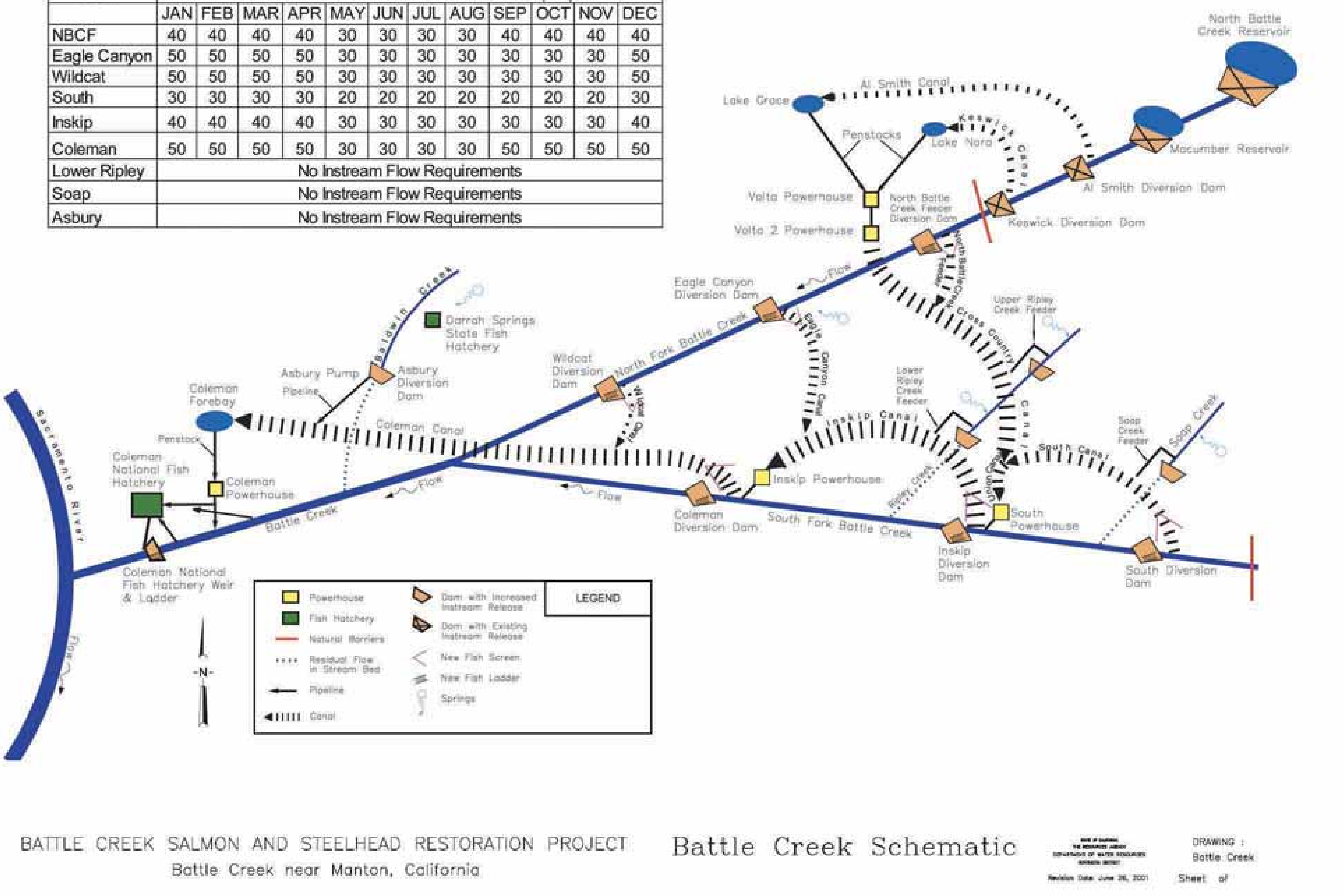

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Figure 3-3
No Dam Removal Alternative

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 (National Marine Fisheries Service 1997a; California Department of Fish and Game 2000a). The instream flows for this alternative were derived from the AFRP (U.S. Fish and Wildlife Service 2001a). 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 (U.S. Fish and Wildlife Service 2001a). 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 on 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 Wildcat 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 pass through 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:

- **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.

- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

All areas temporarily disturbed by construction would be restored to their preconstruction 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 24-month period. Construction is anticipated to begin in spring 2005 and end by summer 2007. 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 pass through 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 pass through 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 pass through 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.** 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 Diversion Dam removal work. The total area affected would be approximately 234,000 square feet.
- **Use of fencing to keep cattle out of construction areas.** The construction contractor will install temporary fences as needed to protect livestock from entering worksites, roads, and use areas. In cases where existing fences on rights-of-way are temporarily removed to facilitate construction, temporary fences will be installed to prevent livestock from straying from or onto adjacent lands. The locations of temporary fences will be coordinated with landowners.

All areas temporarily disturbed by construction would be restored to their preconstruction 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. 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 a roller-compacted concrete (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 33-month period. Construction is anticipated to begin in spring 2005 and end by fall 2008.

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 pass through 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 pass through 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 preconstruction 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 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 15 months. Construction is anticipated to begin in spring 2005 and end in summer 2006.

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.

Environmental Commitments

The No Dam Removal Alternative will incorporate the same environmental commitments identified for the Five Dam Removal Alternative.

Adaptive Management

This alternative will also include elements of adaptive management consistent with the overarching principles of adaptive management set forth by the CBDA 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 3-4. 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 on 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.

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	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

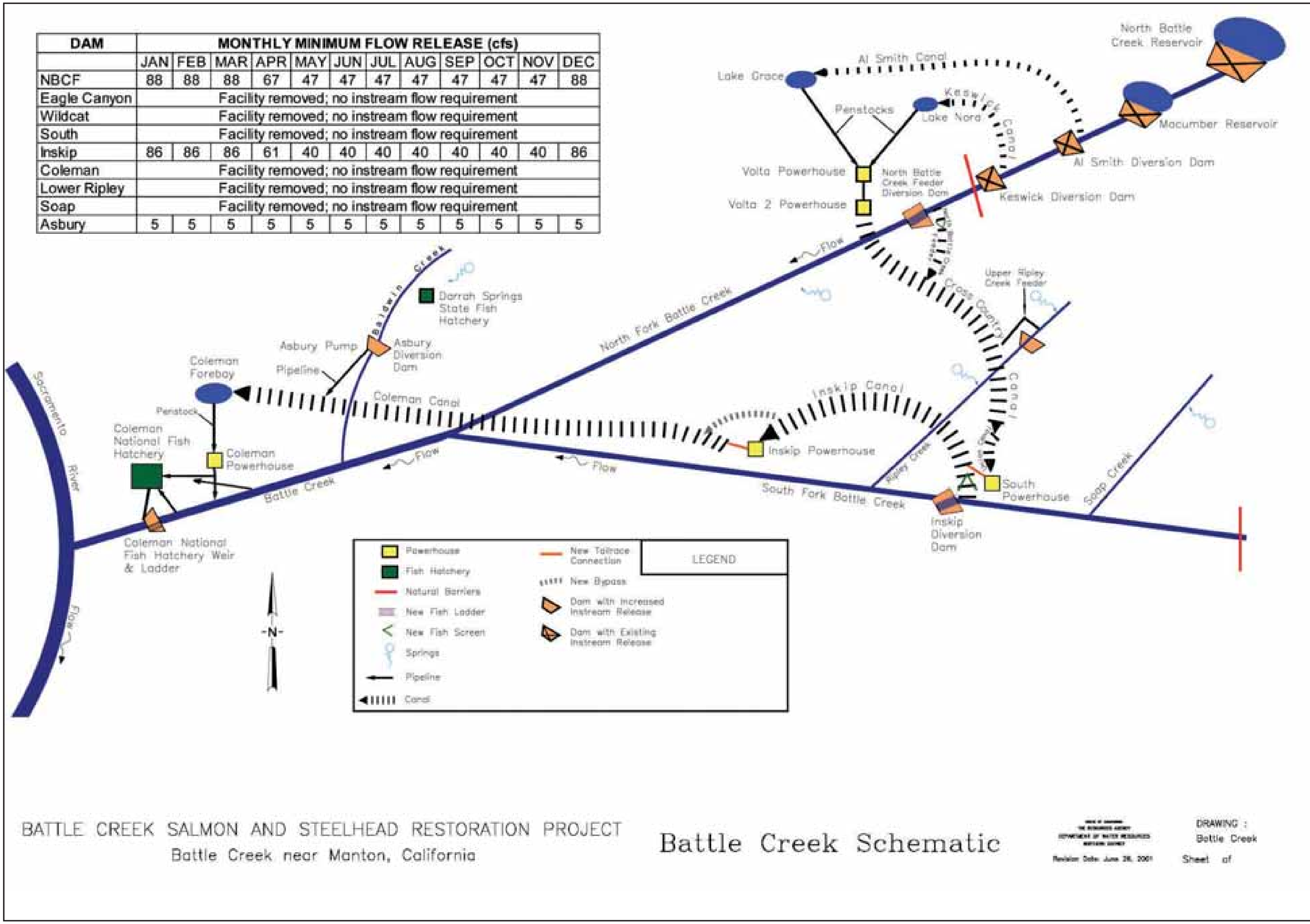

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Figure 3-4
Six Dam Removal Alternative

Table 3-4. Six Dam Removal Alternative Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 47–88 cfs
	Access road construction and improvements
Eagle Canyon Diversion Dam	Dam and appurtenant facilities removed
	Improvement of existing access trail
Wildcat Diversion Dam, Pipeline, and Canal	Dam and appurtenant facilities removed
	Improvement of access roads and trail
South Diversion Dam and Canal	Dam and appurtenant facilities removed
	Access road improvements
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 40–86 cfs
	Construction of South Powerhouse and Inskip Canal connector (tunnel)
	Access road construction and improvements
Coleman Diversion Dam and Inskip Powerhouse	Dam removed
	Construction of Inskip Powerhouse and Coleman Canal connector
	Inskip Powerhouse bypass replaced
	Access road improvements
Lower Ripley Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
	Access road improvements
Soap Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
	Access road improvements
Asbury Pump Station and Diversion Dam	Reoperate
	Creek flow and stage recorder installed
	Minimum instream flow set for Baldwin Creek at 5 cfs

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.

Eagle Canyon 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 flows or fish passage. 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

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. Springs emerge from the cliff near the Eagle Canyon Diversion Dam and along the Eagle Canyon Canal near the MLTF Jeffcoat East and West trout farm facilities. Under the Six Dam Removal Alternative, the Jeffcoat springs would continue to flow into the Eagle Canyon Canal and be conveyed to Inskip Powerhouse. The springs emerging from the cliffs near Eagle Canyon Dam are diverted around the collection system and returned to the North Fork Battle Creek under the terms of an interim flow agreement (see Chapter 6, “Related Projects”). Under the Six Dam Removal Alternative, the dam and the existing flume and remaining collection system would be removed and the springs would flow into North Fork Battle Creek.

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. Helicopters would transport all construction equipment and materials too heavy for workers to carry along the footpaths or flume walkways to and from the site. 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 preconstruction 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 12-month period. Construction is anticipated to begin in summer 2005 and end by spring 2006.

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.

Environmental Commitments

The Six Dam Removal Alternative will incorporate the same environmental commitments identified 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 3-5. 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 on 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 3-5. Three Dam Removal Alternative Components

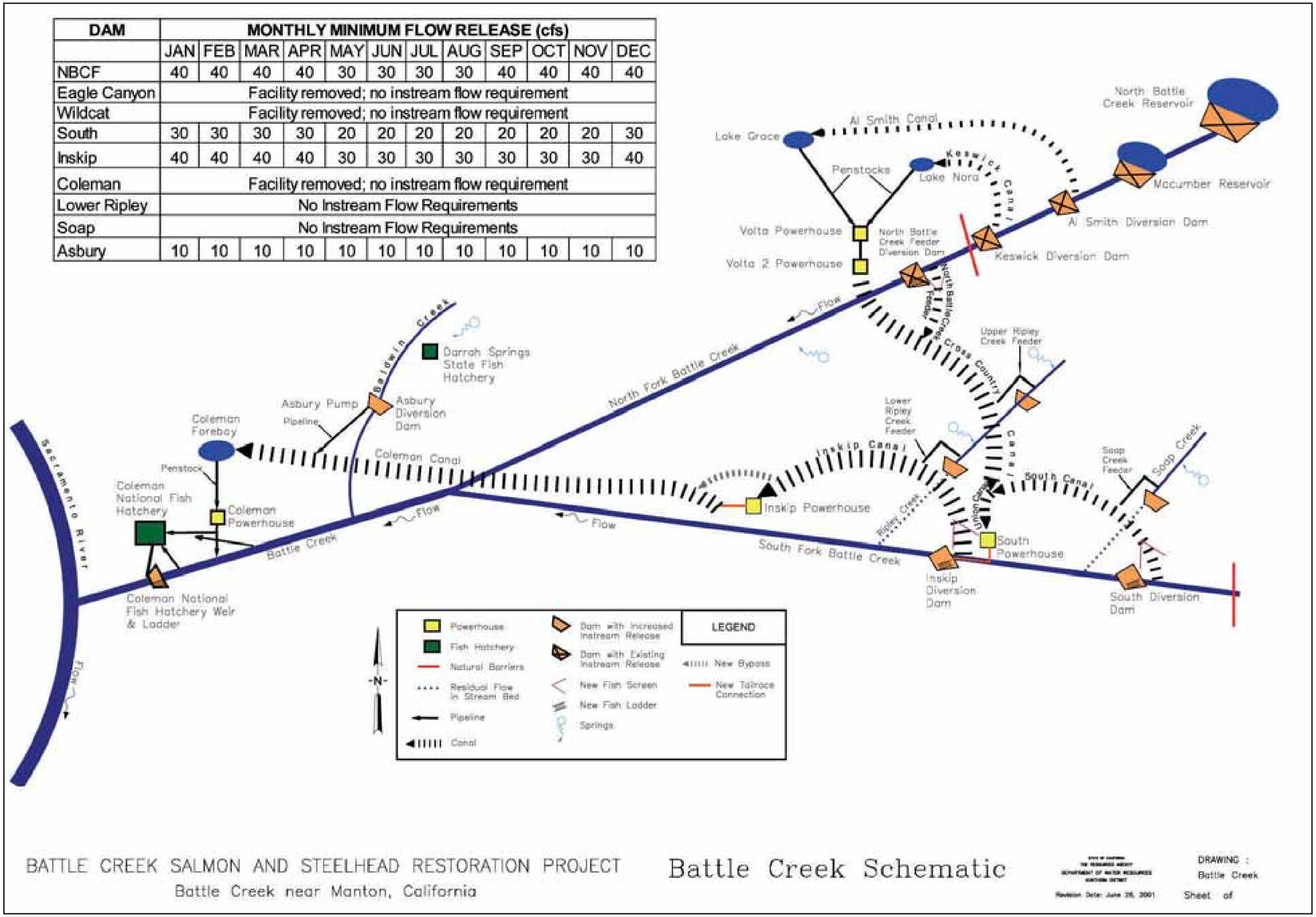
Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 30–40 cfs
	Access road construction and improvements
Eagle Canyon Diversion Dam	Dam and appurtenant facilities removed
	Improvement of existing trail
Wildcat Diversion Dam, Pipeline, and Canal	Dam and appurtenant facilities removed
	Improvement of access roads and trail
South Diversion Dam	90-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 20–30 cfs
	Access road improvements

Site Name	Component
Inskip Diversion Dam and South Powerhouse	220-cfs fish screen
	Fish ladder
	Monthly minimum flow release range from 30–40 cfs
	Construction of South Powerhouse and Inskip Canal connector (flow separator channel)
	Access road construction and improvements
Coleman Diversion Dam and Inskip Powerhouse	Dam removed
	Construction of Inskip Powerhouse and Coleman Canal connector
	Inskip Powerhouse Bypass replacement
	Access road improvements
Asbury Pump Station and Diversion Dam	Reoperate
	Creek flow and stage recorder installed
	Minimum instream flow set for Baldwin Creek at 10 cfs

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 CBDA 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



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

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Figure 3-5
Three Dam Removal Alternative

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 40-month period. Construction is anticipated to begin in spring 2005 and end by fall 2008.

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.

Environmental Commitments

The Three Dam Removal Alternative will incorporate the same environmental commitments identified for the Five 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 3-6 summarizes the proposed elements for the five alternatives analyzed in this EIS/EIR. Table 3-7 summarizes the prescribed minimum continuous monthly instream flow releases by alternative at each diversion dam at which facility modifications are proposed.

Table 3-6. Summary of Facility and Instream Flow Modifications Proposed for Five Salmon and Steelhead Restoration Alternatives

Component	Alternative				
	NA	5D[1]	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 Feeder Diversion Dam and facilities		✓		✓	
Reoperate and gage Asbury Dam		✓		✓	✓
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	✓	✓	✓	✓	✓
Redirect cold water from spring complexes from canals to adjacent creek reaches		✓		✓	✓[2]
Construct channel to separate South Powerhouse tailrace waters from the stream					✓
Provide ramping rate during operations reducing flows below dams		✓	✓	✓	✓

NA = No Action Alternative; 5D = Five Dam Removal Alternative; ND = No Dam Removal Alternative; 6D = Six Dam Removal Alternative; 3D = Three Dam Removal Alternative.

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

[2] Includes only springs at Eagle Canyon.

Table 3-7. Prescribed Minimum Continuous Monthly Instream Flow Releases

Diversion Dam	Monthly Minimum Flow Release (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North Battle Creek Feeder												
Five Dam Removal Alternative [1]	88	88	88	67	47	47	47	47	47	47	47	88
No Dam Removal Alternative	40	40	40	40	30	30	30	30	40	40	40	40
Six Dam Removal Alternative	88	88	88	67	47	47	47	47	47	47	47	88
Three Dam Removal Alternative	40	40	40	40	30	30	30	30	40	40	40	40
Eagle Canyon												
Five Dam Removal Alternative [2]	46	46	46	46	35	35	35	35	35	35	35	46
No Dam Removal Alternative	50	50	50	50	30	30	30	30	30	30	30	50
Six Dam Removal Alternative	Facility removed, no instream flow requirement											
Three Dam Removal Alternative	Facility removed, no instream flow requirement											
Wildcat												
Five Dam Removal Alternative	Facility removed, no instream flow requirement											
No Dam Removal Alternative	50	50	50	50	30	30	30	30	30	30	30	50
Six Dam Removal Alternative	Facility removed, no instream flow requirement											
Three Dam Removal Alternative	Facility removed, no instream flow requirement											
South												
Five Dam Removal Alternative	Facility removed, no instream flow requirement											
No Dam Removal Alternative	30	30	30	30	20	20	20	20	20	20	20	30
Six Dam Removal Alternative	Facility removed, no instream flow requirement											
Three Dam Removal Alternative	30	30	30	30	20	20	20	20	20	20	20	30
Inskip												
Five Dam Removal Alternative [3]	86	86	86	61	40	40	40	40	40	40	40	86
No Dam Removal Alternative	40	40	40	40	30	30	30	30	30	30	30	40
Six Dam Removal Alternative	86	86	86	61	40	40	40	40	40	40	40	86
Three Dam Removal Alternative	40	40	40	40	30	30	30	30	30	30	30	40

Table 3-7. Continued

Diversion Dam	Monthly Minimum Flow Release (cfs)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coleman												
Five Dam Removal Alternative	Facility removed, no instream flow requirement											
No Dam Removal Alternative	50	50	50	50	30	30	30	30	50	50	50	50
Six Dam Removal Alternative	Facility removed, no instream flow requirement											
Three Dam Removal Alternative	Facility removed, no instream flow requirement											
Lower Ripley Creek												
Five Dam Removal Alternative	Facility removed, no instream flow requirement											
No Dam Removal Alternative	No instream flow requirement											
Six Dam Removal Alternative	Facility removed, no instream flow requirement											
Three Dam Removal Alternative	No instream flow requirement											
Soap Creek												
Five Dam Removal Alternative	Facility removed, no instream flow requirement											
No Dam Removal Alternative	No instream flow requirement											
Six Dam Removal Alternative	Facility removed, no instream flow requirement											
Three Dam Removal Alternative	No instream flow requirement											
Asbury												
Five Dam Removal Alternative	5	5	5	5	5	5	5	5	5	5	5	5
No Dam Removal Alternative	No instream flow requirement											
Six Dam Removal Alternative	5	5	5	5	5	5	5	5	5	5	5	5
Three Dam Removal Alternative	10	10	10	10	10	10	10	10	10	10	10	10

[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.

Alternatives Eliminated from Further Consideration

Two additional alternatives are not analyzed in Chapter 4 of this EIS/EIR because they were eliminated from further consideration. These alternatives include the Eight Dam Removal Alternative and Alternative 6. The following sections describe each alternative and explain why they were eliminated from further consideration and are not analyzed in this EIS/EIR.

Eight Dam Removal Alternative (Alternative B)

Following public circulation of the Draft EIS/EIR (July through October 2003), a new alternative, the Eight Dam Removal Alternative, was proposed for analysis by the CBDA outside of the NEPA/CEQA process. As part of this analysis, the Eight Dam Removal Alternative (identified as Alternative B in a cost analysis presented to the CBDA ERP Subcommittee meeting in January 2004 [Pacific Gas and Electric Company 2004]) is compared to the Proposed Action for the Restoration Project (identified as the Five Dam Removal Alternative in this EIS/EIR and also known as the MOU Alternative).

When the two alternatives are compared, habitat benefits for anadromous fish are found to be similar, with the Eight Dam Removal Alternative providing slightly more habitat benefit than the Five Dam Removal Alternative; however, both alternatives provide substantially more benefit to anadromous fish habitat than the No Action Alternative. Based on a May 2004 cost estimate update prepared by Reclamation, which served to update the January 2004 economic analyses (Pacific Gas and Electric Company 2004; Lubben pers. comm.), it was found that the overall cost of the Eight Dam Removal Alternative is approximately $3 million more than the Five Dam Removal Alternative. This assessment was again updated in April 2005 using Reclamation’s updated cost estimate (February 2005) and the CPUC-published Market Price Referent for the replacement power cost. The overall cost of the Eight Dam Removal Alternative remained more costly than the Five Dam Removal Alternative. Therefore, the Eight Dam Removal Alternative is consistently more costly and provides only slightly more habitat benefits for anadromous fish. In addition to differences in overall project costs, the primary difference between the two alternatives is that the Eight Dam Removal Alternative results in significant additional reduced energy production and a reduced ability to meet all Restoration Project objectives and CALFED Program objectives.

An independent consultant model determined that the Five Dam Removal Alternative would result in an approximately 30% reduction in energy production, and the Eight Dam Removal Alternative would result in more than a 50% reduction in energy production (Navigant Consulting, Inc. 2004). Under California law, these respective losses of clean and renewable energy would need to be replaced from a renewable source. PG&E concluded that the additional power lost under the Eight Dam Removal Alternative would cost more than the savings in Restoration Project planning, implementation, and operation and maintenance costs of the new facilities proposed for the Five Dam Removal Alternative.

The Eight Dam Removal Alternative, therefore, would be substantially less effective than the Five Dam Removal Alternative in meeting the Restoration Project objective of minimizing the loss of renewable energy produced by the Hydroelectric Project. Additionally, the Eight Dam Removal Alternative does not meet an important CALFED Program objective that requires support from a willing participant. At this time PG&E, the owner and operator of the Hydroelectric Project, does not believe the Eight Dam Removal Alternative warrants further consideration due to the higher power productions losses and the insignificant increase in habitat benefits (Livingston pers. comm.).

In summary, the Eight Dam Removal Alternative was excluded from further consideration for the following reasons:

- Incremental habitat benefits of the Eight Dam Removal Alternative would be only marginally better compared to the Five Dam Removal Alternative.
- The cost of replacement energy for the Eight Dam Removal Alternative would be excessive.
- The Five Dam Removal Alternative better achieves a key project objective of minimizing the loss of clean and renewable energy produced by the Hydroelectric Project.
- The Eight Dam Removal Alternative lacks support of a willing participant, as required by the CALFED Program objectives.

In consideration of the above, the Proposed Action (i.e., the Five Dam Removal Alternative) as described in the 1999 MOU and as defined earlier in this chapter continues to represent the best balance of resources.

After several months of extensive investigation and discussions and further economic analyses, the members of the Battle Creek PMT—which includes the federal and state lead agencies for the Restoration Project (Reclamation and the State Water Board, respectively), the owner of the Hydroelectric Project (PG&E), and additional signatories to the 1999 MOU (DFG, USFWS, and NOAA Fisheries)—agree that the Eight Dam Removal Alternative should be removed from further consideration and that the Five Dam Removal Alternative currently remains the best opportunity to restore significant amounts of habitat on Battle Creek while maintaining clean and renewable energy produced by the Hydroelectric Project.

Background

In 1999, Reclamation, USFWS, DFG, NOAA Fisheries, and PG&E signed an MOU to pursue a restoration project in Battle Creek (Appendix A). This would entail PG&E voluntarily applying to FERC to amend the Battle Creek

Hydroelectric Project license. The MOU signatories considered several Action Alternatives for Battle Creek. When evaluating the different alternatives to select one as the Proposed Action, the MOU signatories considered the following specific objectives (see Chapter 2 in this report):

- 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 would be marginal as a result of increased instream flow;
- dedicate water diversion rights for instream purposes at dam removal sites;
- construct tailrace connectors and install failsafe[5] fish screens and fish ladders to increase 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 habitat 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 MOU signatories identified the Five Dam Removal Alternative (MOU Alternative) as the Proposed Action because it best meets the project objectives listed above. The Five Dam Removal Alternative includes the removal of five diversion dams, the installation of fish screens and fish ladders at three remaining dams and access roads to maintain these facilities, an increase of instream flows, the installation of new facilities to prevent the mixing of North Fork and South Fork Battle Creek waters, and an adaptive management plan. This alternative is described in detail earlier in this chapter and in the 1999 MOU (Appendix A). The environmental effects associated with construction and implementation of

[5] The MOU defines *failsafe* as a level of performance and reliability. Standards for fish ladders and fish screens are specified in Sections 2.10 and 2.11 of the MOU (Appendix A), respectively. More specific information on fish ladders and fish screens is presented in Table 21 and Table 22, respectively, in the Adaptive Management Plan (Terraqua, Inc. 2004a).

the Restoration Project under the Proposed Action and the Action Alternatives are evaluated in Chapter 4 of this report. While the Eight Dam Removal Alternative is not evaluated as an action alternative, biological benefits and costs are compared and evaluated with the Five Dam Removal Alternative below.

Technical Review of the Restoration Project

Subsequent to the signing of the MOU in 1999, CALFED (now known as CBDA) approved $28 million for the Restoration Project (CALFED Project Number ERP-99-B01). Because of the increased funding estimate, the CALFED ERP Selection Panel formed an independent technical review panel (TRP) to review the technical merit of the Restoration Project. The TRP presented its findings in the *Technical Review Panel Report for the Battle Creek Salmon and Steelhead Restoration Project* (TRP Report), dated September 2003 (Borcalli et al. 2003).

The TRP indicated in its report that in the context of the Proposed Action (MOU alternative), the costs of the elements of the project were reasonable, justified, and cost-effective. However, the TRP noted that this finding does not address the strategic approach taken in the MOU, which identified the Five Dam Removal Alternative as the Proposed Action to balance the needs of fisheries and power production.

The CALFED ERP Selection Panel recommended that the Battle Creek PMT consider a more comprehensive decommissioning of the Hydroelectric Project as a project alternative to determine whether increased benefit could be achieved.

Cost Review of Additional Alternatives Considered

While the PMT was preparing a formal response to the TRP Report in December 2003, the California Resources Agency, a state agency within CBDA, requested that a cost review be conducted on the MOU Alternative (i.e., the Five Dam Removal Alternative) in comparison with additional alternatives. The CBDA Selection Panel asked that this analysis take place outside the context of this NEPA/CEQA process.

In response to the California Resources Agency’s request, a group of economists and engineers from Reclamation, Environmental Defense, the California Hydropower Reform Coalition (CHRC), Natural Heritage Institute, The Metropolitan Water District of Southern California (MWD), and PG&E used FERC’s current cost economic method to conduct a cost review of the MOU Alternative compared with several additional alternatives. The cost review team identified three additional alternatives, which are identified as Alternatives A, B, and C below. Figure 2-2 provides an overview of existing facilities in the project area.

- Alternative A involves decommissioning the entire Hydroelectric Project, including PG&E's facilities upstream of the natural fish passage barriers on Battle Creek;
- Alternative B (i.e., the Eight Dam Removal Alternative) involves decommissioning all diversion dams, and exclude decommissioning of the powerhouse facilities, below the natural fish passage barriers on Battle Creek, with the exception of Asbury Pump Diversion Dam; and
- Alternative C (i.e., Alternative 6) involves decommissioning all diversion dams and powerhouse facilities below the natural fish passage barriers on Battle Creek.

The cost review team concluded that the use of FERC's current cost economic method and the resulting findings adequately represented the relative costs of the various alternatives. The cost review team considered only the financial costs, including planning and implementation costs, and the loss of hydroelectric power associated with the alternatives. The cost analysis did not include relative environmental benefits.

The cost review team presented their preliminary findings at the CBDA ERP Subcommittee meeting January 15, 2004. Based on the preliminary cost results, it was decided at the January 2004 ERP Subcommittee meeting that the PMT would further compare the potential incremental habitat benefits of Alternative B and the MOU Alternative.

Subsequent to the January 2004 preliminary cost results, an independent consultant[6] reviewed the preliminary findings and refined the energy production estimates in April 2004. (DFG and MWD recommended that Navigant, which had assisted with the original cost analysis for the 1999 MOU, reevaluate the January 2004 preliminary findings prepared by the cost review team.) Also, as part of the May 2004 proposal to CBDA for supplemental Restoration Project funding, Reclamation updated the planning and implementation costs to more accurately reflect current pricing of the Restoration Project. These updated cost analyses were incorporated into the January 2004 preliminary findings, which resulted in the August 2004 cost analysis. This assessment was again updated in April 2005 resulting in the overall cost of the Eight Dam Removal Alternative remaining more costly than the Five Dam Removal Alternative.

The updated May 2005 cost analysis is presented in Tables 3-8 and 3-9. Table 3-8 summarizes and compares the MOU alternative and additional Restoration Project alternatives based on the updated implementation costs. Table 3-9 supports the information in Table 3-8. The uncertainties associated with planning and implementation costs, as well as the costs of forgone energy, were assessed by using ranges of values. The cost ranges, shown in parentheses in Table 3-8, account for these uncertainties.

[6] Navigant Consulting, Inc., Battle Creek Salmon Restoration Project model output dated April 27, 2004.

The preliminary cost review completed in January 2004 indicated that the MOU Alternative (the Five Dam Removal Alternative) and Alternative B (the Eight Dam Removal Alternative) were similar in cost. However, the revised cost review completed in May 2005 (presented in Tables 3-8 and 3-9) shows that the expected project costs associated with the Five Dam Removal Alternative are actually lower than the Eight Dam Removal Alternative ($128 million and $139 million, respectively). Because the remaining alternatives (Alternatives A and C) were substantially more expensive than the MOU Alternative, they were excluded from further consideration.

Table 3-8. General Cost Review of Memorandum of Understanding Alternative and Additional Restoration Alternatives

Alternative	Description	Estimated Cost (million U.S. Dollars)
MOU Alternative—Five Dam Removal	Negotiated in the 1999 MOU and identified as the Proposed Action in the EIS/EIR (the Five Dam Removal Alternative); includes the removal of five diversion dams, the installation of fish screens and fish ladders at three remaining diversion dams, an increase of minimum instream flows, the installation of new facilities to prevent the mixing of North Fork and South Fork Battle Creek waters, and an adaptive management plan.	$128 (range from $120 to $136)
Alternative A	Represents decommissioning the entire Battle Creek Hydroelectric Project, including PG&E's facilities upstream of the natural fish passage barriers on Battle Creek; this alternative was not evaluated in this Final EIS/EIR because it did not meet the project objective of minimizing the loss of clean and renewable hydroelectric power and extended beyond the project area.	$233 (range from $206 to $260)
Alternative B—Eight Dam Removal	Represents decommissioning all diversion dams downstream of the natural fish passage barriers on Battle Creek (the Eight Dam Removal Alternative); this alternative is the MOU Alternative plus the decommissioning of the three remaining diversion dams downstream of natural fish barriers and, therefore, does not include the installation of fish screens and fish ladders; although this alternative was not evaluated in this Final EIS/EIR, it has characteristics similar to Alternative 6 (Alternative C described below); unlike Alternative 6, this alternative does not include decommissioning PG&E's powerhouse facilities downstream of the natural fish barriers.	$139 (range from $125 to $154)
Alternative C	Represents decommissioning all facilities downstream of the natural fish passage barriers on Battle Creek (see Alternative 6); this alternative is the MOU Alternative plus the decommissioning of the three remaining diversion dams and powerhouse facilities (except the two Volta Powerhouses) downstream of the natural fish passage barriers and, therefore, does not include the installation of fish screens and fish ladders; this alternative was eliminated from further consideration during the scoping process and, therefore, was not evaluated in this Final EIS/EIR because it did not meet the project objective of minimizing the loss of clean and renewable hydroelectric power.	$165 (range from $145 to $185)

Sources: Pacific Gas and Electric Company 2004; Lubben pers. comm. 2005.

Note: The estimates presented in this table are based on the most current data available in May 2005.

Table 3-9. Detailed Cost Review of Memorandum of Understanding Alternative and Other Restoration Alternatives

Battle Creek Salmon and Steelhead Restoration Project Cost Summary				
	Proposed Action (MOU)	Alternative A Decommission Entire Battle Creek Hydro Project	Alternative B Decommission All Diversion Downstream of Natural Barriers	Alternative C Decommission All Facilities Downstream of Natural Barriers
Average annual energy, gigawatt hours (GWh)	**162.2**	**0**	**110.4**	**59.3**
Average annual energy, percent reduction	30%	100%	52%	74%
Total planning and implementation costs, $ thousands	**77,643**	**94,110**	**58,940**	**54,645**
Design and construct screens and ladders, with connectors/bypass	33,096	0	0	0
Decommissioning costs, with connectors/bypass	23,104	70,800	45,005	33,335
Environmental compliance, monitoring and mitigation	10,806	23,310	11,185	21,310
MLTF pathogen problem resolution	5,500	0	2,750	0
Future water acquisition	3,000	0	0	0
Reimbursed forgone power (net present value)	2,137	0	0	0
Sensitivity analyses, net present value in 2005 dollars, millions				
1. Expected case				
Planning and implementation costs	77.6	94.1	58.9	54.6
Replacement power costs	48	161	84	120
Increased Operations & Maintenance (O&M)	2	(22)	(4)	(9)
Total	128	233	139	165
2. Power value uncertainty				
A. 5-cent power values				
Planning and implementation costs	77.6	94.1	58.9	54.6
Replacement power costs	40	134	70	100
Increased O&M	2	(22)	(4)	(9)
Total	120	206	125	145
B. 7-cent power values				
Planning and implementation costs	77.6	94.1	58.9	54.6
Replacement power costs	56	188	98	140
Increased O&M	2	(22)	(4)	(9)
Total	136	260	153	185
3. Construction of cost uncertainty				
A. Construction costs 10% less than expected				
Planning and implementation costs	69.9	84.7	53.0	49.2
Replacement power costs	48	161	84	120
Increased O&M	2	(22)	(4)	(9)
Total	120	224	133	160
B. Construction costs include $9.2 to 12 million for MLTF, or 25% over-run				
Planning and implementation costs	84.1	117.6	73.7	68.3
Replacement power costs	48	161	84	120
Increased O&M	2	(22)	(4)	(9)
Total	135	257	154	179

Sources: Pacific Gas and Electric Company 2004; Lubben pers. comm. 2005.

Note: The estimates presented in this table are based on the most current data available in May 2005.

Comparison of Alternatives

At the request of the ERP Subcommittee, the PMT formed a group of technical experts to analyze the biological differences between the Five Dam Removal Alternative (MOU Alternative, see Figure 3-2) and the Eight Dam Removal Alternative (Alternative B, see Figure 3-6). Specifically, a group of experts, including representatives from Reclamation, USFWS, DFG, The Nature Conservancy, PG&E, and CHRC, analyzed habitat benefits, which include geomorphology, habitat and temperature, hydrology, and fish passage. The following topics were also analyzed to clearly define the differences between the Five Dam and Eight Dam Removal Alternatives:

- habitat benefits associated with both alternatives,
- risk of transferring serious and catastrophic fish diseases to other fish communities and state waters in California,
- direct project costs and hydroelectric energy reductions associated with both alternatives, and
- the ability of both alternatives to meet Restoration Project objectives and CALFED Program objectives.

The results of each topic are summarized below.

Habitat Benefits

The Battle Creek PMT, including representatives from Reclamation, DWR, USFWS, NOAA Fisheries, and DFG, conducted a comparative analysis of the habitat benefits associated with the Five Dam Removal Alternative and the Eight Dam Removal Alternative. The resource agencies concluded that, compared to the existing conditions present under the current FERC license, both alternatives would significantly improve habitat and passage conditions for the target species. However, the habitat and passage conditions predicted for the Eight Dam Removal Alternative did not represent a significant improvement over those predicted for the Five Dam Removal Alternative.

Table 3-10 summarizes the findings with respect to geomorphology, habitat and temperature, hydrology, and fish passage. These findings were also discussed at the March 15, 2004, public meeting held in Red Bluff, California, and are presented in detail in a draft report entitled *Further Biological Analyses for Information Presented on March 15, Regarding the Differences between the Five Dam Removal Alternative and the Eight Dam Removal Scenario* (California Department of Fish and Game 2004). Additional information related to SNTEMP limitations is located in the March 15, 2004, public meeting record (Reclamation and State Water Board 2004) and in Appendix R, “Water Temperatures in the Battle Creek Restoration Area,” of this report. The Nature Conservancy prepared a separate analysis of sediment transport under the Five Dam Removal Alternative and the Eight Dam Removal Alternative (The Nature

Conservancy 2004). Copies of DFG's and The Nature Conservancy's reports are found on the CBDA Web site:

http://www.calwater.ca.gov/Programs/EcosystemRestoration/EcosystemBattleCreek.shtml.

The CHRC also provided a review of incremental biological benefits associated with the Five Dam and Eight Dam Removal Alternatives and provided comments on the PMT's analysis. CHRC presented their review at the public meeting held in Red Bluff on March 15, 2004. Their analysis is detailed in a report entitled *Analysis of Dam Removal Alternative B, Battle Creek Salmon and Steelhead Restoration Project* (California Hydropower Reform Coalition 2004). A copy of CHRC's report is found on the CBDA Web site:

http://www.calwater.ca.gov/Programs/EcosystemRestoration/EcosystemBattleCreek.shtml.

Although the PMT (and DFG) concluded that the Eight Dam Removal Alternative failed to provide any significant biological advantages over the Five Dam Removal Alternative (see summary in Table 3-10), the CHRC asserts that, compared with the Five Dam Removal Alternative, the Eight Dam Removal Alternative (Alternative B) would substantially increase summer base flows, restore interannual flow variability in summer, reduce temperatures in most areas, and reduce North Fork/South Fork mixing. The report also emphasized the importance of the descending limb of the hydrograph, i.e., the transition from the winter (high) to summer (low) flow season (Norlander pers. comm.).

The CALFED ERP conducted a peer review of the biological analyses prepared by DFG and that prepared by the CHRC entitled *Review of Documents Related to Alternatives for Dam Removal* (California Bay-Delta Authority 2004). A copy of this technical report is found on the CBDA Web site:

http://www.calwater.ca.gov/Programs/EcosystemRestoration/EcosystemBattleCreek.shtml.

Table 3-10. Comparison of the Incremental Benefits of the Five Dam and Eight Dam Removal Alternatives

Factor	Comparison of the Eight Dam Removal Alternative and the Five Dam Removal Alternative
Geomorphology	Removing the additional three diversion dams under the Eight Dam Removal Alternative (including North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams) does not provide substantial improvement in sediment transport characteristics necessary for maintaining spawning areas because the dams are too small to appreciably alter the magnitude or duration of flow events and sediment transport.

DAM	MONTHLY MINIMUM FLOW RELEASE (cfs)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NBCF	Facility removed; no instream flow requirement											
Eagle Canyon	Facility removed; no instream flow requirement											
Wildcat	Facility removed; no instream flow requirement											
South	Facility removed; no instream flow requirement											
Inskip	Facility removed; no instream flow requirement											
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

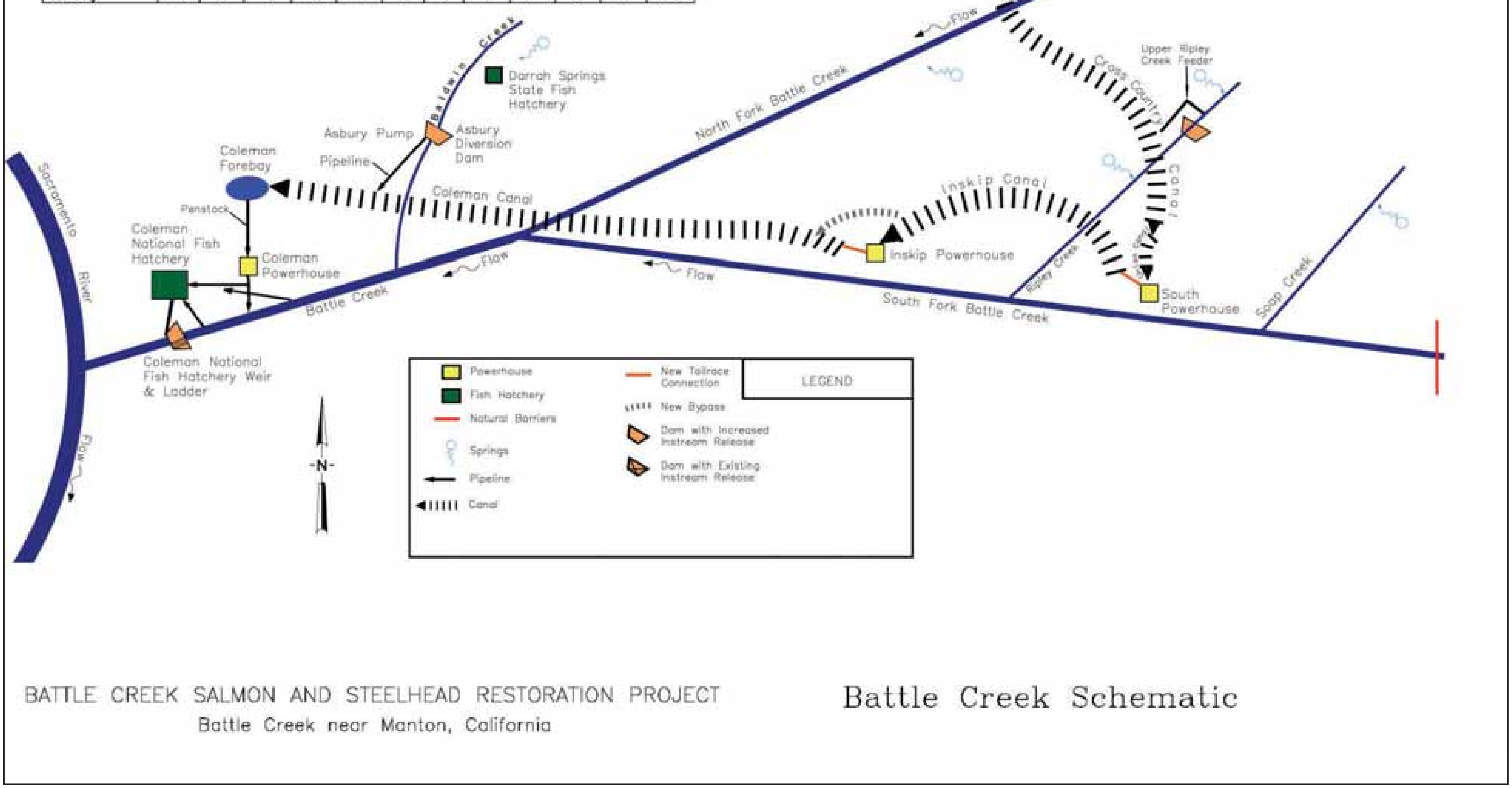

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Figure 3-6
Eight Dam Removal Alternative

Factor	Comparison of the Eight Dam Removal Alternative and the Five Dam Removal Alternative
Habitat and Temperature	Removing the additional three diversion dams under the Eight Dam Removal Alternative does not substantially increase the predicted minimum amount of habitat usable by the target species for spawning or rearing or substantially improve the temperature regime for fish in each stream reach. Improvement is indicated by changing the temperature range from less tolerable to more tolerable for temperature-sensitive life stages. During the summer, the valley reaches of Battle Creek are not suitable for the most-temperature-sensitive life stages of the target species under either alternative, and in some cases even with the unimpaired flow. The Five Dam Removal Alternative provides a greater ability to adaptively manage instream flows for the benefit of Chinook salmon and steelhead. .Removal of all dams, as recommended under the Eight Dam Removal Alternative, would result in less adaptability to manage stream flows.
Habitat—Spawning/Rearing	Water temperature is higher in the mainstem and lower run reaches under the Five Dam Removal Alternative, but this area is not used for winter-run Chinook salmon spawning habitat. The colder upper reaches are only slightly warmer, and there is no difference for the farthest reaches compared with the Eight Dam Removal Alternative. Water temperature is colder on the mainstem and lower run reaches under the Eight Dam Removal Alternative, but still not cold enough to be beneficial for winter-run Chinook salmon spawning habitat. The upper reaches are only slightly cooler, and for the farthest reaches, there is no difference from the Five Dam Removal Alternative. The Adaptive Management Plan for the Five Dam Removal Alternative has the ability to acquire additional surface water or spring release as needed to improve the temperature regime (see Table 17 in the Draft Adaptive Management Plan [Terraqua, Inc. 2004a]).
Habitat—Hydrology	The Five Dam Removal Alternative uses the prescription flow set by the Battle Creek Project Management Team and described in the 1999 Memorandum of Understanding as the *large flows*. These flows more closely approximate the optimal flows for the various life stages of Chinook salmon and steelhead compared to the Eight Dam Removal Alternative. However, given the natural variability of the system, the difference between the two alternatives is small. The Eight Dam Removal Alternative appears to result in more variable flows that may or may not be optimal for all life stages of Chinook salmon and steelhead. However, given the natural variability of the Battle Creek system, the difference between the two alternatives is small.
Hydrology	Removing the additional three diversion dams under the Eight Dam Removal Alternative does not substantially change the manner in which streamflows fluctuate within the natural range of flows for this location and season. This is attributable to the lack of storage in the Battle Creek hydroelectric system, which would impair runoff, and the small diversion capacity of the run of the river dams relative to wet season events. The main difference between the two alternatives is flow level. The Five Dam Removal Alternative would have lower flows than the Eight Dam Removal Alternative. The Eight Dam Removal Alternative would have higher flows than the Five Dam Removal Alternative and essentially represents natural conditions. It is possible that there are additional ecosystem benefits from essentially providing natural flow conditions. Spence et al. discuss the importance of salmonid habitats having streamflows that fluctuate within the natural range of flows for the given location and season (Spence et al. 1996).

Factor	Comparison of the Eight Dam Removal Alternative and the Five Dam Removal Alternative
Fish Passage	Under the Five Dam Removal Alternative, fish ladders would be installed at the three dam sites that would be removed under the Eight Dam Removal Alternative. The fish ladders are scientifically designed and would result in only limited instances of passage delay. Under the Eight Dam Removal Alternative, the three additional diversion dams would be removed and flows would be increased; however, increased flows would not necessarily improve fish passage. There are channel features that can become barriers at both high and low flows, and the optimal unimpaired flow level is less than the maximum flows. Because of the uncertainty related to fish passage, the same level of adaptive management is expected for both alternatives. Under the Five Dam Removal Alternative, more maintenance work on fish screens and ladders would be required. Under the Eight Dam Removal Alternative, less maintenance would be required because no fish screens and fish ladders would be constructed at the project sites. Because of all the uncertainty associated with fish passage of natural barriers, it is difficult to determine whether one alternative is better than the other. Different areas may act as barriers at higher flows rather than lower flows.
Sediment Transport	There is little difference between the two alternatives with respect to sediment bedload transport. Differences between the two alternatives with respect to fine sediment transport are unknown but expected to be minimal.
Power Generation	The Five Dam Removal Alternative would result in the generation of 30% less power for the Hydroelectric Project. The Eight Dam Removal Alternative would result in the generation of 50% less power for the Hydroelectric Project. Also, there would be no backup system if an emergency resulted in a system shutdown.
Uncertainties—Project Long-Term Success	There is greater uncertainty associated with the continued successful operation of the proposed fish passage facilities under the Five Dam Removal Alternative. Because there would be fewer human-made facilities, there would be more certainty associated with the Eight Dam Removal Alternative.
Uncertainties—MOU	The MOU is complete and was signed in 1999 by the five signatories (U.S. Department of the Interior, Bureau of Reclamation; U.S. Fish and Wildlife Service; National Marine Fisheries Service; California Department of Fish and Game; and Pacific Gas & Electric Company). It is uncertain whether a new MOU for the Eight Dam Removal Alternative could be negotiated (Livingston pers. comm. 2004).
Uncertainties—Community Support	The Battle Creek Watershed Conservancy has indicated in a letter to Reclamation that they do not support the Eight Dam Removal Alternative (Lucas pers. comm. 2004). The BCWC does support the Five Dam Removal Alternative contingent on the Four Agencies (i.e., NOAA Fisheries, USFWS, DFG, and Reclamation) meeting the four proposed agency actions outlined in a letter from the BCWC to the Four Agencies dated February 23, 2004 (Battle Creek Watershed Conservancy 2004).

Source: Reclamation and State Water Board 2004.

Risk of Transferring Serious Fish Diseases

Naturally spawning Chinook salmon and steelhead are known to carry virulent diseases that can have serious adverse effects on other anadromous and non-anadromous fish communities (U.S. Fish and Wildlife Service 1997c). Many of these diseases are waterborne and can be passed into groundwater supplies (Pert pers. comm.). As part of the Hydroelectric Project, PG&E canals divert water from Battle Creek to various project powerhouses. Currently, Battle Creek water seeps into the local shallow groundwater table as it passes through two unlined PG&E canals—Eagle Canyon Canal and Inskip Canal. Groundwater that may become contaminated with these fish diseases resurfaces as natural springs that two MLTF facilities—Jeffcoat (including Jeffcoat East, Jeffcoat West, and the Jeffcoat nursery) and Willow Springs—use as its main water supply. The canal seepage could potentially transport waterborne pathogens from Battle Creek into the spring-fed water supplies of these MLTF facilities.

Resident rainbow trout above the MLTF intake have commingled in the past with wild anadromous fish and would continue to commingle under the No Action Alternative or existing conditions; therefore, the resident rainbow trout are potential carriers of diseases that are also carried by anadromous fish and considered a possible threat to MLTF rainbow trout. Because resident rainbow trout would continue to be present in MLTF's water source under the Eight Dam Removal Alternative, there would be a slight risk of disease transmission to MLTF that is considered to be less than the No Action Alternative or existing conditions and substantially less than any of the Action Alternatives.

Implementing the Restoration Project would increase the abundance and upstream distribution of Chinook salmon and steelhead in Battle Creek, which could increase the incidence of pathogens in PG&E's canals diverting Battle Creek water. Water leaking from PG&E's canals could then contaminate the water source for MLTF's Jeffcoat and Willow Springs facilities, which in turn could contaminate its farmed trout. Once their farmed trout are infected, MLTF could transmit waterborne diseases to other waters in the state of California by stocking those waters with diseased fish (Cox pers. comm.). This increased risk of infecting fish communities and waters throughout California is analyzed as a significant fish impact and a significant water quality impact in this report (see Impacts 4.1-8 and 4.4-4, respectively, in Chapter 4) because the effects of waterborne diseases can be particularly serious for fish that reside in waters where such diseases do not occur and, therefore, do not have as much immunity to the disease. This increased risk is also considered a significant impact on MLTF's beneficial use of this water (Impact 4.4-3) and a socioeconomic effect on MLTF (Effect 4.16-4). To reduce these impacts to a less-than-significant level, mitigation measures are identified and described under Impact 4.1-8. Because a structural solution is not possible to eliminate the hydrologic connection between Inskip Canal and MLTF's Willow Springs facility, investigations are ongoing to determine the feasibility of implementing four different mitigation options at this site, including the construction of an on-site disinfection facility, relocating Willow Springs operations to an off-site facility to raise rainbow trout where the water source is not hydrologically connected to waters that support anadromous fish, modifying Willow Springs business operations to ensure that hatchery fish are not stocked in other waters in the state, or acquiring the Willow Springs aquaculture business. Implementing one of these mitigation measures would address the risk of transferring serious and catastrophic fish diseases throughout California. However, the project proponents are unaware of any actual incidences of MLTF fish or Darrah Springs

State Fish Hatchery fish being infected by the IHN virus, given historical anadromous fish population trends in Battle Creek.

The impacts described above would be less than significant under the Eight Dam Removal Alternative because Eagle Canyon Canal would be decommissioned under this alternative and would no longer divert Battle Creek water that may transport pathogens to the water source for MLTF's Jeffcoat facilities. Although Inskip Canal would continue to divert water under the Eight Dam Removal Alternative, the source of its water would be diverted from Battle Creek above natural fish barriers where there would still be some risk of being exposed to diseases from resident fish carrying virulent fish diseases but not to the extent as under the No Action Alternative or existing conditions.

Although there would continue to be a slight risk of disease transmission to MLTF under the Eight Dam Removal Alternative, because this risk is less than the No Action Alternative or existing conditions, the risk of transporting pathogens to MLTF's Willow Springs water source via Inskip Canal under the Eight Dam Removal Alternative would be considered less than significant. The Eight Dam Removal Alternative was therefore found to reduce the potential for spreading infections fish diseases compared to the Five Dam Removal Alternative.

Direct Project Costs and Hydroelectric Energy Reductions

According to the updated May 2005 cost estimate prepared by Reclamation for the Restoration Project, direct planning and implementation costs for the Five Dam Removal Alternative are estimated to be greater ($78 million) compared to the Eight Dam Removal Alternative ($59 million) (see Table 3-9).

Although direct project costs are more expensive for the Five Dam Removal Alternative, an independent consultant[7] determined that the Eight Dam Removal Alternative would result in more than a 50% reduction of renewable energy production from the Hydroelectric Project (see Table 3-9). In contrast, using the same consultant's model, the Five Dam Removal Alternative would result in approximately a 30% reduction of energy production (see Table 3-9).

The increase in forgone renewable energy production from 30% to 50% would require PG&E to invest in costly alternative renewable energy sources, which results in the Eight Dam Removal Alternative being more costly overall (see Tables 3-8 and 3-9). As a result, the Eight Dam Removal Alternative is not preferred because this alternative provides only slightly more habitat benefits for anadromous fish and replacement power costs associated with this alternative are substantially greater compared to the Five Dam Removal Alternative.

[7] Navigant Consulting, Inc. Battle Creek Salmon and Steelhead Restoration Project model output dated April 27, 2004.

Replacing Lost Hydroelectric Energy

The alternative sources of power currently available to PG&E are increased purchases and new generation developments. Because the Hydroelectric Project powerhouses are considered "renewable" small hydroelectric facilities per the California Public Utilities Commission (CPUC), the Hydroelectric Project falls within the framework of the Renewable Portfolio Standards (RPS) Program. The RPS Program was adopted by the state of California in 2002 and requires that an electrical corporation must increase its total procurement of eligible renewable energy resources by at least an additional 1% of retail sales per year so that 20% of its retail sales are procured from eligible energy resources no later than December 31, 2017. In addition, the RPS Program calls for the CPUC to establish a methodology to determine the market price of electricity for terms corresponding to the length of contracts with renewable generators. This market price is known as a market price referent (MPR)[8]. In order to replace the reduced power production and dependable capacity[9] output of the Hydroelectric Project that would occur as a result of implementing the Restoration Project, another source of renewable electrical energy would need to be obtained.

To calculate the value of the renewable energy that would be needed to replace the lost hydropower, PG&E used the "2004 Market Price Referents for the RPS Program," which were issued by the CPUC in February 2005 along with the associated Market Price Referent Staff Report, which publicly disclosed the 2004 MPRs. On February 7, 2005, it came to CPUC staff attention that there had been a technical error in the MPR calculation. The Revised MPR report was issued on February 11, 2005 (California Public Utilities Commission 2005).

The Revised MPR Staff Report describes the key assumptions and inputs used to calculate the MPRs required by Decision 04-06-015[10]. The resulting MPRs provide the CPUC with an estimation of the long-term market price of electricity for baseload[11] and peaking[12] power products that will be used in evaluating bid products received during the 2004 RPS Program power solicitations. The MPRs

[8] The MPR must reflect the long-term market price of electricity a utility would need to purchase to meet its capacity and energy needs from conventional fossil fuel resources instead of the renewable resources proposed under the RPS bidding process. The MPR developed by the CPUC must consider the value of different products including baseload, peaking, and as-available output. Pursuant to California Public Utilities Code § 399.15(a)(1), electric utility customers will pay no more than the MPR for renewable power; if the price of the renewable power exceeds the MPR, the seller of the renewable power may seek to recover the difference from the California Energy Commission.

[9] Dependable capacity is the load-carrying ability of a hydroelectric plant under adverse hydrologic conditions for a specified time interval and period of a particular electric system load. The Hydroelectric Project dependable capacity is based on the Hydroelectric Project's load-carrying ability during the critical hydrologic period (e.g., 1977) coincident with the Licensee's peak electric system load. Currently, the peak system load in California occurs during summer heat storms, typically in July or August.

[10] On June 9, 2004, the CPUC issues Decision (D.) 04-06-015, an Opinion Adopting a Market Price Referent. The assumptions and inputs used to calculate the MPRs are available on page 31, footnote 21 of D.04-06-015.

[11] Baseload production occurs when a power plant runs more or less continuously producing electricity at an essentially constant rate.

[12] Peaking power generation occurs during hours of highest daily, weekly, or seasonal loads.

include transformer losses and line losses and, thus, reflect prices for power delivered to specified zonal delivery points in northern and southern California. The following MPRs (in 2004 dollars) represent "the levelized price at which the proxy power plant revenues exactly equal the expected proxy power plant costs on a net-present value (NPV) basis." Based on the adopted MPR methodology, the 10-, 15-, and 20-year MPRs for a baseload resource[13] such as the Hydroelectric Project are all 6.05 cents per kilowatt hour (cents/kWh)[14].

The cost comparison shows that when considering the replacement power costs associated with each action alternative (using this CPUC-published information), the Five Dam Alternative Removal is the lower-cost restoration alternative compared to the Eight Dam Removal Alternative. Table 3-9 presents a detailed comparison of reduced hydroelectric power and planning and implementation costs associated with the Five Dam Removal Alternative and the Eight Dam Removal Alternative.

Preferred Voluntary FERC License Amendment Option

PG&E reaffirmed its commitment to the 1999 MOU and the Proposed Action (the Five Dam Removal Alternative) in a letter presented to the Four Agencies (DFG, NOAA Fisheries, USFWS, and Reclamation) on April 6, 2004 (Livingston pers. comm.). In its letter, PG&E noted the PMT's conclusion that there is not a significant difference in the amount of anadromous fish habitat improvement with the Eight Dam Removal Alternative compared to the Five Dam Removal Alternative. PG&E further stated that after 8 months of extensive collaborative investigation of scenarios outside of the 1999 MOU, it is clear that the MOU alternative remains the best opportunity to restore significant amounts of habitat on Battle Creek while maintaining a viable, renewable Hydroelectric Project. PG&E concluded that, while it appreciates the opportunity to collaborate with other stakeholders, it believes that the extensive additional information gathered regarding the Eight Dam Removal Alternative demonstrates that further consideration of this alternative is unnecessary. Therefore, PG&E remains committed to the Five Dam Removal Alterative and does not offer the Eight Dam Removal Alternative as a voluntary license amendment option.

[13] Baseload resource is defined by the Energy Division as a resource with a ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the same period of 92%.

[14] For more information, refer to page 6 of D.04-06-015.

Ability to Meet Project Objectives and CALFED Program Objectives

One of the project objectives identified for the Restoration Project, as described in Chapter 2 of this report, is to minimize the loss of clean and renewable energy produced by PG&E's Hydroelectric Project. As mentioned above, the Eight Dam Removal Alternative would result in more than a 50% reduction of renewable energy production. In contrast, the Five Dam Removal Alternative would result in approximately a 30% reduction of energy production. Given the significant reduction in renewable energy production resulting from the Eight Dam Removal Alternative, the Five Dam Removal Alternative better achieves this important project objective.

The CALFED Program objectives, as defined by the ROD (CALFED Bay-Delta Program 2000c), include solution principles that any CALFED project must satisfy. Because the Battle Creek Restoration Project is tiered from the CALFED ROD, the Eight Dam Removal Alternative and Five Dam Removal Alternative were evaluated according to the solution principles, which are listed below.

- **Reduce Conflicts in the System.** S*olutions will reduce major conflicts among beneficial users of water.* Water in the Battle Creek project area is presently used for hydroelectric power generation and to provide limited fish habitat. Because the Eight Dam Removal Alternative would result in all the sideflow water downstream of the natural barriers being used for fish, and none of the water would be used for hydroelectric power generation, it is unlikely that this alternative would reduce conflicts within the system.
- **Be Equitable.** *Solutions will focus on solving problems in all problem areas. Improvements for some problems will not be made without corresponding improvements for other problems.* The Eight Dam Removal Alternative and the Five Dam Removal Alternative both help to solve anadromous fish habitat issues by improving habitat in Battle Creek; however, the Eight Dam Removal Alternative significantly increases the loss of renewable energy produced by the Battle Creek Hydroelectric Project and eliminates all of the hydroelectric potential from sidewater in the Restoration Project area. In addition, there is not a significant difference in the amount of improved habitat that the Eight Dam Removal Alternative provides over the No Action Alternative compared to the amount of improved habitat that is provided by the Five Dam Alternative over the No Action Alternative (U.S. Fish and Wildlife Service 2004).
- **Be Affordable.** *Solutions will be implementable and maintainable within the foreseeable resources of the CALFED Bay-Delta Program and stakeholders.* As explained above in the section titled Planning and Implementation Costs and Hydroelectric Energy Reductions, the total cost for the Eight Dam Removal Alternative is expected to be more than for the Five Dam Removal Alternative, resulting in the Five Dam Removal Alternative being the more affordable alternative.
- **Be Durable.** *Solutions will have political and economic staying power and will sustain the resources they were designed to protect and enhance.* Under

the Eight Dam Removal Alternative, the dedication of water rights to the environment in perpetuity as described under the Five Dam Removal Alternative has not been discussed. At this time PG&E does not believe the Eight Dam Alternative warrants further consideration (Livingston pers. comm.), and the State Water Board can transfer water rights only to instream environmental purposes that are voluntarily offered by the owner, regardless of the FERC action.

- **Be Implementable.** *Solutions will have broad public acceptance and legal feasibility, and will be timely and relatively simple to implement compared with other alternatives.* The Eight Dam Removal Alternative is not implementable because it lacks a willing participant (i.e., PG&E) (Livingston pers. comm.), which is a requirement of any CALFED project. In addition, the majority of the local community does not support the Eight Dam Removal Alternative as stated by the Battle Creek Watershed Conservancy (Lucas pers. comm.).
- **Have No Significant Redirected Impacts.** *Solutions will not solve problems in the Bay-Delta system by redirecting significant negative impacts, when viewed in their entirety, in the Bay-Delta or other regions of California.* As mentioned above, implementation of the Eight Dam Removal Alternative would require procurement of significantly more renewable replacement energy. In response, the CHRC has proposed to use wind power to compensate for the incremental loss of hydropower associated with the Eight Dam Removal Alternative (California Hydropower Reform Coalition 2004). However, power generation from wind turbines would result in additional environmental impacts, such as raptor mortality resulting from collisions with wind turbines, viewsheds altered by the construction of new wind farms, and noise, depending on the size and location of the facility. This increment of additional redirected impact could be considered significant, depending on details associated with the source of replacement power.

Conclusions

To conclude this analysis, the Five Dam Removal Alternative better meets the project objectives identified for the Restoration Project and the CALFED Program objectives. Implementation of the Five Dam Removal Alternative is more equitable than the Eight Dam Removal Alternative and better reduces conflicts among beneficial water users of Battle Creek by meeting the project objectives to restore habitat for self-sustaining populations of Chinook salmon and steelhead and minimize the loss of clean and renewable hydroelectric power generation. According to the cost estimates presented in this analysis, the overall cost of implementing the Eight Dam Removal Alternative is expected to be more expensive than the Five Dam Removal Alternative.

Most importantly, the CALFED Program objectives require that the Proposed Action for the Restoration Project must have broad public acceptance as well as a willing participant. The Battle Creek Watershed Conservancy, which represents the local community, does not support the Eight Dam Removal Alternative

(Battle Creek Watershed Conservancy 2005). Additionally, PG&E, the owner and operator of the Hydroelectric Project, is committed to the Five Dam Removal Alternative and does not believe the Eight Dam Removal Alternative warrants further consideration as a voluntary license amendment option (Livingston pers. comm.).

Alternative 6

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 objective to minimize 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 Feeder Diversion and Canal;
- Soap Creek Feeder and Pipeline;
- Asbury Diversion Dam, Pumping Facility, and Pipeline; and
- Pacific Power Diversion and Canal.

As presented in Table 3-9, Alternative 6 (Alternative A) would cost substantially more to implement than the Proposed Action. In addition, 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 kilowatts (kW). If, as identified above, three of these powerhouses were decommissioned, approximately 75%, or 26,550 kW, of power production would be eliminated. The lost generating capacity would shut down the entire Hydroelectric Project because the cost to operate and maintain the remaining facilities would cost more than the cost to purchase replacement power. The cost of the replacement power was calculated according to the methodology described above under the Eight Dam Removal Alternative[15]. Therefore, it would be in the best interest of PG&E's electricity consumers to obtain the lower-cost electricity through power purchases, rather than from continued operations at the Hydroelectric Project. Consequently, partial decommissioning as formulated in this alternative would likely lead to a full decommissioning of the entire Hydroelectric 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 effects 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 occur 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 and need or the project objectives (see Chapter 2 in this report), Alternative 6 has been eliminated from further consideration and will not be discussed further.

[15] For more information on the methodology used to calculate replacement energy and the dependable capacity and system reliability of the Hydroelectric Project, refer to Section 4.16 in this EIS/EIR.