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Power Generation

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PO Box 770000
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ORIGINAL

June 24, 2002

TO PARTIES ADDRESSED:

KILARC – COW CREEK HTDROELECTRIC PROJECT RELICENSING (FERC NO. 606)

FIRST STAGE CONSULATION DOCUMENT - MEETING AND SITE VISIT

Pursuant to Federal Energy Regulatory Commission (FERC) regulation 18 CFR § 16.8(b)(1), Pacific Gas and Electric Company (Licensee) is providing the attached copy of the First Stage Consultation Document for the Kilarc – Cow Creek Hydroelectric Project for your information. By letter dated March 8, 2002, Licensee filed its Notice of Intent to submit an application for new license by March 27, 2005. The current license will expire on March 27, 2007.

Public meetings are scheduled for Tuesday, August 6, 2002 and a site tour is scheduled for Wednesday, August 7, 2002 to comply with the requirements of FERC regulations 18 CFR § 16.8(b)(2) - (3). Two public meetings will be held at the Red Bluff Community Center, 1500 S. Jackson St. in Red Bluff on August 6. In the afternoon a meeting is scheduled for resource agencies from 1:30 PM to 4:00 PM and a general public meeting is scheduled for 7:00 PM to 9:00 PM. The agenda for both meetings will be the same. The site tour will start at 8:00 AM at the Whitmore General Store and is expected to last most of the day. Some hiking may be involved and poison oak may be encountered. Please dress appropriately.

Resource agencies and the public are invited to attend both the site visit and the public meeting. Following the meeting, resource agencies will have 60 days to provide their comments to Licensee under FERC regulation 18 CFR § 16.8(b)(4). The agenda for the public meeting will be as follows:

- Review of FERC Relicensing Guidelines
- Description of the Existing Project
- Resource Issues and Study Methodologies
- Public Comment

Licensee will make copies of the attached document available for inspection at the Shasta County Library at 1855 Shasta Street in Redding and the Tehama County Library at 645 Madison Street in Red Bluff.

If you have any questions concerning the attached document, please call me at (415) 973-6915 or Bill Zemke at (415) 973-1646.

Sincerely,

Angela Risdon

Angela Risdon
Kilarc – Cow Creek Relicensing Project Manager

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BEFORE THE

FEDERAL ENERGY REGULATION COMMISSION

KILARC-COW CREEK PROJECT

FERC NO. 606

APPLICATION FOR NEW LICENSE

FIRST STAGE CONSULTATION PACKAGE

JUNE 2002

Kilarc-Cow Creek Project, FERC No. 606

ORIGINAL

BEFORE THE

FEDERAL ENERGY REGULATION COMMISSION

KILARC-COW CREEK PROJECT

FERC NO. 606

APPLICATION FOR NEW LICENSE

FIRST STAGE CONSULTATION PACKAGE

JUNE 2002

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KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR FIRST STAGE OF CONSULTATION

1.0 INTRODUCTION

Pacific Gas and Electric Company (hereafter referred to as Licensee) is the owner and operator of the Federally-licensed Kilarc and Cow Creek Powerhouse facilities (FERC No. 606). The Licensee intends to file an Application for New License for the Kilarc and Cow Creek Project by March 2005, 2 years prior to expiration of the current license.

This document initiates the first stage consultation process for Project licensing, and fulfills the requirements of Title 18, Section 16, Subpart B of the Federal Energy Regulatory Commission's (FERC's) Code of Federal Regulations (CFR) for the filing and processing of an application for new license. This document contains information describing the Project's physical features, location, current operations, hydrology, and environmental setting, as well as the Licensee's proposals for future operations and studies. These descriptions are subject to change, based on new information obtained through consultations and studies conducted during preparation of the application.

As part of the relicensing process, the Licensee has reviewed potential upgrades to the Project and no upgrades are proposed at this time. The Licensee is not proposing any changes to the Project or its operation. Maintenance and replacement of facilities would be performed as required.

This document contains the specific information required for the First Stage of Consultation as outlined in 18 CFR Section 16.8 (b). The specific information contained within the package includes:

(1) a general map showing the existing Project.

(2) a summary of the existing operational mode of the Project (described in Section 3.0).

(3) a description of the potentially affected environment and existing protection and mitigation measures (Section 4.0).

(4) hydrologic (streamflow and water regime) information (provided in Section 5.0), including drainage area, natural flow periodicity, monthly flow rates and durations, mean flow figures, and records of flow data (Appendix A).

(5) a description of proposed studies, including associated study methodologies (presented in Section 6.0) for each of the specific resources.

This Package is organized into the following sections:

1.0 Introduction

2.0 Project Maps

3.0 Project Descriptions and Summary of Operational Modes

4.0 Affected Environment

5.0 Hydrology

6.0 Proposed Studies and Methods for the Exhibit E Workplan

7.0 Literature Cited

In addition, this document contains three Appendices, A through C. Appendix A provides hydrologic data from the Cow Creek Watershed. Appendix B provides complete lists of special-status species, and Appendix C contains the Project study plans.

Definitions for terms used in this document:

"Project" refers to existing Kilarc-Cow Creek Project facilities within the Project boundaries.

"Project Area" is the zone of potential, reasonably direct impact. It usually extends 0 to 100 ft out from Project features including the reach of the Old Cow Creek between the Kilarc Diversion and the reach of South Cow between the South Cow Diversion and confluence with Hooten Gulch.

"**Immediate vicinity**" is the area extending to about 1-mi from Project features.

"Project vicinity" is the area extending to about 10 mi out from Project features.

"Project Region" is an area on the order of County or National Forest size.

"Project Stream" is a stream potentially affected by Project operations

"Study Area" may differ within each section of the document; it is based upon the type of studies proposed and the area necessary to conduct those studies.

GLOSSARY OF TERMS

Term	*Definition*
	A
A	Ampere
AA	Federal Antiquities Act
ADA	Americans with Disabilities Act
Adit	An almost vertical pipe or short horizontal passage entering a tunnel, either to add water from a conduit, sluice or other water source, or as a maintenance access tunnel (also referred to as a portal if located at the beginning or end of the tunnel)
af	acre-foot, the amount of water needed to cover 1 acre to a depth of 1 foot
Afterbay	A reservoir located immediately downstream from a powerhouse, sometimes used to re-regulate flows to the river or stream
AFRP	Anadromous Fish Restoration Program
AGC	Automatic Generation Control (the ability to control the megawatt output of a given powerhouse from remote site, such as the ISO) used to support California electric regulation system
APE	Area of Potential Effect as pertaining to Section 106 of the National Historic Preservation Act
Automatic/ semi-automatic/ manual powerhouses	An automatic powerhouse can be started, stopped, and have its load and voltage changed from a remote or master station, via supervisory control. A semiautomatic powerhouse with SCADA may allow a remote station to change load and/or voltage, and may allow a remote shutdown, but must be started manually. A semi-automatic powerhouse without SCADA will send alarms to a remote or master station. A manual powerhouse must have all its functions performed at the powerhouse.
	B
Basin Plan	The RWQCB Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin, on-line edition, 2000 with updates
BVWD	Bella Vista Water District
Black Start Capability	The ability of a unit to start up without the use of an external transmission or distribution voltage power source
BMP	Best Management Practice
BOD	biological oxygen demand

Term	*Definition*
BP	Before Present
C	
C	Celsius
CCWMG	Cow Creek Watershed Management Group
CDF	California Department of Forestry
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game
CDPR	California Department of Parks and Recreation
CDSOD	California Division of Safety of Dams within the CDWR
CDWR	California Department of Water Resources
CE	A species or subspecies listed as endangered under the California Endangered Species Act
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CEPPC	California Exotic Pest Plant Council
CFR	Code of Federal Regulations
cf	cubic foot
cfs	cubic feet per second
CNDDB	California Natural Diversity Data Base
CNPPA	California Native Plant Protection Act
CNPS	California Native Plant Society
CNPS-1A	Plants presumed to be extinct in California
CNPS-1B	Species considered by the CNPS as rare or endangered in California and elsewhere
CNPS-2	Species considered by the CNPS as rare or endangered in California but more common elsewhere
CNPS-3	Species that require more information before assigning to other lists – A review list
CNPS-4	Species considered by the CNPS as plants of limited distribution

Term	*Definition*
Conduit	A pipe, flume, or canal used for diverting or moving water from one point to another, usually used when there is no existing streambed or waterway
CP	Amphibian and reptile species designated as protected under the CDFG sport-fishing regulations as authorized by the California Code of Regulations, Title 14
CPUC	California Public Utilities Commission
CR	A species or subspecies listed as rare under the California Endangered Species Act
CRMP	Cultural Resource Management Plan
CSC	Special Concern Species, an administrative designation by CDFG
CT	A species or subspecies listed as threatened under the California Endangered Species Act
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWA	Federal Clean Water Act
D	
DAU	Cascade-North Sierra Nevada Deer Assessment Unit
dbh	diameter at breast height
DEA	draft environmental assessment
DEIR	Draft Environmental Impact Report
Distribution System	The substations, transformers and lines that convey electricity from high-power transmission lines to the consumer
DO	dissolved oxygen
DPR	Department of Parks and Recreation
E	
EA	Environmental Assessment
EAP	Emergency Action Plan
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Federal Endangered Species Act
EVC	Existing Visual Condition

Term	*Definition*
F	
F	Fahrenheit
FAC	Federal Advisory Committee
FACA	Federal Advisory Committee Act
FE	A species or subspecies listed as endangered under the Federal Endangered Species Act
FEMA	Federal Emergency Management Agency
FEPD	A federally-listed endangered species currently proposed for delisting from the ESA
FERC	Federal Energy Regulatory Commission
FERC Project Boundary	The area surrounding Project facilities and features as delineated in Exhibit Drawings of the FERC license.
Flashboards	Removable boards installed seasonally in reservoir spillways to temporarily increase storage capacity
FLPMA	Federal Land Policy and Management Act
Flume	A lined structure, commonly made of wood, metal or concrete, used for conveyance of water, usually where no streambed exists or the topography is not suitable for a canal or tunnel
Forebay	A reservoir upstream from the powerhouse, from which water is drawn into a tunnel or penstock for delivery to the powerhouse
FP	A species or subspecies designated as "fully protected" under the California Fish & Game Code
FPA	Federal Power Act
fps	Feet per second
FR	Federal Register
FSC	Special Concern Species, an administrative designation by USFWS (former category 2 species)
FSCD	First Stage Consultation Document, also known as Initial Consultation Document or ICD
FSS	A species or subspecies designated as "sensitive" by the USFS
FT	A species or subspecies listed as threatened under the Federal Endangered Species Act
ft	feet

Term	*Definition*
FTPD	A federally listed, threatened species currently proposed for delisting from the ESA
FWCA	Fish and Wildlife Coordination Act
FYLF	Foothill Yellow-legged Frog
G	
g	gram
General Plan	Shasta County General Land Use Plan
Generator	A machine powered by a turbine that produces electric current
GIS	Geographic Information System
GWh	gigawatt hour (equals one million kilowatt hours)
H	
HABTAT	IFIM simulation model
"H"-frame structure	A wood-pole transmission structure that consists of two wood poles with a horizontal cross arm above the conductor
Hp	Horsepower
HPTP	Historic Properties Treatment Plan
hr	Hour
HSI	Habitat Suitability Indices
Hz	hertz (cycles per second)
I	
ICD	Initial Consultation Document, see FSCD
IFIM	USFWS Instream Flow Incremental Methodology
Immediate Vicinity	The area extending to about one mile out from Project features
in	Inch
ISO	California Independent System Operator
J	
K	
k	kilometer: 1,000 meters
kg	kilograms: 1,000 grams

Term	*Definition*
kg/day	kilograms per day
kg/ha	kilograms per hectare
kg/yr.	kilograms per year
KOP	Key Observation Point
kV	kilovolts: 1,000 volts
kVA	kilovolt amperes
kW	kilowatts: 1,000 watts
kWh	kilowatt-hour: 1,000 watt hours
L	
l	liter
Licensee	Pacific Gas and Electric Company
M	
m	meter
MBTA	Migratory Bird Treaty Act
MCL	Maximum Containment Level
µ	micro
mgC/m^2	miligrams of carbon per square meter
µg/l	micrograms per liter
µmho/cm	micromohos per centimeter, a measurement of conductivity
mg/l	milligrams per liter
mi	mile
Mills/kWh	0.001 cents per kilowatt hour
MIR	minimal implementation requirement, a USFS system
MIS	USFS Management Indicator Species
Mm	millimeters
MSL	mean sea level
Must-Run	Energy or ancillary services necessary to maintain system reliability
MVA	megavolt-ampere
MW	megawatt
MWh	megawatt-hours

Term	*Definition*
N	
ND	no data available
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NGVD	National Geodetic Vertical Datum
NHI	Natural Heritage Institute
NHPA	National Historic Preservation Act
NMFS	Department of Commerce, National Marine Fisheries Service
NOI	Notice of Intent
NPS	National Parks Service
NRHP	National Register of Historical Places
NTU	Nephelometric turbidity unit
NWI	National Wetlands Inventory
NWS	National Weather Service
O	
P	
PA	Programmatic Agreement
PAOT	people at one time
Peaking	Operation of generating facilities to meet maximum instantaneous electrical demands
Penstock	An inclined pressurized pipe through which water flows from a forebay or tunnel to the powerhouse turbine
pf	power factor
PG&E	Pacific Gas and Electric Company, regulated utility subsidiary of PG&E Corporation
PH	powerhouse
PHABSIM	Physical HABitat SIMulation
PMF	Probable maximum flood
POAOR	California Public Opinions and Attitudes in Outdoor Recreation Survey

Term	*Definition*
Power Factor	The ratio of actual power to apparent power. Power factor is the cosine of the phase angle difference between the current and voltage of a given phase. Unity power factor exists when the voltage and current are in phase
Project	Licensee's Kilarc-Cow Creek Project, FERC No. 606
Project Area	Zone of potential, reasonably direct impact. It usually extends 0 to 100 feet out from Project features.
Project Region	An area on the order of County or National Forest size
Project vicinity	The area extending to about 10 miles out from Project features
Protection	All of the relays and other equipment which are used to open the necessary circuit breakers to separate pieces of equipment from each other when trouble develops
Protective Relay	A device whose function is to detect defective lines or apparatus, or other power system conditions of an abnormal or dangerous nature, and to initiate appropriate control circuit action
PSR	Pacific Southwest Region of USFS
PURPA	Public Utilities Regulatory Policies Act
Q	
QF	A qualifying facility, a cogenerator or small power producer that sells its excess power to a public utility
R	
ramping	The act of increasing or decreasing stream flows from a powerhouse, dam or division structure
relicensing	The process of acquiring a new license for a Project that has an existing license from FERC
Reservoir Useable Capacity	A volume measurement of the amount of water that can be stored for generation, down to a minimum level
Riparian	Relating to the bank of a natural course of water
RM	River mile as measured along the river course
RNA/ACEC	Research Natural Area/Area of Critical Environmental Concern
rpm	revolutions per minute
RTU	remote terminal unit. A remotely located piece of equipment used for collecting data and/or for operating equipment via SCADA

Term	*Definition*
Run-of-the-River	A hydro Project that uses the flow of a stream with little or no reservoir capacity for storing water
RWQCB	Regional Water Quality Control Board
S	
SCADA	Supervisory Control and Data Acquisition System
SCORP	State Comprehensive Outdoor Recreation Plan
Secchi	A method of measuring surface transparency in a reservoir
SHPO	California Department of Parks and Recreation, Office of Historic Preservation, State Historic Preservation Officer
Sluice	An artificial channel for conducting water, with a valve or floodgate to regulate the flow
SMZ	Streamside Management Zone as defined by SNF
SNEP	Sierra Nevada Ecosystem Project
SNTEMP	USFWS' Stream Temperature Model
SOHA	Spotted Owl habitat areas
Special Status Species	Species or subspecies listed under the FESA or CESA as endangered or threatened, or by a Federal or State agency as a species of special concern, sensitive species, fully protected species or management indicator species
Spill Channel	Property down gradient from a conduit for which an easement over private property or withdrawal under FERC license has been granted. A spill channel is used when it becomes necessary to release water from a section of conduit
Spillway	A passage for releasing surplus water from a reservoir
sq. ft.	square foot
sq. mi.	square mile
State	State of California
Station Use	Energy used to operate the generating facility's auxiliary equipment
STORET	USEPA's computerized water quality data storage system
Study Area	The geographic area covered by a specific study
SUP	Special Use Permit issued by the Forest Service

Term	*Definition*
Surge Chamber	A structure, similar to a holding tank, located on a tunnel or penstock which is used to absorb and attenuate the overflow and prevent any disruption due to a sudden change in water pressure through a tunnel or penstock
SWDU	Statement of Water Diversion and Use
Switching Center	The main control center for any given river system, which is responsible for operation of the automatic, semiautomatic and manual powerhouses on that river system. The Switching Center is staffed 24 hours a day
SWP	State Water Project
SWRCB	State Water Resource Control Board
T	
Tailrace	Channel through which water is discharged from the powerhouse turbines
TCP	Tradition Cultural Properties
TDS	total dissolved solids
Three-winding Transformer	A transformer with a primary, secondary and tertiary winding which may be used to connect generation with two different voltage transmission circuits, or with both distribution and transmission circuits, without the use of additional transformers
TP	total phosphorus
Trash Rack	A mechanism, found on a dam or intake structure, which clears the water of debris before the water passes through the structure
TSS	total suspended solids
Turbine	A machine that converts the energy of a stream of water into the mechanical energy of rotation. This energy is then used to turn an electrical generator or other device. Also called a "water wheel"
U	
USBIA	U.S. Department of Interior, Bureau of Indian Affairs
USBLM	U.S. Department of Interior, Bureau of Land Management
USBR	U.S. Department of Interior, Bureau of Reclamation
USC	United States Code
USCOE	U.S. Department of Defense, Army Corps of Engineers
USDA	U.S. Department of Agriculture

Term	*Definition*
USDI	U.S. Department of Interior
USEPA	U. S. Environmental Protection Agency
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Department of Interior, Fish and Wildlife Service
USGS	U.S. Department of Interior, Geological Survey
V	
V	Volts
VES	Visual Encounter Serveys
VQO	Visual Quality Objectives, a USFS System
VQI	Visual Quality Index, a USFS System
W	
W	Watts
WHR	California Wildlife Habitat Relationships Database
WUA	Weighted usable area
X	
Y	
YOY	young-of-the-year
Z	
ZPE	Zone of Potential Effect. Physical area in which the Project has a potential for influence on resources. May be different for each resource area

KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR FIRST STAGE OF CONSULTATION

2. PROJECT MAPS

18 CFR § 16.8 (b) First stage consultation.

(1) A potential applicant must provide each of the appropriate resource agencies and Indian tribes, listed in paragraph (a)(1) of this section, and the Commission with the following information:

(i) Detailed maps showing existing Project boundaries, if any, proper land descriptions of the entire Project Area by township, range, and section, as well as by state, county, river, river mile, and closest town, and also showing the specific location of all existing and proposed Project facilities, including roads, transmission lines, and any other appurtenant facilities;

KILARC-COW CREEK PROJECT
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REQUIREMENTS FOR FIRST STAGE OF CONSULTATION

2.0 PROJECT MAPS

MAP	DESCRIPTION
J	General Map
K-1	Conduits to Kilarc Powerhouse
K-1A	Tables for Canals, Etc. Shown on K-1
K-2	Conduits for Cow Creek Powerhouse
L-1	Details North Canyon Creek & South Canyon Creek Canyons
L-2	Details Kilarc Main Canal
L-3	Details Kilarc Forebay
L-4	Profile of Kilarc Penstock
L-5	Plan and Sections – Kilarc Powerhouse
L-6	Details Mill Creek, South Cow Creek, South Cow Creek Main Canals
L-7	Details of Cow Creek Forebay
L-8	Profile of Cow Creek Penstock
L-9	Plan and Sections – Cow Creek Powerhouse
R-1	General Plan for Recreational Use
R-2	Plan for Recreation Use and Kilarc Forebay
S	Details of Fish Ladder, South Cow Creek Dam

The above K and L drawings have been removed pursuant to the intent of the FERC's Docket No. RM02-4, "Rules Regulating Critical Energy Infrastructure Information" (CEII). As FERC explains in its January 16, 2002 "Notice of Inquiry and Guidance for Filings in the Interim: ("January 16 NOI"), under this docket FERC is now "considering whether to revise its rules to address public availability of [CEII]", due to "the need to protect the safety and well-being of American citizens from attacks on our nation's energy infrastructure [that may arise from] easy public access [to CEII]."

FERC has not yet issued revised rules pursuant to Docket No. RM02-4. The Licensee will comply with the revised rules with respect to the removed documents, when such revised rules are issued by FERC.

In the interim, the removed documents may be reviewed by contacting the Licensee's Project Manager at (415) 973-6915. Persons wishing to view or copy the removed documents may be asked to first sign a non-disclosure agreement restricting their use of the documents.

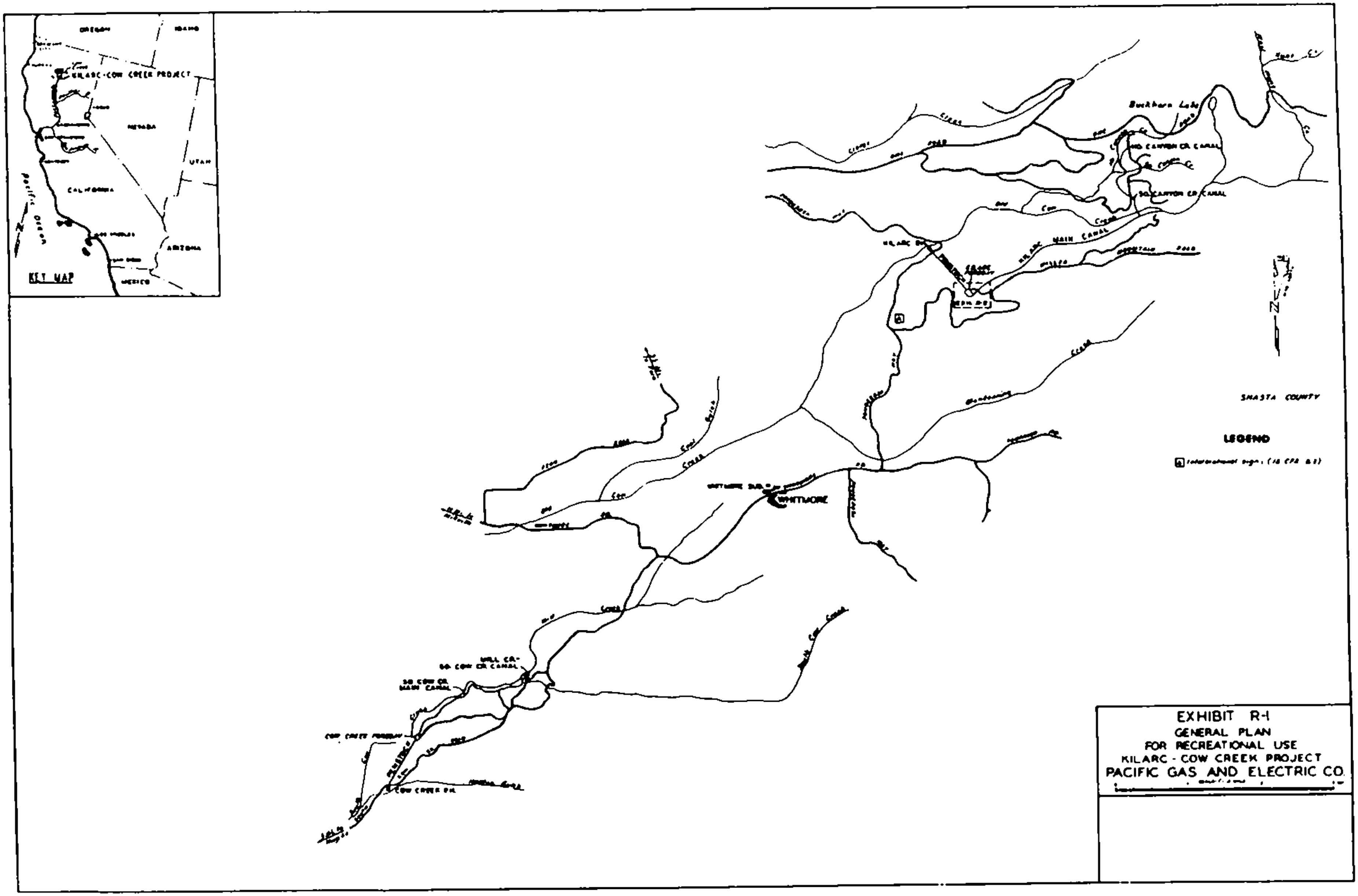

Figure 2-1. Exhibit R-1, General Plan for Recreational Use.

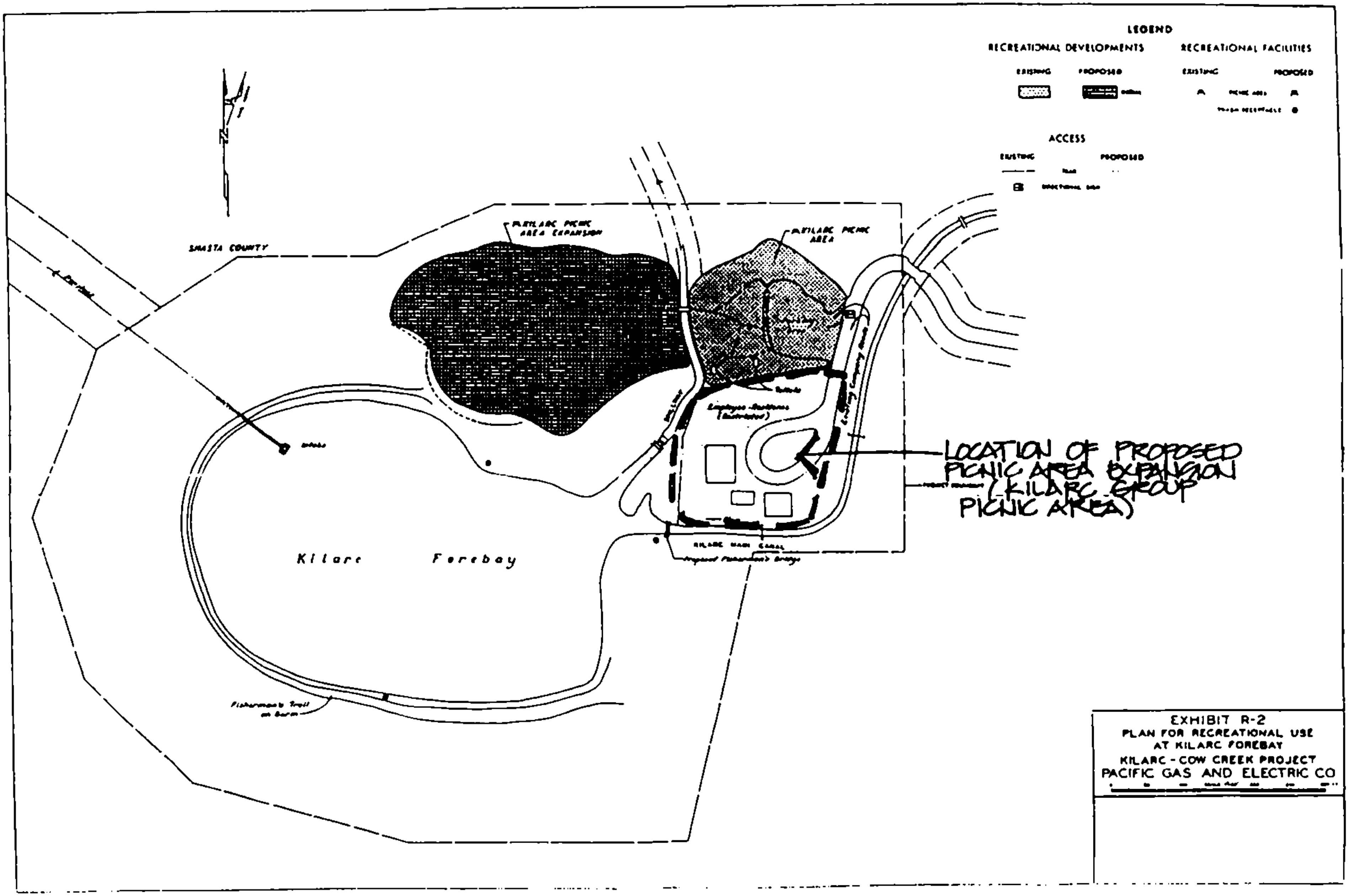

Figure 2-2. Exhibit R-2, Plan for Recreational Use at Kilarc Forebay.

KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR FIRST STAGE OF CONSULTATION

3.0 GENERAL ENGINEERING DESIGN

18 CFR § 16.8 (b) First stage consultation.

(1) A potential applicant must provide each of the appropriate resource agencies and Indian tribes, listed in paragraph (a)(1) of this section, and the Commission with the following information:

(ii) A general engineering design of the existing Project and any proposed changes with a description of any existing or proposed diversion of a stream through a canal or a penstock;

KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR
FIRST STAGE OF CONSULTATION

3.0 PROJECT DESCRIPTIONS AND SUMMARY OF OPERATIONAL MODES

3.1 KILARC-COW CREEK PROJECT

The Project is located in Shasta County, California, approximately 30 mi east of the City of Redding and near the rural community of Whitmore. The Project's two powerhouses, Kilarc and Cow Creek, are supplied with water diverted from North and South Canyon Creeks, Old Cow Creek, Mill Creek, and South Cow Creek. Water for power generation is diverted by a canal system from these creeks and delivered into the Forebays at the head of the penstocks of the two powerhouses.

The Project is located in two separate drainage areas, Old Cow Creek (Kilarc Powerhouse) and South Cow Creek (Cow Creek Powerhouse). Accordingly, two study areas were designated for the purpose of describing Project components and the affected environment, summarizing existing and proposed operations, and identifying potential impacts related to the existing Project.

A total of 187.13 acres of land exists within the Project boundary lines. Of this total, 18.86 acres are patented lands subject to Section 24 of the Federal Power Act (FPA), 117.36 acres are Licensee-owned lands, and 50.91 acres are privately-owned lands, for which the Licensee has acquired all of the necessary Project-related rights.

A list of Project facilities is provided in Table 3-1. Table 3-2, Kilarc-Cow Fact Sheet, provides technical information on the Project, which is summarized below.

3.2 KILARC FACILITIES

3.2.1 Project Description

The Old Cow Creek Watershed encompasses approximately 80 square miles (sq. mi.), with 25 sq. mi. located above the Kilarc Diversion Dam. The average yearly runoff at the dam is 48,900 acre-feet (af) with about 55 percent diverted to the Kilarc Powerhouse. The estimated dependable capacity of the Kilarc Powerhouse is about 1.2 megawatt (MW) and the average annual energy generated is 19.1 million kilowatt hours (kwh).[1]

Key Project components include:

- North Canyon Creek Diversion Dam and Canal
- South Canyon Creek Diversion Dam and Canal
- Canyon Creek Siphon
- Kilarc Main Canal Diversion Dam and Main Canal
- Kilarc Forebay Dam
- Kilarc Forebay, Penstock and Powerhouse

The location of Project facilities is shown in Exhibit J. The North Canyon Creek Canal diverts water from North Canyon Creek into South Canyon Creek. The water from South Canyon Creek is diverted into South Canyon Creek Canal, which then enters Canyon Creek Siphon and then into the Kilarc Main Canal. Water from Old Cow Creek is also diverted into the Kilarc Main Canal, which then flows into the Kilarc Forebay. From the Kilarc Forebay, water flows through the penstock to the Kilarc Powerhouse and then back to Old Cow Creek. A general description of the key Project components follows.

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[1] Based on 25 year historic operation (1977 to 2001).

North Canyon Creek Diversion Dam

Water is diverted from North Canyon Creek into the North Canyon Creek Canal at the North Canyon Creek Diversion Dam. The dam is a timber structure, 9.9-ft long, 1-ft high, with a crest elevation of 3,939.5 ft above Mean Sea Level (MSL). The dam was constructed in 1907.

North Canyon Creek Canal

Constructed in 1907, the North Canyon Creek Canal is unlined 3 ft wide by 1.5 ft deep and has a total length of 0.35 mi, with a capacity of 2.5 cubic feet per second (cfs) and an average grade of 0.0021.

South Canyon Creek Diversion Dam

Water is diverted from South Canyon Creek into the South Canyon Creek Canal at the South Canyon Creek Diversion Dam. The dam is a concrete structure, 37.8-ft long and 3-ft high with a crest elevation of 3,893.6 ft above MSL. South Canyon Creek Diversion Dam was constructed in 1907.

South Canyon Creek Canal

Constructed in 1907, the South Canyon Creek Canal has a total length of 0.74 mi with a capacity of 7.5 cfs and an average grade of 0.0021. The conduit consists of 0.71 mi of unlined canal, 4-ft wide by 2-ft deep, and 0.03 mi of flume, 2-ft wide by 1.8-ft deep.

Canyon Creek Siphon

Water from South Canyon Creek Canal flows into Canyon Creek Siphon. The siphon consists of a 0.17 mi 12-in diameter pipe which then coveys the water into the Kilarc Main Canal.

Kilarc Main Canal Diversion Dam

Water is diverted from Old Cow Creek into the Kilarc Main Canal at the Kilarc Diversion Dam. The dam is a concrete structure, 83.0-ft long, 8-ft high with a crest elevation of 3,814.0 ft MSL.

Kilarc Main Canal

Constructed in 1903-1904, the Kilarc Main Canal has a total length of 3.65 mi with a capacity of 52 cfs and an average grade of 0.0021. The conduit consists of 2.03 mi of canal, 1.44 mi of a 5.5-ft by 3-ft flume, and 0 18 mi of a 6 ft by 7 ft tunnel.

Kilarc Forebay Dam

The dam at Kilarc Forebay is earth filled and has a maximum height of 13 ft, a maximum base width of 43 ft, and a crest length of 1,419 ft at 3,782.4 MSL. The spillway is 10.0-ft wide, 3.0-ft deep, and has a rated capacity of 50 cfs with 1.6 ft of freeboard. The intake structure has a 48-in slide gate, with a manual lift, protected by a grizzly, over the opening to the Kilarc Penstock.

Kilarc Forebay

The Kilarc Forebay was constructed in 1903. It has a gross and usable storage capacity of 30.4 af at an elevation of 3,782.4 ft MSL and a surface area of 4.5 acres. During normal operations the water surface elevation varies by approximately 3 ft.

Kilarc Penstock

Constructed in 1903-1904, the Kilarc Penstock is 4,801-ft long. It is made of riveted steel with a diameter that varies from 48 in to 36 in and a plate thickness varying from 0.19 to 0.25 in. The maximum flow capacity is 43 cfs.

Kilarc Powerhouse

The Kilarc Powerhouse is a 65 ft by 40 ft steel frame structure (plan dimensions), constructed in 1903-1904 and composed of rubble masonry walls and a corrugated iron roof. The powerhouse contains two 3,000 HP Pelton single jet horizontal impulse turbines. Each turbine operates at a speed of 300 revolutions per minute (rpm) under a normal maximum gross head of 1,192 ft.

The power plant contains two Westinghouse synchronous generators rated at 1,500 and 1,730 kilowatts (kW), each producing 3-phase, 60-hertz alternating current at 2,200 and

2,300 volts. The plant also contains two solid state, Marathon Electron Series 431OA, 160-amp, 125 DC volt exciters. One 45 kW, 125-volt exciter is direct connected to a 60-HP Westinghouse induction motor; a similar exciter is direct connected to a 60-HP Pelton impulse wheel.

The Project includes a 4,500-kilovolt-amperes (kVA) transformer bank, which steps up voltage from 2,200/2,300 volts to 66,000 volts. The bank consists of one oil-immersed, air-cooled, three-phase, outdoor-type transformer. Each generator (described above) is connected to the 2,200-volt bus through an SF6 (sulfur hexaflouride) circuit breaker and manually-operated disconnect switch. A 60-kilovolt (kV) manually-operated disconnect switch is provided for the outgoing transmission line. The Licensee's interconnected transmission system passes through the powerhouse switchyard via a 70-ft long, 60 kV transmission line tap.

3.2.2 Summary of Existing and Proposed Operational Mode

The Kilarc Powerhouse is operated as a run-of-river facility supplying base-loaded energy to the grid. The powerhouse is designed for semi-automatic operation with float control, and operates unattended with alarms to Pit 3 Powerhouse.

The Kilarc Powerhouse is supplied with water diverted from North and South Canyon Creeks and Old Cow Creek. The amount of water diverted complies with the Licensee's water rights (see Table 3.1-2). Water use is discussed in more detail in Section 4.2. Water is delivered into the Kilarc Forebay at the head of the penstock by a canal system (described in Section 3.2.1). The spillway at Kilarc Forebay is rated for 50 cfs, which is approximately the capacity of the Kilarc Main Canal. Kilarc Forebay has a gross and useable storage capacity of 30.4 af. Normal water level fluctuation is about 1 ft.

Two agricultural diversions exist within the Project boundary, the Murphy Ditch (located near the South Canyon Creek Diversion) and the Grindlay Williams (located in the bypass reach).

The Licensee will continue to operate the Project as it has in the past, with modifications occurring when it is necessary to do maintenance on the Project or in the interest of public safety.

3.2.3 Routine Maintenance Activities

At the Kilarc, South Canyon Creek, and North Canyon Creek diversion structures, routine maintenance consists of manually cleaning the intake trash racks from once a week to daily, depending on debris in the creeks. The slide and radial gates are inspected and lubricated on a monthly basis. The major powerhouse and switchyard equipment is visually inspected on a daily basis.

Annually, the Project is shut down for three to five days during low flow periods of October through December. During the annual shutdown, typical activities include inspection, repair, and preventive maintenance on the generator, turbine, circuit breakers, transformer banks, penstock, and Kilarc Main Canal tunnel. Every year, the Kilarc Main Canal is drained, inspected, and repaired if necessary. Every two years, the tunnel is drained and internally inspected and repaired if necessary.

3.3 COW CREEK FACILITIES

3.3.1 Project Description

The South Fork Cow Creek Watershed encompasses approximately 78 sq. mi., with 53 sq. mi. above the South Cow Creek Diversion Dam. The average yearly runoff at the dam is 79,500 af, with about 37 percent diverted to the Cow Creek Powerhouse. The estimated dependable capacity of the Cow Creek Project is about 400 kW and the estimated average annual energy generated is 12.0 million kwh.[2]

Key Project components include:

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[2] Based on 25 year historic operations (1977 to 2001).

- Mill Creek Diversion Dam and Mill Creek-South Cow Creek Canal
- South Cow Creek Diversion Dam and Main Canal
- Cow Creek Forebay Dam
- Cow Creek Forebay, Penstock and Powerhouse

The location of Project facilities is shown in Exhibit J. The Mill Creek-South Cow Creek Canal diverts water from Mill Creek into South Cow Creek. From South Cow Creek, the water is diverted into the South Cow Creek Main Canal and into the Cow Creek Forebay. From Cow Creek Forebay, water flows through the penstock to Cow Creek Powerhouse, into Hooten Gulch, and back into South Cow Creek. A general description of the key Project components follows.

Mill Creek Diversion Dam

Water is diverted from Mill Creek into the Mill Creek-South Cow Creek Canal at the Mill Creek Diversion Dam. The dam is a concrete structure, 40.3-ft long, 2.5-ft high with a crest elevation of 1,575.8 ft above MSL.

Mill Creek-South Cow Creek Canal

Constructed in 1907, the Mill Creek-South Cow Creek Canal is unlined 5-ft by 3.3-ft cross section and has a total length of 0.17 mi, with a capacity of 10 cfs and an average grade of 0.0021.

South Cow Creek Diversion Dam

Water is diverted from South Cow Creek into the South Cow Creek Main Canal at the South Cow Creek Diversion Dam. The dam is a concrete capped steel bin wall and rock fill dam, 86.5-ft long, 16-ft high with a crest elevation of 1,561.4 ft above MSL.

South Cow Creek Main Canal

Constructed in 1907, the South Cow Creek Main Canal has a total length of 2.06 mi with a capacity of 50 cfs and an average grade of 0.0015. The conduit consists of 2.02 mi of 13 feet by 4.8-ft deep canal and 0.04 mi of 6 ft by 6.8 ft tunnel.

Cow Creek Forebay Dam

The dam is earth-filled and has a maximum height of 16 ft, a maximum base of 54 ft, and a crest length of 653 ft at an elevation of 1,538.9 ft above MSL. The spillway is 49.7 ft wide, 1.7 ft deep, and has a rated capacity of 50 cfs with 1.2 ft of freeboard. The intake structure has a 42-in slide gate, hydraulically operated and protected by a grizzly.

Cow Creek Forebay

Cow Creek Forebay was built in 1907, has a gross and useable storage capacity of 5.4 af at an elevation of 1,537.2 ft above MSL and a surface area of 1.0 acre. During normal operations the water surface elevation varies by approximately 1 foot.

Cow Creek Penstock

The Cow Creek Penstock is 4,487 ft long and was built in 1907. Beginning at the upstream end, the first 15 ft of the penstock consists of 0.19-in thick steel pipe, with a diameter that tapers from 42 to 36 in. The next 766 ft consists of 36-in diameter, 0.5-in welded steel pipe. The final 3,706 ft is made of riveted steel with a 30-inch diameter and plate thickness that varies from 3/16 to 7/16 in and includes a short, tapered section.

Cow Creek Powerhouse

The Cow Creek Powerhouse is a approximately 53.5 ft by 35 ft steel truss structure (plan dimensions), constructed in 1907 and composed of cut-stone walls and a corrugated iron roof. The powerhouse contains two 1,500 HP Pelton single jet overhung impulse turbines. Each turbine operates at a speed of 400 rpm under a design gross head of 715 ft.

The power plant contains two 900 kVA General Electric synchronous generators, at 0.8 power factor each producing 3-phase, 60-hertz alternating current at 2,300 volts. One 40 kW, 125-volt belt-driven exciter is connected to each of the generators.

The Project includes a single 2,000 kVA transformer which steps up the voltage output to 66,000 volts. The transformer is a 3-phase, oil-immersed, self-cooled, outdoor unit. Each generator (described above) is connected to the 2,300-volt bus through an air-circuit breaker (ACB) and manually operated disconnect switch. A 60-kV OCB and a 60-kV disconnect switch are provided for the outgoing transmission line. The Licensee's interconnected transmission system passes through the powerhouse switchyard via a 70-ft long, 60-kV transmission tap line.

3.3.2 Summary of Existing and Proposed Operational Mode

The Cow Creek Powerhouse is operated as a run-of-river facility supplying base-loaded energy to the grid. The powerhouse is designed for semi-automatic operation, with float control and operates unattended, with alarms to Pit 3 Powerhouse.

The Cow Creek Powerhouse is supplied with water diverted from Mill Creek and South Cow Creek. The amount of water diverted complies with Licensee's water rights (see Table 3-3). Water use is discussed in more detail in Section 4.2. Water is delivered into the Cow Creek Forebay at the head of the penstock by a canal system (described in Section 3.3.1). The spillway at Cow Creek Forebay is rated for 50 cfs, which is approximately the capacity of the South Cow Creek Main Canal. Cow Creek Forebay has a gross and useable storage capacity of 5.4 af. Normal water level fluctuation is about 1 ft.

Two agricultural diversions exist within the South Cow Creek Project boundary, the Wagoner Ditch (in the diverted reach) and the Abbott Diversion (immediately below the Cow Creek Powerhouse). A mini-hydro diversion also exists within the Project boundary, which diverts water from the tailrace in Hooten Gulch.

The Licensee will continue to operate the Project as it has in the past, with modifications occurring when it is necessary to do maintenance on the Project or in the interest of public safety.

3.3.3 Routine Maintenance Activities

At the Mill Creek and South Cow Creek diversion structures, routine maintenance consists of manually cleaning the intake trash racks from once a week to daily, depending on debris in the river. The slide and radial gates are inspected and lubricated on a monthly basis. The major powerhouse and switchyard equipment is visually inspected on a daily basis.

Annually, the Project is shut down for 3 to 5 days during low flow periods, October through December. During the annual shutdown, typical activities include inspection, repair and preventive maintenance on the generator, turbine, circuit breakers, transformer banks, penstock, and South Cow Creek Main Canal tunnel. Every year, the canal is drained, inspected, and repaired if necessary. Every 2 years, the tunnel is drained and internally inspected and repaired if necessary.

Table 3-1. Project Facilities

KILARC DEVELOPMENT
North Canyon Creek Diversion Dam
South Canyon Creek Diversion Dam
Kilarc Main Canal Diversion Dam
Kilarc Forebay Dam
North Canyon Creek Canal
South Canyon Creek Canal
Canyon Creek Siphon
Kilarc Main Canal Diversion Dam
Kilarc Forebay
Spillway (4)
Kilarc Penstock
Kilarc Powerhouse
Kilarc Turbines (2)
Kilarc Generators (2)
Kilarc Transformer
COW CREEK DEVELOPMENT
Mill Creek Diversion Dam
South Cow Creek Diversion Dam
Cow Creek Forebay Dam
Mill Creek – South Cow Creek Canal
Cow Creek Forebay
Spillways (4)
Cow Creek Penstock
Cow Creek Powerhouse
Cow Creek Turbines (2)
Cow Creek Generators (2)
Cow Creek Transformer

KILARC-COW CREEK PROJECT
FERC No. 606

Table 3-2. Fact Sheet

GENERAL INFORMATION	
Owner and Operator	Pacific Gas and Electric Company
FERC Project Number	606
Current License Term	February 1, 1980 to March 27, 2007
Commenced Commercial	Kilarc in 1904 and Cow Creek in 1907
Counties	Shasta
Watershed	Old Cow Creek and South Cow Creek
Federal Lands	18.86 acres
Non-Federal Lands	168.27 acres
Installed capacity	less than 5 MW

KILARC DEVELOPMENT

Dams	
North Canyon Creek Diversion Dam	diverts water from North Canyon Creek into the North Canyon Canal, then flows into South Canyon Creek Canal
Construction Date	1907
Hazard Classification	Low
Type	Timber
Height	1 ft
Crest Elevation	3,939.5 ft (USGS)
Crest Width	
Crest Length	9.9 ft
Minimum Flow Requirements	none
South Canyon Creek Diversion Dam	diverts water from South Canyon Creek into South Canyon Creek Canal, then flows into Kilarc Main Canal

Table 3-2 Fact Sheet (continued).

Construction Date	1907
Hazard Classification	low
Type	concrete
Height	3 ft
Crest Elevation	3,893.6 ft (USGS)
Crest Length	37.8 ft
Minimum Flow Requirements	none
Kilarc Main Canal Diversion Dam	diverts water from Old Cow Creek into Kilarc Main Canal
Construction Date	completed in 1904
Hazard Classification	low
Type	concrete
Height	8 ft
Crest Elevation	3,814 ft USGS
Crest Length	83.0 ft
Minimum Flow Requirements	2 cfs
Kilarc Forebay Dam	
Construction Date	1903
Type	earthfill
Height	13 ft
Crest Elevation	3,785.4 ft (USGS)
Crest Width	43 ft
Crest Length	1.419 ft
Minimum Flow Requirements	none
Canals	**Total length 4.7 mi**
North Canyon Creek Canal	unlined 0.35 mi, capacity of 2.5 cfs
South Canyon Creek Canal	0.74 mile, capacity of 7.5 cfs (.71 miles unlined, and 0.03 miles of flume)

Table 3-2 Fact Sheet (continued).

Canyon Creek Siphon	0.17 mi pipe
Kilarc Main Canal	3.65 mi, capacity of 52 cfs (2.03 mi of canal, 1.44 mi of flume, and 0.18 mi of wood lined tunnel)
Kilarc Forebay	
Normal Maximum Water Surface	3,782.4 ft
Normal Minimum Water Surface	3,781.8 ft
Drainage Area	none
Gross Storage	30.4 af
Usable Storage	30.4 af
Surface Area at Maximum Water Surface	4.5 acres
Traskrake	automated
Intake	intake structure has a 48-in slide gate, manual lift, protected by a grizzly, over the opening to the Kilarc Penstock
Spillways (4)	
Spillway 1	Along the Kilarc Main Canal
Spillway 2	Along the Kilarc Main Canal
Spillway 3	Along the Kilarc Main Canal
Spillway at forebay	10-ft wide, 3.0-ft deep, rated capacity of 50 cfs with 1.6 ft of free board
Kilarc Penstock	
Type	riveted steel
Construction Date	1904
Size	48 in to 36 in
Thickness	min. 1/4 in to 13/16 in
Length	4,801 ft
Maximum Flow Capacity	43 cfs

Table 3-2 Fact Sheet (continued).

Kilarc Powerhouse	
Location	N.W. ¼, Sec 33, T.33N., R.1E., M.D.B. & M P.O. Address: Whitmore.
Date of Commission	Unit No. 1 - 10/1903, Unit No. 2 - 5/1904
Structure	steel frame with rubble masonry walls and corrugated iron roof
Type	single story
Construction Material	steel and rock
Approximate size	65 ft x 40 ft
Nearby Special Areas	
Kilarc Turbines (2)	
Make	Pelton Company
Type	single jet horizontal impulse turbine
Rated HP each	3,000
Total HP	6,000
RPM	300
Normal Max. Gross Head	1,192 ft
Kilarc Generators (2)	
Make	Westinghouse
Type	horizontal indoor
Rating of Units	Unit No. 1 - 1,500 kW Unit No. 2 - 1,730 kW
Installed Capacity	3,230 kW
Bus Voltage	2.2 kV & 2.3 kV

Table 3-2 Fact Sheet (continued).

Exciter Volts	two solid state, Marathon Electron Series 431OA, 160 amp125 DC volt exicters
Exciter KW	
Exciter R.P.M.	
Kilarc Transformer	
Make and Type	Kuhlman Electric Co., 3 phase
KVA Capacity Each	4,000
KVA Capacity Total	4,000
Maximum H.T. Capacity	66,000 volts
Maximum L.T. Capacity	2,300 volts
Connect to H.T. Line	63,000 volts
Connect to L.T. Line	2,300 volts
Kilarc Transmission Line	
	Kilarc-Deschutes 60 KV Transmission Line, Kilarc Cedar Creek 60kV Transmission Line - NONPROJECT

COW CREEK DEVELOPMENT

Dams	
Mill Creek Diversion Dam	diverts water into Mill Creek-South Cow Creek Canal, then flows into South Cow Creek
Location	300 ft upstream for confluence of Mill Creek
Construction Date	1907
Hazard Classification	low
Type	concrete
Height	2.5 ft
Crest Elevation	1,575.8
Crest Width	40.3 ft
Minimum Flow Requirements	none

Table 3-2 Fact Sheet (continued).

South Cow Creek Diversion Dam	diverts water from South Cow Creek into South Cow Creek Main Canal, then flows into South Cow Creek Forebay
Construction Date	1907
Hazard Classification	low
Type	concrete capped steel bin wall
Height	16 ft
Crest Elevation	1,561.4
Crest Length	86.5
Minimum Flow Requirements	4 cfs, or 2 cfs in dry years
Fishways measures	fish screen and ladder
Cow Creek Forebay Dam	
Location	T.32, R.1W, S.31
Construction Date	1907
Hazard Classification	low
Type	earthfill
Height	16 ft
Crest Elevation	1538.9
Crest Width	6 ft
Crest Length	653 ft
Minimum Flow Requirements	none
Canals	total length is 2.1 mi
Mill Creek - South Cow Creek Canal	0.17 mi with a capacity of 10 cfs
South Cow Creek Main Canal	2.06 mi (2.02 mi of canal and 0.04 mi of tunnel) with a capacity of 50 cfs
Cow Creek Forebay	
Normal Maximum Water Surface	1537.2 ft

Table 3-2 Fact Sheet (continued).

Normal Minimum Water Surface	1536.4 ft
Drainage Area	none
Gross Storage	5.4 af
Usable Storage	5.4 af
Surface Area at Maximum Water Surface	1 acre
Length	653 ft
Maximum Width	54 ft
Traskrake	automated
Spillways	
Spillway 1	Along South Cow Main Canal
Spillway 2	Along South Cow Main Canal
Spillway 3	Along South Cow Main Canal
Spillway 4 (nearest forebay)	49.7 ft wide, 1.7 ft deep, rated capacity of 50 cfs, 1.2 ft of free board
Cow Creek Penstock	
Type	Two parts: 1) riveted steel and 2) wielded steel
Construction Date	
Size	riveted steel – 30 in and welded steel 36 in
Thickness	riveted steel min - 3/16 in, max 7/16 in, welded steel – 1/2 in
Length	riveted steel - 3,721 ft and welded steel – 766 ft
Maximum Flow Capacity	50 cfs
Closest downstream facility	
Cow Creek Powerhouse	
Location	S.E. 1/4, Sec. 6, T.31N., R.1W., M.D.B. & M. P.O. Address: Millville
Date of Commission	1907

Table 3-2 Fact Sheet (continued).

Structure	cut stone walls, corrugated iron roof on steel trusses
Type	single story
Construction Material	ut stone
Approximate size	53 in 5 ft x 35 ft
Nearby Special Areas	
Cow Creek Turbines (2)	
Make	Pelton Company
Type	single jet overhung impulse turbine
Rated HP each	1,500
Total HP	3,000
RPM	400
Normal Max. Gross Head	715 ft
Cow Creek Generators (2)	
Make	General Electric Company
Type	horizontal indoor
Rating of Units	900 KVA at 0.80 power factor
Installed Capacity	1,400 kW
Bus Voltage	2.3 kV
Exciter Volts	125
Exciter kW	40
Exciter R.P.M.	1,150
Cow Creek Transformer	
Make and Type	Wagner, 3-phase
kVA Capacity Each	2,000
kVA Capacity Total	2,000

Table 3-2 Fact Sheet (continued).

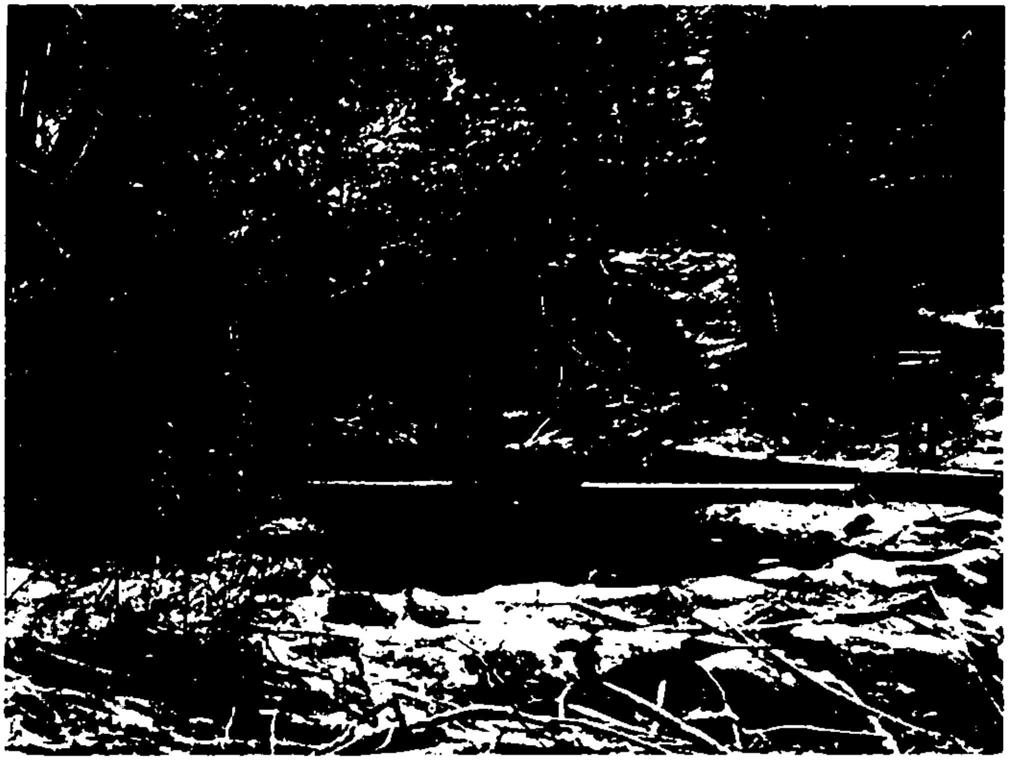
Maximum H.T. Capacity	70,600 volts
Maximum L.T. Capacity	2,400 volts
Connect to H.T. Line	68,800 voltsYG
Connect to L.T. Line	2,400 volts
Cow Creek Transmission Line	
	Kilarc - Redding 60 KV Transmission Line, extending 70 ft to PG&E's interconnected transmission system. NONPROJECT

3.3.4 Photographic Tour

This section presents a photographic introduction to the Project Area. The accompanying photographs show the primary Project facilities.

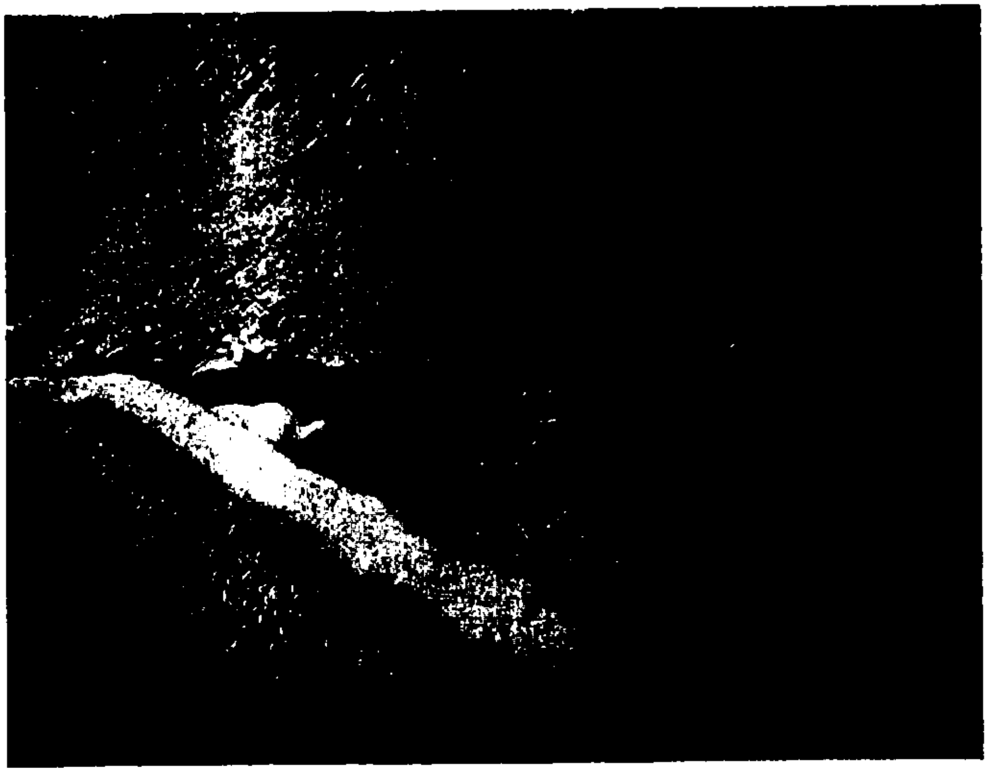
NORTH CANYON CREEK DIVERSION

NORTH CANYON CREEK CANAL



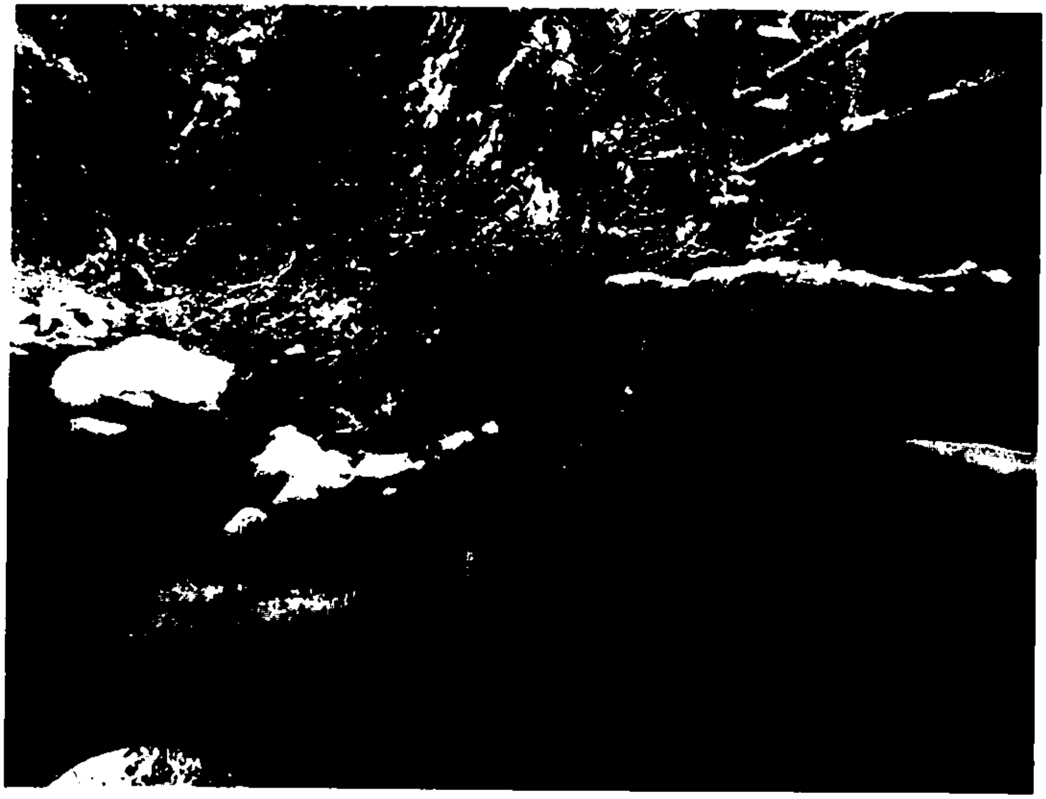
SOUTH CANYON CREEK DIVERSION

SOUTH CANYON CREEK CANAL

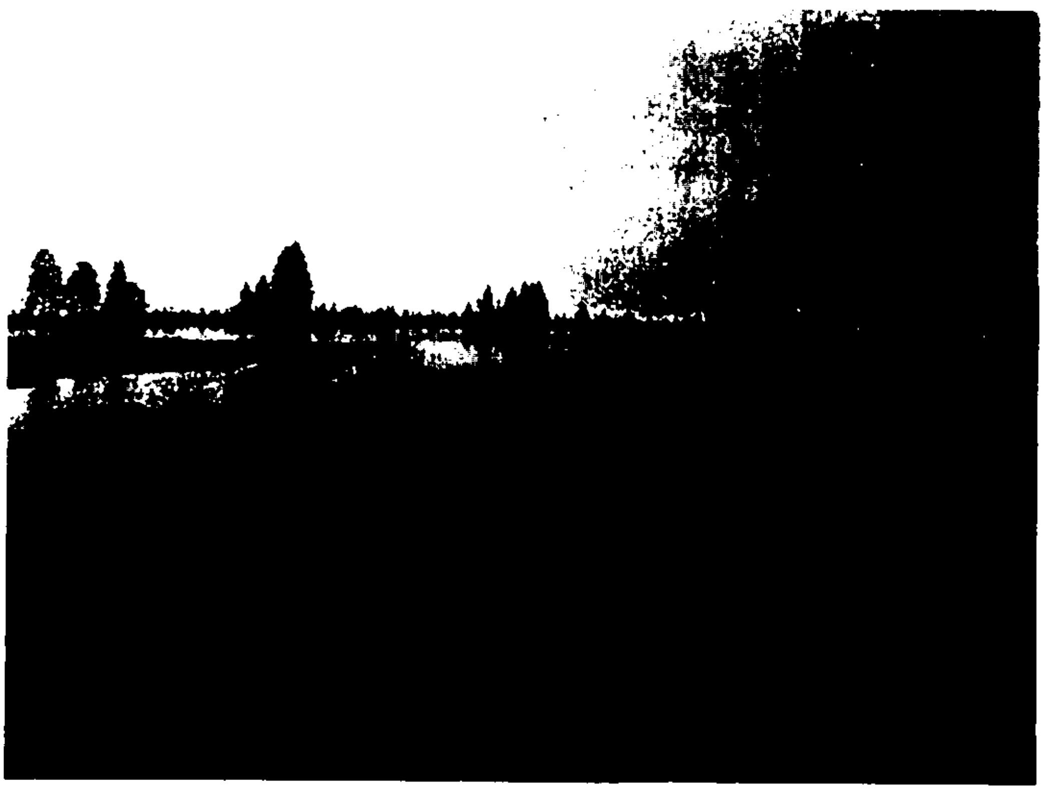


KILARC MAIN DIVERSION DAM

KILARC MAIN CANAL



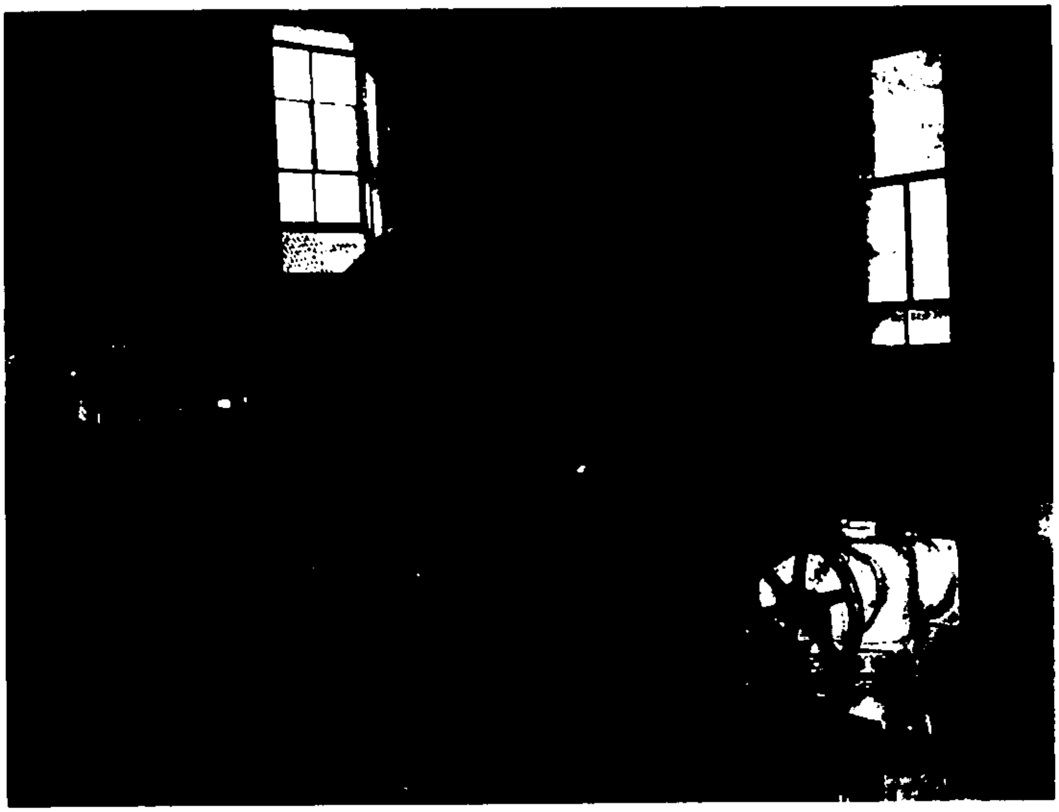
KILARC MAIN DIVERSION BYPASS FLOW



KILARC FOREBAY

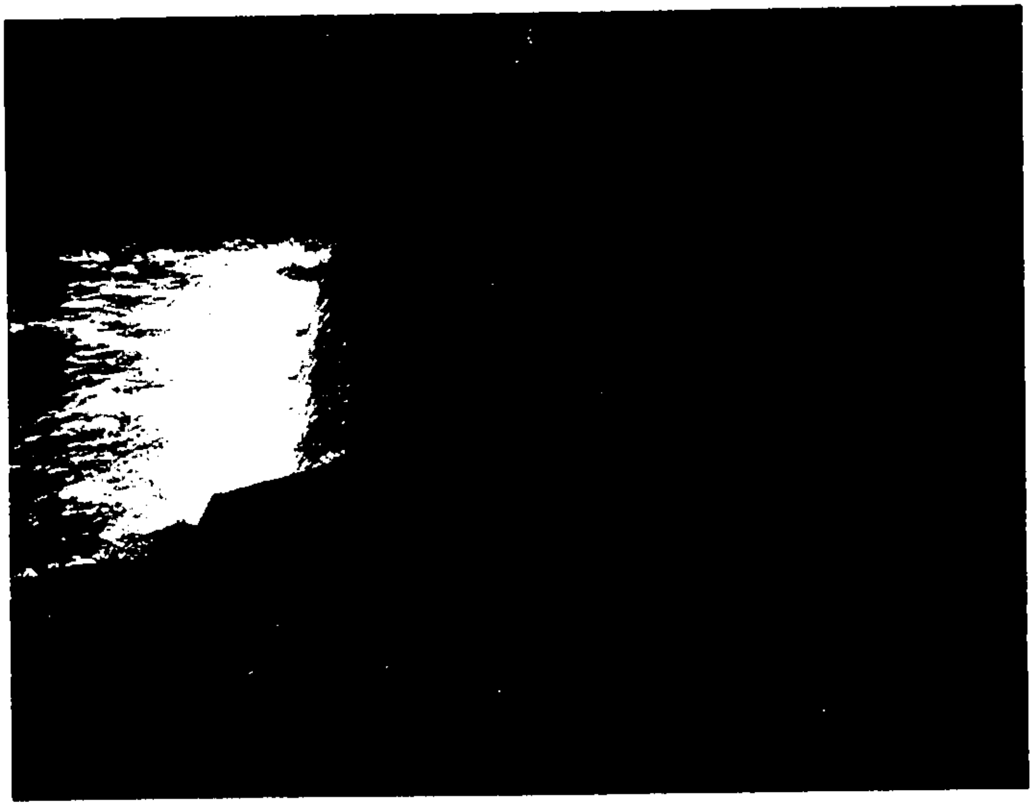
PICNIC AREA AT KILARC FOREBAY

KILARC POWERHOUSE

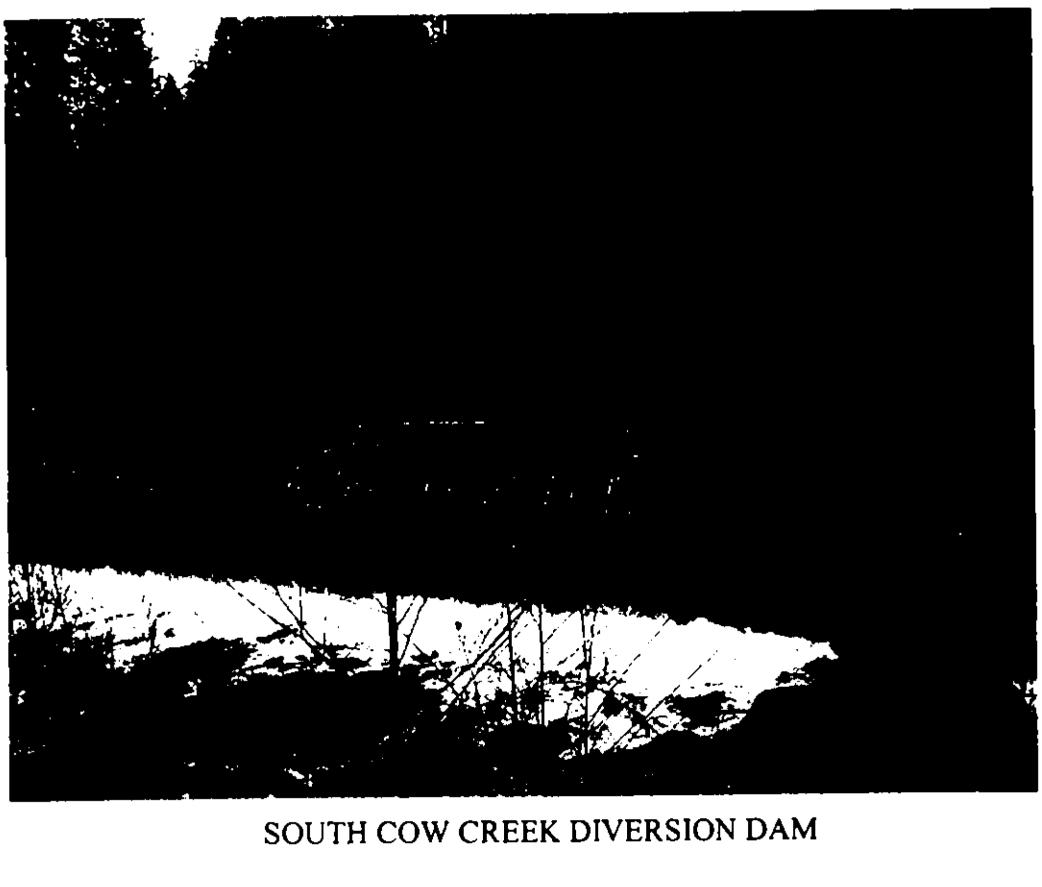


KILARC POWERHOUSE

KILARC TAILRACE



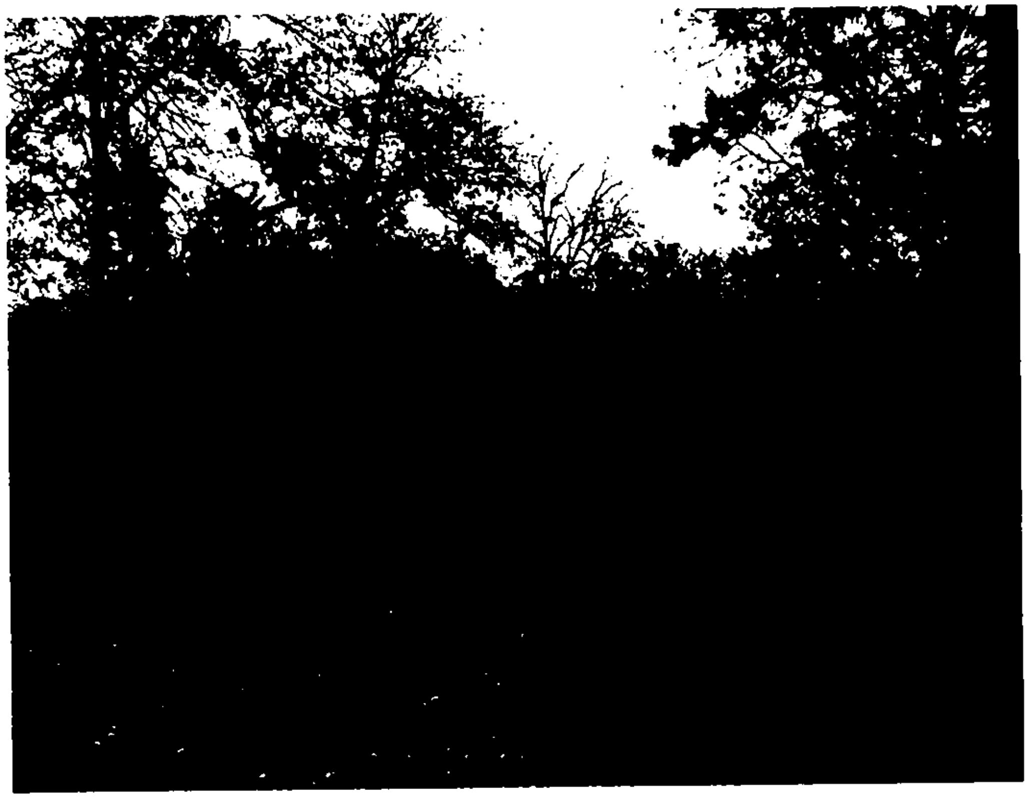
MILL CREEK DIVERSION DAM



SOUTH COW CREEK DIVERSION DAM

SOUTH COW CREEK FISH LADDER

SOUTH COW CREEK FISH SCREEN



SOUTH COW CREEK MAIN CANAL

COW FOREBAY

COW CREEK POWERHOUSE

COW CREEK POWERHOUSE OUTFLOW

KILARC-COW CREEK PROJECT

FERC NO.606

REQUIREMENTS FOR FIRST STAGE OF CONSULTATION

4.0 AFFECTED ENVIRONMENT

18 CFR § 16.8 (b) First stage consultation.

(1) A potential applicant must provide each of the appropriate resource agencies and Indian tribes, listed in paragraph (a)(1) of this section, and the Commission with the following information:

(iv) Identification of the environment affected or to be affected, the significant resources present and the applicant's existing and proposed environmental protection, mitigation, and enhancement plans, to the extent known at that time;

KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR FIRST STAGE OF CONSULTATION

4.0 ENVIRONMENTAL IMPACTS

4.1 Environmental Setting

4.1.1 Location

The Project is located in Shasta County in Northern California, approximately 30 mi east of the City of Redding and near the rural communities of Whitmore and Millville. The Project Area is located at the boundary of the Great Valley and Cascade Range geomorphic provinces and encompasses the Old Cow Creek and South Cow Creek Watersheds.

The Old Cow Creek and South Cow Creek Watersheds drain an approximate area of 158 sq. mi. in the foothills at the southern end of the Cascade Mountain Range. Figure 4.1-1 presents the general location of the watershed. The South Cow Creek Project Area is primarily foothill oak and brush with low quality commercial forests at the higher elevations. The Old Cow Creek Project Area is primarily commercial forest with scattered grazing lands.

4.1.2 Climate and Weather

The Project Area is located in the northern portion of the Sacramento drainage climatic region. The primary influence on climate in this region is the semi-permanent, high-pressure system known as the Pacific High weather system, which causes summer months to be dry, except for occasional thunderstorms. The Pacific High moves northward during the summer and tends to prevent storms from moving across California. During the winter, the Pacific High migrates southward, permitting storm centers to move into and across California. Temperatures in the Project Area vary from cold to relatively mild in winter and hot in summer.

Summer temperatures in excess of 100 degrees Fahrenheit (°F) are not uncommon. Annual precipitation in the region increases with elevation and ranges between 16 and 80 in, with an annual average of about 40 in. January is generally the wettest month and July is the driest. Thunderstorms normally occur during the summer season.

During the winter months, precipitation at Kilarc Forebay usually falls as snow, which normally persists until March. The average annual precipitation in the vicinity of Kilarc Forebay is 43.12 in and the average annual temperature is 59.3° F. The average maximum temperature during July (the warmest month of the year) is 94° F and the average minimum temperature during January (the coldest month of the year) is 34° F.

At Cow Creek Forebay, rain is the principal form of precipitation. The average annual precipitation for the Cow Creek Project vicinity is 38.74 in. The average maximum temperature during July is 97° F and the average minimum during January is 37.7° F.

4.1.3 Topography

The elevation within the Project Area ranges from about 820 ft above MSL at the Cow Creek Powerhouse to 3,940 ft above MSL at the North Canyon Creek Diversion. The topography varies from gently rolling low hills near the Cow Creek Powerhouse to steep, narrow canyons in the upper Old Cow and Canyon Creek Watersheds.

Old Cow Creek occupies a narrow, steep-gradient channel within a steep-walled canyon. The Kilarc Main Canal follows the upper part of the canyon to the Kilarc Forebay. The Kilarc Forebay is situated on a flat plateau at the west end of a spur from Miller Mountain. The Kilarc Powerhouse is situated on a terrace above the streambed of Old Cow Creek.

South Cow Creek occupies an incised, low- to moderate-gradient channel. The terrain surrounding South Cow Creek consists of broad plateaus and rolling hill slopes. The Cow Creek Main Canal flows to the Cow Creek Forebay, which is sited on the flat crest of a southwest-trending ridge capped with volcanic rocks. The Cow Creek Powerhouse, located on Hooten

Gulch, is sited on fairly level ground in a gently-dissected alluvial valley at the junction of several small tributaries.

4.1.4 Vegetative Cover

The Kilarc Powerhouse and Forebay are situated in the transition life zone of California. A mixed conifer forest comprised of ponderosa pine, Douglas fir, incense cedar, and California black oak is typical of this zone and is the predominate vegetative association at Kilarc Forebay.

Cow Creek Powerhouse and Forebay are located in the upper-Sonoran life zone of the foothills, which abut California's Great Valley. The oak-grey pine association at Cow Creek Forebay has a sparse and scattered overstory.

4.1.5 Land Development

The Project is located in Shasta County, approximately 30 mi east of the City of Redding and near the rural communities of Millville and Whitmore. The economy of Shasta County is based primarily on timber production, hydroelectric power generation, and tourism. In general, the two watersheds that encompass the Project contain privately-owned grazing lands and private-and state-owned timberlands. Several small ranches are located in the vicinity of the Project. Of the total 187.13 acres within the Project boundary, 18.86 acres are patented lands subject to Section 24 of the Federal Power Act, 117.36 acres are Licensee-owned lands, and 50.91 acres are privately owned, for which the Licensee has acquired all of the necessary Project-related rights.

Land uses in the lower South Cow Creek Watershed consist primarily of grazing and rural residential, with some timber, wildlife habitat, and recreation resource management. Land in the upper South Cow Creek Watershed is primarily State-owned forest that is managed for timber harvest. Land in the immediate vicinity of the Cow Creek Powerhouse and associated facilities is primarily used for cattle grazing, with some smaller portions in private timber, and rural residential.

The Old Cow Creek Watershed consists of lands utilized for cattle grazing (private), management of wildlife habitat and recreation resources (State), and timber harvest (State and private). Lands in the immediate vicinity of the Kilarc Powerhouse and associated facilities are primarily managed for timber harvest, with some smaller portions used for cattle grazing.

4.1.6 Population Size and Density

The 2000 Census reported a population of 163,256 in Shasta County (U.S. Census Bureau). The average population density within Shasta County is 42.4 residents per sq. mi. The largest city in Shasta County is Redding with a population of 80,865 residents (2000 Census), and the next largest are Anderson City (9,022 residents) and Shasta Lake City (9,008 residents), with the remaining population located in small rural communities.

The rural community of Whitmore is located approximately midway between the two Project Study Areas. The Whitmore area had an estimated population of 824 in the 2000 Census. The rural community of Millville is approximately 12 mi west of the Cow Creek Powerhouse and had an estimated population of 610 in the 2000 Census. Another 6 mi to the west is the town of Palo Cedro, with an estimated population of 1,247.

4.1.7 Floodplains

Floodplains throughout most of the Project Area are quite narrow. In the Old Cow Creek portion of the Project Area, the creek flows through a V-shaped narrow canyon that does not contain a floodplain. In the South Cow Creek portion of the Project Area, the creek flows through a V-shaped channel but South Cow Creek is more gently incised than the portion of Old Cow Creek in the Project Area.

Flood flows in Old Cow Creek and South Cow Creek occur by a combination of winter rains and spring snowmelt. There are no water storage facilities within Old Cow or South Cow Creeks that provide flood control. The Project has no effect on flood control in the watershed areas because the diversion impoundments are so small. Kilarc Forebay has approximately 5.4 af and the Cow Creek Forebay has approximately 30.4 af in useable-storage capacity, respectively.

LARGE-FORMAT IMAGES

One or more large-format images (over 8 ½" X 11") go here. These images are available in FERRIS at:

For Large-Format(s):

Accession No.: 20030615-0124

Security/Availability:

- ☑ PUBLIC
- ☐ NIP
- ☐ CEII
- ☐ NON-PUBLIC/PRIVILEGED

File Date: 7-1-02 Docket No.: P-606

Parent Accession No.: 20020705-0298

Set No.: 1 of 1

Number of page(s) in set: 3

TRP-G REV.- 4/2003 (yellow)

4.2 Water Use and Quality

4.2.1 Environment Affected by Existing Project

The Kilarc-Cow Creek Project is located in Shasta County near the boundary of two geologic provinces, the Great Valley and the Cascade Range. The Project Area is situated in the foothills and lower mountains of the Cascade Mountain Range and is encompassed by the Old Cow Creek and South Cow Creek Watersheds, which drain an area of 158 sq. mi. Both creeks flow in a southwesterly direction and are important tributaries to Cow Creek, which is a tributary to the Sacramento River. The headwaters of both watersheds originate near the western slopes of Mt. Lassen. The Old Cow Creek headwaters originate near Crater Peak and the South Cow Creek headwaters originate near Latour Butte, both within the Lassen National Forest.

Old Cow Creek and South Cow Creek are located in the Cow Creek hydrologic area (hydrologic unit number 507.3) as identified in the Fourth Edition Water Quality Control Plan (Basin Plan) for the Sacramento River Basin (CRWQB-CVR 1998). The Basin Plan designations for the beneficial uses of the Cow Creek Project waters are irrigation, stock watering, power, contact recreation, other non-contact recreation, cold fresh water habitat, warm and cold water spawning, and wildlife habitat. The Basin Plan also identifies municipal and industrial supply, and canoeing and rafting as potential designated uses. Based on the beneficial uses identified in the Basin Plan, the Cow Creek Project waters are considered cold water fishery habitat.

4.2.2 Existing Water Use

4.2.2.1 Water Rights

The water diversion rights used by the Licensee in the operation of its Kilarc-Cow Creek Project were affirmed by the Cow Creek adjudication, Decree of the Superior Court for Shasta County, California, Number 38577, entered August 25, 1969. Table 3.1-2 summarizes the Licensee's diversion rights.

4.2.2.2 Water Uses

Water is diverted from the springs and creeks of the Cow Creek Watershed to serve agricultural, domestic, and power production needs. Conflicts between water users resulted in the adjudication of water rights on Little Cow Creek in 1932, Oak Run Creek in 1932, Clover Creek in 1937, and the Old Cow/South Cow Creek system in 1969. The adjudication of Little Cow, Oak Run, and Clover Creeks identified 116, 23, and 26 water rights, respectively. The adjudication of water rights on the Old Cow/South Cow Creek system established 116 water rights on these two streams (including Cow Creek below the confluence of South Cow and Old Cow Creeks) (SHN Consulting Engineers & Geologists, Inc. [SHN] 2001).

4.2.2.3 Project Diversions

Licensee diverts water from Old Cow Creek, South Cow Creek, and three tributaries for power generation in the Cow Creek Watershed (Figure 4.2-1). Hydropower use is a non-consumptive use of water because the water is returned to the creek after passing through the generator. The power generation facilities and the diversions have been operational since 1903.

The Project diversions include North Canyon Creek, South Canyon Creek, and the Kilarc Diversion on Old Cow Creek. On South Cow Creek, Licensee diverts water from Mill Creek and South Cow Creek. There are minimum instream flow requirements downstream of the Kilarc diversion and the South Cow Creek diversion.

4.2.2.4 Old Cow Creek System

Kilarc Main Canal

The Kilarc Main Canal diverts water in the upstream reaches of Old Cow Creek and conveys the water to the Kilarc Forebay. From there, the water enters the Kilarc Powerhouse Penstock where it drops approximately 1,192 ft to the powerhouse and then returns to the river. About 3.8 mi of Old Cow Creek are bypassed with this diversion. The diversion is augmented with flow from North Canyon Creek and South Canyon Creek.

Licensee diverts water to the Kilarc Main Canal from Old Cow Creek at a concrete diversion dam. The Kilarc Diversion Dam is 8 ft high and is located in section of creek with a high channel slope and cascading pools. This dam is a run-of-the-river dam; that is, no appreciable amount of water is stored behind it. Water may flow over the dam and continue down Old Cow Creek or be diverted into the Kilarc Main Canal. Water typically flows over the dam during high flow periods, or whenever the creek flow exceeds the canal capacity of 52 cfs.

The canal is on the left bank (facing downstream) of the creek. Water entering the canal is regulated with a radial gate at the head of the canal. About 50 ft downstream of the gate, water is returned to the river through a Cipolletti weir and an overflow weir. The Cipolletti weir maintains the 2-cfs minimum instream flow requirement. The overflow weir prevents the canal from being overcharged. Downstream on the canal, a gage measures the flow that remains in the canal. The flow released back to the creek is monitored and reported by the U.S. Department of Interior, Geological Survey (USGS) as Station No. 11372325. At several locations along the canal, water may be returned to the creek through overflow spillways.

The Kilarc Main Canal empties into the Kilarc Forebay. The forebay regulates water into the penstock and the powerhouse. An overflow spillway is available to return water to Old Cow Creek. Water entering the penstock flows to the powerhouse and through the turbines to generate power or may be bypassed around the turbines.

Along the canal, conveyance losses or runoff accretion may occur. These losses or gains vary seasonally. The average flow of Kilarc Main Canal, measured downstream of the instream flow release, is 32 cfs for water years 1981 through 2001. The diversions from Old Cow Creek to the canal vary throughout the year, reaching a monthly average maximum of 47 cfs in April and an average minimum of 11 cfs in September (Figure 4.2-2). Individual flows have ranged from 0 cfs, when the canal is not in use, to 52 cfs.

The 20 and 80 percentiles show variation in the average monthly flows and the extremes in average monthly flow (Figure 4.2-3). For example, from July to September, 80 percent of the time the monthly diversion exceeds 14 to 20 cfs, while 20 percent of the time the diversion exceeds 26 to 39 cfs. The median period of high diversion rates is March to May. However, 20 percent of the time the primary diversion season extends from December to June (Figure 4.2-3).

Canyon Creek

The Kilarc Main Canal flow is augmented downstream of the canal gage with flow from North and South Canyon Creeks. Water is diverted from North Canyon Creek into an unlined ditch (North Canyon Creek Canal) and conveyed to South Canyon Creek. Here, additional water may be diverted into the ditch (South Canyon Creek Canal) and conveyed to the Kilarc Main Canal. The estimated canal capacity is about 5 cfs (SWRB 1965).

The Canyon Creek diversions are not gaged and therefore, historic flows are unknown.

The North Canyon Creek diversion consists of a small dam that can divert the entire flow of the creek. The water is conveyed to South Canyon Creek where a small dam can divert water to the Canyon Creek Siphon that conveys the water across Old Cow Creek to the Kilarc Main Canal. The Licensee does not divert water from South Canyon Creek unless the flow exceeds the senior water rights downstream on South Canyon Creek.

The Canyon Creek diversions are used during high runoff years to supplement the canal flow.

South Cow Creek System

South Cow Creek

The South Cow Creek Main Canal diverts water just upstream of the confluence with Mill Creek. Several other water uses divert water from South Cow Creek upstream of this diversion. The water is conveyed to South Cow Creek Forebay and then into the penstock to the powerhouse. This diversion bypasses 3.9 mi of South Cow Creek.

Water is diverted into the South Cow Creek Main Canal via a concrete diversion dam. The dam is 16 ft high with a crest length of 86.5 ft. Stream flow at the dam may either flow over the dam or into the South Cow Creek Main Canal. Typically, water flows over the dam when the flow exceeds the canal capacity of 50 cfs.

Water entering the canal may be returned to the creek through a fish ladder at the diversion dam. The remaining flow passes through a fish screen and into the canal. The flow returned to the creek through the ladder is intended to meet the minimum instream flow of 4 cfs (which may be reduced to 2 cfs when the Sacramento River runoff at Bend Bridge is forecasted to be less than 70 percent of normal). The flow released back to the creek is monitored and reported by the USGS as Station No. 11372080.

The flow in the canal empties into the South Cow Creek Forebay. At this point, the water enters the penstock and flows to the powerhouse. The powerhouse releases water to Hooten Gulch, a tributary of South Cow Creek. Flow in Hooten Gulch provides the water supply for the Abbott Ditch. Therefore, without flow through the powerhouse, Abbott Ditch water rights could not be met. Currently, the Licensee schedules powerhouse outages through the powerhouse based upon the Abbott Ditch water needs (Kogut pers. comm.).

The average flow of South Cow Creek Main Canal, measured downstream of the fish ladder, is 32 cfs for water years 1981 through 1997. The diversions from South Cow Creek to the canal vary throughout the year, reaching a monthly average maximum of 53 cfs in February to March and an average minimum of 7 cfs in September (Figure 4.2-4). Individual flows have ranged from 0 cfs, when the canal is not operational, to 55 cfs.

The 20 and 80 percentiles show variation in the average monthly flows and the extremes in average monthly flow (Figure 4.2-5). For example, from July to September, 80 percent of the time the monthly diversion exceeds 5 to 11 cfs, while 20 percent of the time the diversion exceeds 22 to 37 cfs. The median period of high diversion rates is January to May. However, 20 percent of the time the primary diversion season extends from December to June.

Mill Creek

Mill Creek is a tributary to South Cow Creek downstream of the South Cow Creek Diversion Dam. The Licensee diverts water from Mill Creek about 50 yards upstream of its confluence with South Cow Creek. Water is diverted at a 2.5-ft high dam and conveyed through an open ditch (Mill Creek-South Cow Creek Canal) to South Cow Creek at the diversion dam.

The flow in Mill Creek upstream of the diversion consists of the natural flow and water imported from South Cow Creek through German Ditch.

4.2.2.5 Other Water Uses

Agricultural and Domestic

About 5,774 acres were irrigated in South Cow and Old Cow Creeks at the time of the adjudication (SWRB 1969). The California Department of Water Resources (CDWR) periodically measures the amount of irrigated land contained in the watershed to estimate water use. The primary crop in the watershed is irrigated pasture.

Many of the diversions use unlined canals to convey the water from the creek to the place of use. Along the canal, water is lost to evaporation, transpiration by plants, and seepage. Although the fate of the seepage has not been studied, it most likely returns to the creek through the groundwater and therefore is not lost to the system. Canal seepage was estimated in German Ditch to be 1.1 cfs/mi (SWRB 1969).

There are no direct diversions from Old Cow Creek upstream of the Kilarc Diversion Dam or between the diversion and the powerhouse, where the flow is returned to the creek. There are several water rights on Old Cow Creek downstream of the powerhouse.

There are several diversions from South Cow Creek upstream of the South Cow Creek Diversion Dam (Table 4.2-1). Licensee has water rights at the terminus of the German Ditch for diversion to Mill Creek. However, in recent years water has not been available at the end of German Ditch for this diversion (Kogut pers. comm.).

The Wagoner Ditch diverts water from South Cow Creek upstream of Hooten Gulch and is the only water right between the South Cow Creek Diversion Dam and the return flow from the powerhouse.

Abbott Ditch diverts water from Hooten Gulch downstream of the South Cow Creek Powerhouse. The diversion depends on flow originating from the powerhouse except when natural runoff is present in Hooten Gulch.

Hydropower

There are other hydropower diversions in the watershed. The Olson Powerhouse diverts water from Old Cow Creek 1.2 mi downstream of the Kilarc Powerhouse. Water is diverted to the powerhouse and a minimum instream flow of 30 cfs is maintained downstream of the diversion.

The Neil Tocher water right diverts water from Canyon Creek, a tributary to Old Cow Creek. The Licensee also has water rights on South Canyon Creek and cannot divert water unless the Tocher water right is first satisfied.

The Wild Oak Powerhouse diverts water from Hooten Gulch downstream of the Cow Creek Powerhouse for generation of power. The water is returned to Hooten Gulch a short distance downstream. During periods of low natural runoff in Hooten Gulch, the Wild Oak diversion depends on discharge from the Cow Creek Powerhouse.

4.2.3 Existing Water Quality

Limited water quality data for Old Cow Creek and South Cow Creek near the Project are available from several studies conducted intermittently by the CDWR, California Department of Fish and Game (CDFG), USGS, Licensee, Shasta College, and the Roseburg Resources Company, between 1956 and 2000. These data, including analytical results for nutrients, minerals, metals, and temperature, are presented in: (1) the Cow Creek Watershed Assessment (SHN 2001), (2) the Preliminary Water Quality Assessment of Cow Creek Tributaries (Hannaford 2000), (3) the 1976 Application for New License (PG&E 1976) for the Kilarc-Cow Creek Project, and (4) CDFG records (CDFG 1992), and are summarized below. A summary of the available water quality data is presented in Table 4.2-2. This table does not completely summarize when field parameter data were collected because it was not presented in SHN 2001.

According to SHN 2001, field measurements for the following parameters from the Old Cow Creek and South Cow Creek tributaries have all been within acceptable limits based on the Basin Plan: dissolved oxygen [greater than 7.0 miligram per liter (mg/L)], pH (at or between 6.5 and 8.5), alkalinity, and turbidity (varies as a percentage over background). Specific data for these parameters were not presented in SHN 2001.

In support of the 1976 Application of New License (PG&E 1976), field parameter data were collected by the Licensee and CDFG in the spring and summer of 1974, respectively. Eight water quality monitoring stations were located in the immediate vicinity of the Project. The measured water quality parameters included temperature, dissolved oxygen, specific conductivity, alkalinity, pH, and ammonia-nitrogen and are summarized in Table 4.2-3. Based on these data, dissolved oxygen ranged from 8.5 to 11.6 mg/L, a range that is within the Basin Plan standard (7 mg/L), at stations along both the Old Cow Creek and South Cow Creek tributaries. Specific conductivity, which was measured during the period of lowest expected flow to obtain the highest yearly values, ranged from 105 to 190 micromhos/cm. There is no Basin Plan criteria for specific conductivity for this stream system. Total alkalinity ranged from 68 to 103 mg/L and pH ranged from 7.5 to 9.5. Only one pH reading (value of 9.5) was not within the Basin Plan limits. This reading was measured at PG&E/CDFG Station 1 (upstream end of South Cow Creek Main Canal) in the summer of 1974. Because increased summertime photosynthesis probably caused the pH 9.5 reading and there appeared to be no problem with fish populations, this high value was considered to be insignificant (PG&E 1976). Ammonia-nitrogen was not measurable above 1 mg/L. Temperature is discussed in Section 4.2.3.1.

For Old Cow Creek, the only available nutrient and mineral data were collected at CDWR Station A4-8448 located near Kilarc Powerhouse between 1997 and 1982, and are summarized in Table 4.2-4. Of these data, only dissolved nitrate (NO_3 as N) and chloride have drinking water criteria (i.e., maximum contaminant levels [MCL]); the range of concentrations for these constituents are well below their drinking water criterion.

For South Cow Creek, available nutrient, mineral and metal data were collected at two CDWR stations: Station A4-8555 located near Whitmore about 9 mi upstream from the Cow Creek

Powerhouse and Station 8500 located near Millville about 4 mi downstream from the Cow Creek Powerhouse. The available nutrient data from Station A4-8555 were collected between 1997 and 1980, and are summarized in Table 4.2-5. Of these data, only dissolved nitrate (NO_3 as N) has a drinking water criterion (i.e., MCL); the range of concentrations for these constituents are well below their drinking water criterion.

The available mineral and metal data from Station A4-8500 were collected between 1959 and 1980, and are summarized in Table 4.2-6. Of these data, arsenic, cadmium, iron, and manganese exceeded the drinking water criteria. These metal data represent one sampling event in 1977.

4.2.3.1 Temperature

Temperature is a significant limiting factor for aquatic biota. Excessive temperatures can induce high metabolic rates and oxygen debt stress in fish and invertebrates. Historical temperature data for Old Cow Creek and South Cow Creek near the Project are available from several studies conducted intermittently by the CDWR, the Licensee, CDFG, USGS, Shasta College, and the Roseburg Resources Company, between 1956 and 2000.

For Old Cow Creek, the temperature readings taken between 1974 and 1992, either near Kilarc Powerhouse or within Kilarc Main Canal, ranged from 6° Celsius (C) to 26.1°C. A temperature of 25°C (considered to be a lethal temperature threshold for juvenile Chinook salmon) was only exceeded once during these studies; a temperature of 26.1°C was recorded CDWR Station A4-8448 (near Kilarc Powerhouse) during June in the critical dry year of 1977. Temperature fluctuations recorded in the vicinity of the Kilarc Powerhouse and Kilarc Canal between May and November 1974 are shown on Figure 4.2-6. During a study conducted by Shasta College in 1999, the temperature in the middle reach of Old Cow Creek (near Olson Powerhouse downstream from the Kilarc Powerhouse) averaged 17.2°C in the summer months, with a maximum observed temperature of 20.8°C; the temperature fluctuation is shown on Figure 4.2-7. During a study conducted by Roseburg Research Company from 1996 to 1998, the maximum observed temperature in the middle and upper reaches of Old Cow Creek (upstream from Kilarc Powerhouse) was 19.4°C. The maximum observed temperature observed in Hunt Creek, a tributary to Old Cow Creek upstream from Kilarc Powerhouse, was 23.4°C. During a study conducted by CDFG in 1992, the temperature in the middle reach of Old Cow Creek (at Fern Bridge downstream of the Kilarc Powerhouse) ranged from 10.1°C to 21°C; the temperature fluctuation is shown on Figure 4.2-8.

For South Cow Creek, the temperature readings taken in 1974 and between 1999 and 2000 either near Cow Creek Powerhouse, within South Cow Creek Main Canal and Mill Creek/South Cow Creek Canal, or within the adjacent South Cow Creek (portion parallel to South Cow Creek Main Canal) ranged from 9°C to 25.9°C. Temperature fluctuations recorded in the vicinity of the Cow Creek Powerhouse between April and November 1974 are shown on Figure 4.2-8. During a study conducted by Shasta College from 1999 through 2000, the temperature downstream of Cow Creek Powerhouse averaged 21.7°C in the summer months, with a maximum observed temperature of 25.9°C; the temperature fluctuation is shown on Figure 4.2-7. During a study conducted by CDFG in 1992, the temperature in the middle reach of South Cow Creek (at Ponderosa Way upstream of the Cow Creek Powerhouse) ranged from 9.5°C to 22.5°C; the temperature fluctuation is shown on Figure 4.2-8. During studies conducted by CDWR and USGS from 1957 to 1982, the maximum observed temperature at CDWR Station A4-8500 (near Millville) was 31°C (summer months between 1957 and 1968); the average observed temperature during this period was 22°C. During studies conducted by CDWR and CDFG from 1977 to 1992, the maximum observed temperature at or near CDWR Station A4-8555 (near Whitmore) was 24.4°C (June 1977).

4.2.4 Sedimentation

The Old Cow Creek and South Cow Creek tributaries are bedrock-controlled streams. There area numerous bedrock exposures, large boulders and cobbles, waterfalls and the minimal alluvial deposits along the lower streams near the Sacramento River.

The primary sources of sediment to the Old Cow Creek and South Cow Creek tributaries are the thin soils found in the watershed and weathered rock from upslope. The soils present within the Project Area consist of sandy loam materials formed over highly weathered bedrock. The bedrock is composed of fluvial deposited material of the Tehama and Red Bluff Formations.

Sediment also is transported into the Project reach along the Old Cow Creek and South Cow Creek tributaries from upstream watershed areas. Sediments derived from watershed areas upstream of the Project must pass the North Canyon Creek, South Canyon Creek and Kilarc Diversion Dams along Old Cow Creek, and Mill Creek and South Cow Creek Diversion Dams along South Cow Creek. These diversion dams appear to have little or no impact on coarse-sized sediments (gravel and larger sizes) because of the limited storage capacity behind the dams. Some sand and silt passes into the Kilarc Canal and is deposited; this material is removed annually. Silt accumulation in the forebays is removed every 8 to 12 years.

4.2.5 Impacts Related to the Existing Project

4.2.5.1 Water Quality Impacts

The Project is a run of the river project and does not impound an appreciable volume of water that would result in alterations of the hydrology of each creek. The Project diverts water at the intake structures and returns the water back to the creeks downstream. The relatively short diversions are not believed to have negative impacts on water quality in the Project Area.

4.2.5.2 Temperature Impacts

The diversion of water may result in increased water temperatures in the bypass reaches of Old Cow and South Cow Creeks. The length of the bypass reaches are 3.8 mi and 3.9 mi, respectively. At the point of diversion, South Cow Creek has warmer water temperatures than Old Cow Creek. The Project operations may also have a cooling effect on the reaches downstream of the tailrace. Water temperature effects will be evaluated using available data and data collected during the 2003 field season as described in Section 6.3.1.3.

4.2.5.3 Sedimentation Impacts

Sediment is transported into the Project reaches along the Old Cow Creek and South Cow Creek from upstream watershed areas. Sediment transported in the Project reaches passes over the Project diversion dams due to the lack of available storage. The sediment found along the Old Cow Creek and South Cow Creek through the Project reaches includes a wide range of particle size, from fine silts to house-sized boulders. The Project is not believed to contribute to the sediment load of the creeks or to affect their ability to transport sediment load.

4.2.6 References

California Department of Fish and Game. Unpublished. Temperature data for Old Cow Creek and South Cow Creek, Summer 1992.

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State Water Resources Board, 1969. Cow Creek Adjudication Decree of the Superior Court for Shasta County, California. No. 38577.

TABLES

Table 4.2-1. Water Rights Upstream of South Cow Creek Diversion Dam.

Diversion	Water Right Number
Beal Creek Ditch	42
German Ditch	43
Hufford-Knight Ditch	44
Atkins Mill Ditch	45
Knight South Ditch	46
Worden Ditch	47
Hagaman Ditch	48
Morelli-Carr Ditch	49
Upper Hamp Creek Ditch	50
Lower Hamp Creek Ditch	51
Lansing South Ditch	53
Rose Ditch	54
Lansing North Ditch	55
East Hufford Ditch	60
Rolands-Staiger Ditch	61

Table 4.2-2. Summary of Available Water Quality Data for Old Cow Creek and South Cow Creek.

Agency	Station ID	Sampling Location	Data Collected	Period of Record	Computer Files
Old Cow Creek					
CDWR	A4-8448	Near Kilarc Powerhouse	Nutrients	1977-1981	Microfiche
			Mineral, Physical, Temperature	1977-1982	Microfiche
USGS	11372325	Near Kilarc Powerhouse	Flow	1983-1999	Electronic
	11372330	Olsen Powerhouse		1990-1999	
	11372350	Below Olsen Powerhouse		1990-1997	
CDFG	6	Below Kilarc Powerhouse	Temperature and other field parameters	Summer 1974	Paper
	7	Above Kilarc Powerhouse			
	8	Upstream end of Kilarc Main Canal			
		Fern Bridge	Temperature	1992	Electronic
PG&E	6	Below Kilarc Powerhouse	Temperature and other field parameters	Spring 1974	Paper
	7	Above Kilarc Powerhouse			
	8	Upstream end of Kilarc Main Canal			
Shasta College	Middle Old Cow Creek		Temperature, Fecal Coliform, Physical	1999-2000	Electronic
Roseburg Resources	33N02E29-#330	Old Cow Creek Mid	Temperature	1996-1998	Electronic
	33N02E20-#332	Old Cow Creek Upper			
	33N02E27-#338	Hunt Creek			

Table 4.2-2. Summary of Available Water Quality Data for Old Cow Creek and South Cow Creek (continued).

Agency	Station ID	Sampling Location	Data Collected	Period of Record	Computer Files
South Cow Creek					
CDWR	A4-8500	Near Millville	Nutrients	1971-1972	Microfiche
			Minerals	1959	Microfiche
			Minor Elements	1977	Microfiche
			Physical, Temperature	1959	Microfiche
	A4-8555	Near Whitmore	Nutrients	1977-1980	Microfiche
			Minerals, Physical, Temperature	1977-1982	Microfiche
CDFG	1	Upstream end of South Cow Creek Main Canal	Temperature and other field parameters	Summer 1974	Paper
	2	Mill Creek (South Cow Creek)			
	3	Near Cow Creek Powerhouse			
	4	South Cow Creek Parallel to South Cow Creek Main Canal			
		Ponderosa Way		1992	Electronic
PG&E	1	Upstream end of South Cow Creek Main Canal	Temperature and other field parameters	Spring 1974	Paper
	3	Near Cow Creek Powerhouse			
	4	South Cow Creek Parallel to South Cow Creek Main Canal			
	5	South Cow Creek Parallel to South Cow Creek Main Canal			

Table 4.2-2. Summary of Available Water Quality Data for Old Cow Creek and South Cow Creek (continued).

Agency	Station ID	Sampling Location	Data Collected	Period of Record	Computer Files
USGS	11372080	Near Whitmore	Flow	1984-1999	Electronic
	11372200	Near Millville	Flow	1983-1999	
			Temperature	1956-1968	
			Water Quality	1966-1971	
CDFG		Ponderosa Way	Temperature	1992	Electronic
Shasta College	Middle South Cow Creek		Temperature, Fecal Coliform, Physical	1999-2000	Electronic
Roseburg Resources	32N01E02-#334	Glendenning Creek	Temperature	1996-1998	Electronic
	32N01E22-#336	South Cow Creek			

Source: Modified from SHN 2001

Table 4.2-3. Water Quality of South Cow and Old Cow Creeks.

Sample Location	Sample Location Number	Water Temp °F	Water Temp °C	Dissolved Oxygen (ppm)	Specific Conductivity (micromhos/cm)	Total Alkalinity (ppm)	pH	Ammonia-Nitrogen (ppm)	Sampling Event
Upstream end of South Cow Creek Main Canal	1	50.5	11	10.7	-	-	7.5	-	Spring 1974
		64	18	9.4	140	86	9.5	<1	Summer 1974
Mill Creek (South of Cow Creek Canal)	2	58	14	9.7	190	103	8.3	<1	Summer 1974
Near Cow Creek Powerhouse	3	49	9	11.4	-	-	7.5	-	Spring 1974
		62	17	9.8	140	86	8.5	<1	Summer 1974
South Cow Creek Parallel to South Cow Creek Main Canal	4	49.5	10	11.4	-	-	7.4	-	Spring 1974
		62	17	9.5	165	103	8.2	<1	Summer 1974
South Cow Creek Parallel to South Cow Creek Main Canal	5	54	12	10.4	-	-	7.5	-	Spring 1974
Below Kilarc Powerhouse	6	48	9	10.6	-	-	7.5	-	Spring 1974
		53	12	10.3	105	68	8.4	<1	Summer 1974
Above Kilarc Powerhouse	7	51	11	10.3	-	-	7.5	-	Spring 1974
		68	20	8.5	125	86	8.5	<1	Summer 1974
Upstream end of Kilarc Main Canal	8	43	6	11.6	-	-	7.5	-	Spring 1974
		56	13	9.6	105	68	8.2	<1	Summer 1974

ppm parts per million (equivalent to micrograms per liter) **Source:** PG&E 1976

Table 4.2-4. Summary of Nutrient and Mineral Water Quality Data, Near Kilarc Powerhouse (CDWR Station A4-8448), Old Cow Creek, 1977 to 1982.

Constituents	Range of Concentrations (mg/L)	EPA Primary Drinking Water MCL (mg/L)	EPA Secondary Drinking Water MCL (mg/L)
Total ammonia and organic nitrogen (NH_3+Org. N)	0.02-0.7	-	-
Dissolved nitrate (NO3 as N)	0.01-0.13	10.0	-
Dissolved orthophosphate (PO4)	0.00-0.04	-	-
Total phosphorous (P)	0.01-0.12	-	-
Calcium (Ca)	7.0*	-	-
Magnesium (Mg)	3.0*	-	-
Sodium (Na)	2.2-6.0*	-	-
Potassium (K)	1.2*	-	-
Chloride (Cl)	0.0-1.0*	-	250
Boron (B)	0.1*	-	-
Total Hardness	5-68*	-	-

mg/L milligrams per liter

* Concentrations represent dissolved constituent.

Source: SHN 2001

Table 4.2-5. Summary of Nutrient Water Quality Data, CDWR Whitmore Station (A4-8555), South Cow Creek, 1977 to 1980.

Constituent	Range of Concentrations (mg/L)	EPA Primary Drinking Water, MCL (mg/L)
Total ammonia and organic nitrogen (NH_3 + Org. N)	0.0-0.22	-
Dissolved nitrate (NO_3 as N)	0.00-0.02	10.0
Dissolved orthophosphate (PO_4)	0.00	-
Total phosphorous (P)	0.00-0.11	-

Source: SHN 2001

Table 4.2-6. Summary of Mineral and Metal Water Quality Data, CDWR Millville Station (A4-8500), South Cow Creek, 1959 to 1977.

Constituent	Range of Concentrations (mg/L)	CA Primary Drinking Water MCL (mg/L)	CA Secondary Drinking Water MCL (mg/L)	Basin Plan Standards (mg/L)
Minerals		-	-	-
Calcium (Ca)	18-21	-	-	-
Magnesium (Mg)	4.9-8.1	-	-	-
Sodium (Na)	5.2-6.8	-	-	-
Potassium (K)	1.1-2.7	-	-	-
Sulfate (SO4)	0.0-0.6	500	250	-
Chloride (Cl)	1.4-2.5	-	250	-
Boron (B)	0.02-0.06	-	-	-
Total Hardness	60-103	-	-	-
Metals				
Arsenic (As)	0.06	0.05	-	0.010
Cadmium (Cd)	0.01	0.005	-	0.022
Chromium (Cr)	-	-	-	-
Copper (Cu)	0.00	1.3	1	0.0056
Iron (Fe)	16	-	0.3	0.030
Lead (Pb)	0.00	0.015	-	-
Manganese (Mn)	0.37	-	0.05	0.005
Mercury (Hg)	-	0.002	-	-
Molybdenum (Mo)	-	-	-	-
Selenium (Se)	-	0.05	-	-
Zinc (Zn)	0.13	-	5.0	0.016

Single values represent single sampling event.

Concentrations represent dissolved constituent.

Source: SHN 2001

FIGURES

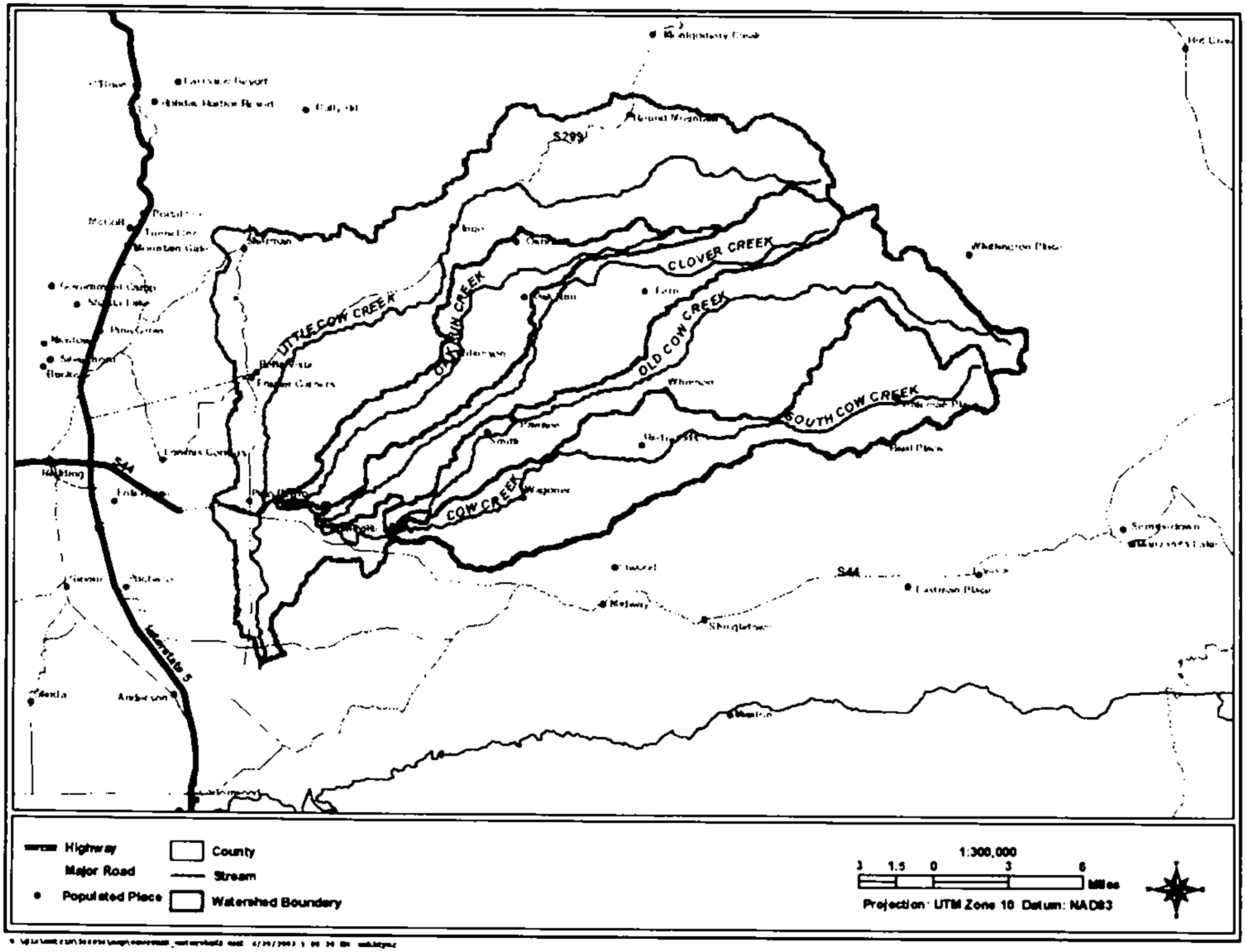

Figure 4.2-1. PG&E Diversions and Other Water Uses in the Cow Creek Watershed.

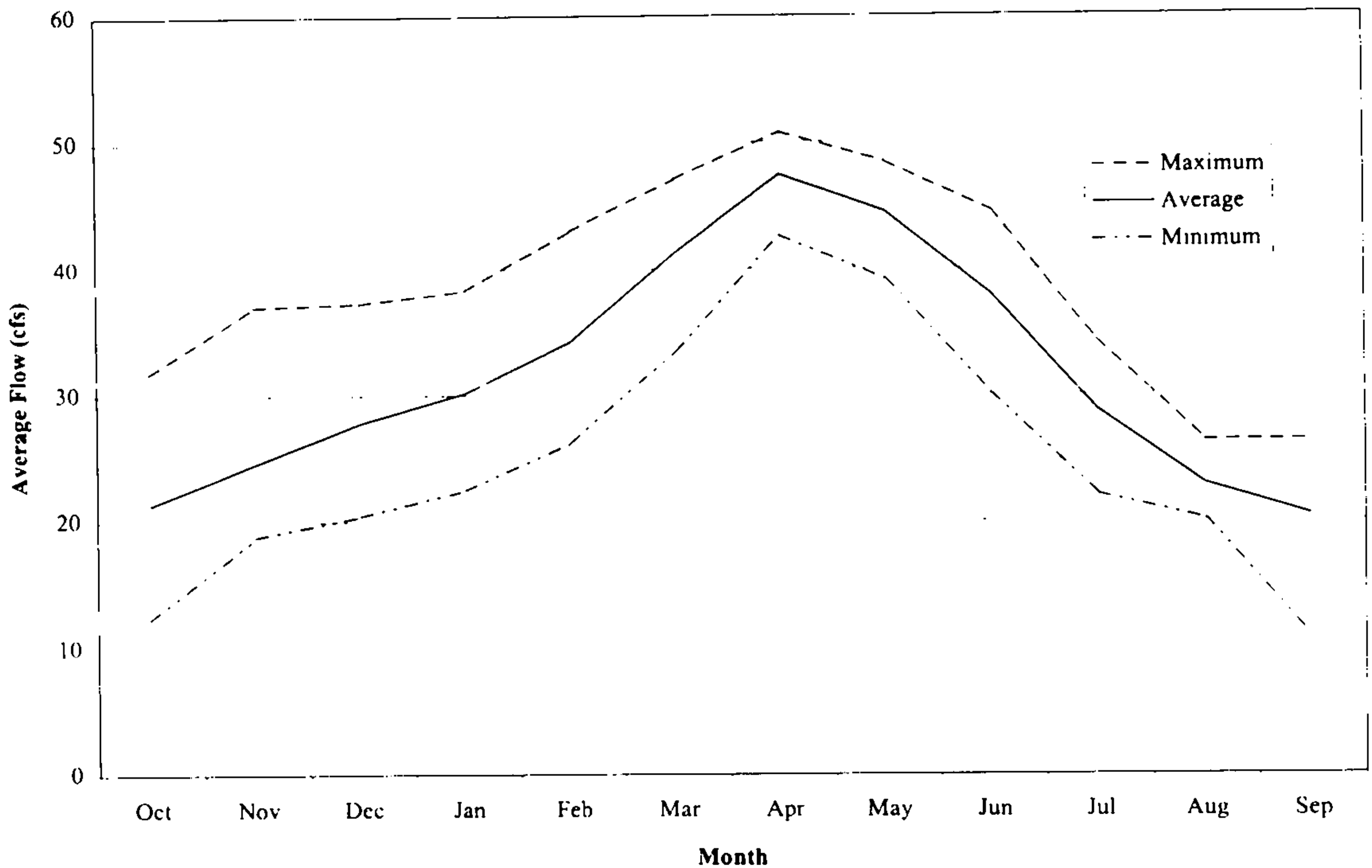

Figure 4.2-2. Average Monthly Diversions at Kilarc Diversion Dam (1971 to 2001).

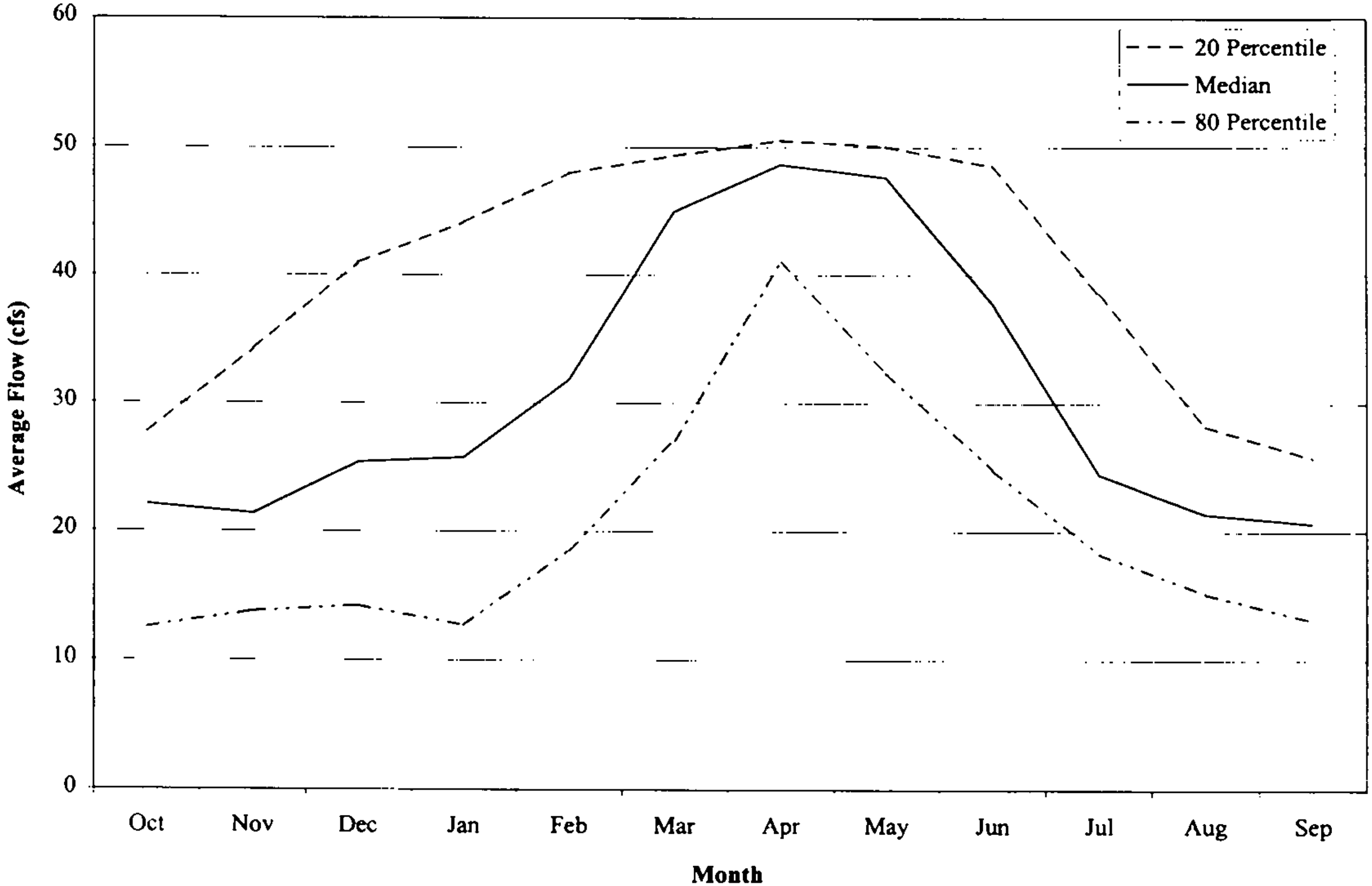

Figure 4.2-3. Exceedance of Average Monthly Diversions at Kilarc Diversion Dam (1971 to 2001).

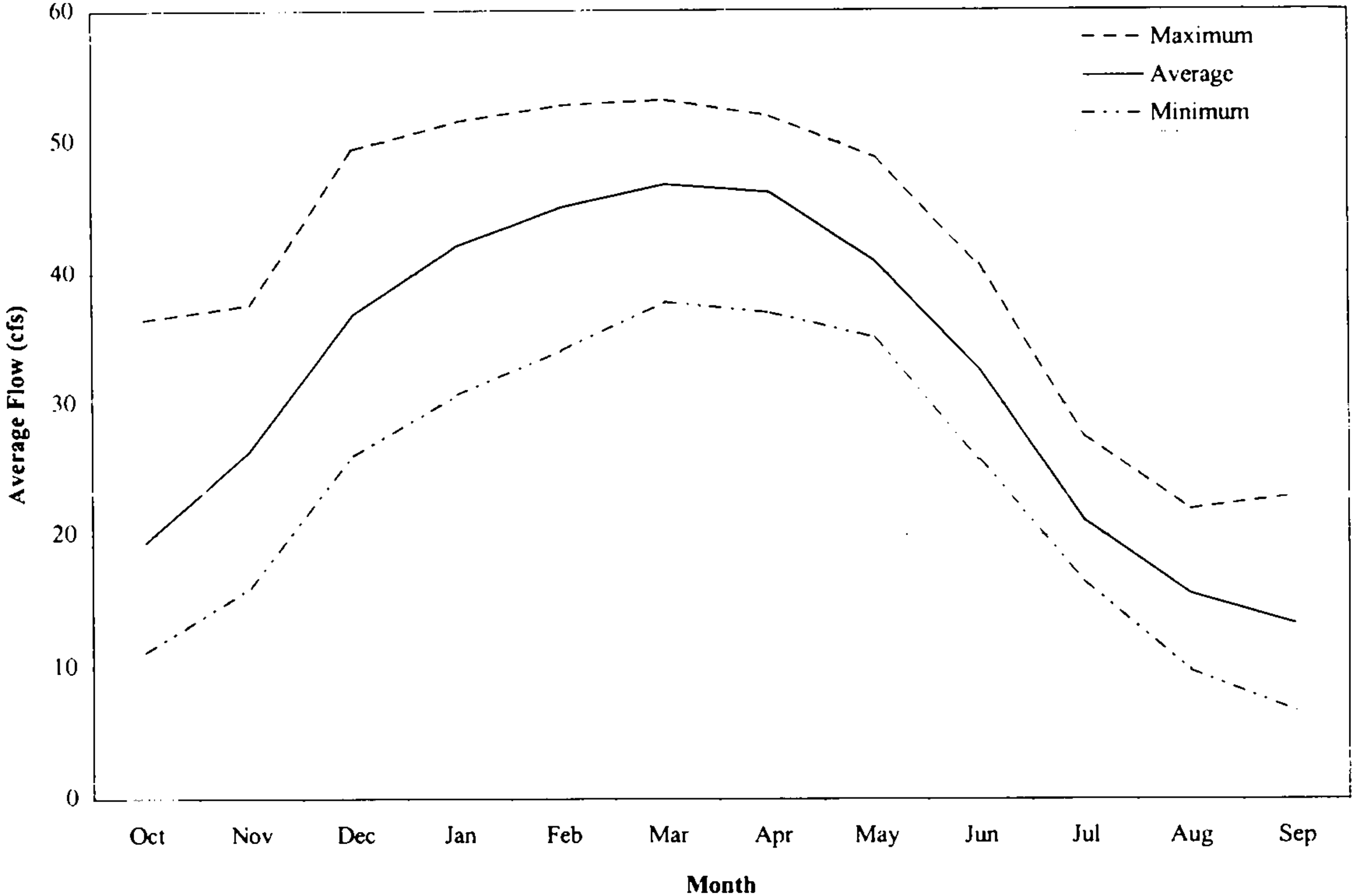

Figure 4.2-4. Average Monthly Diversions at South Cow Creek Diversion Dam (1981 to 1997).

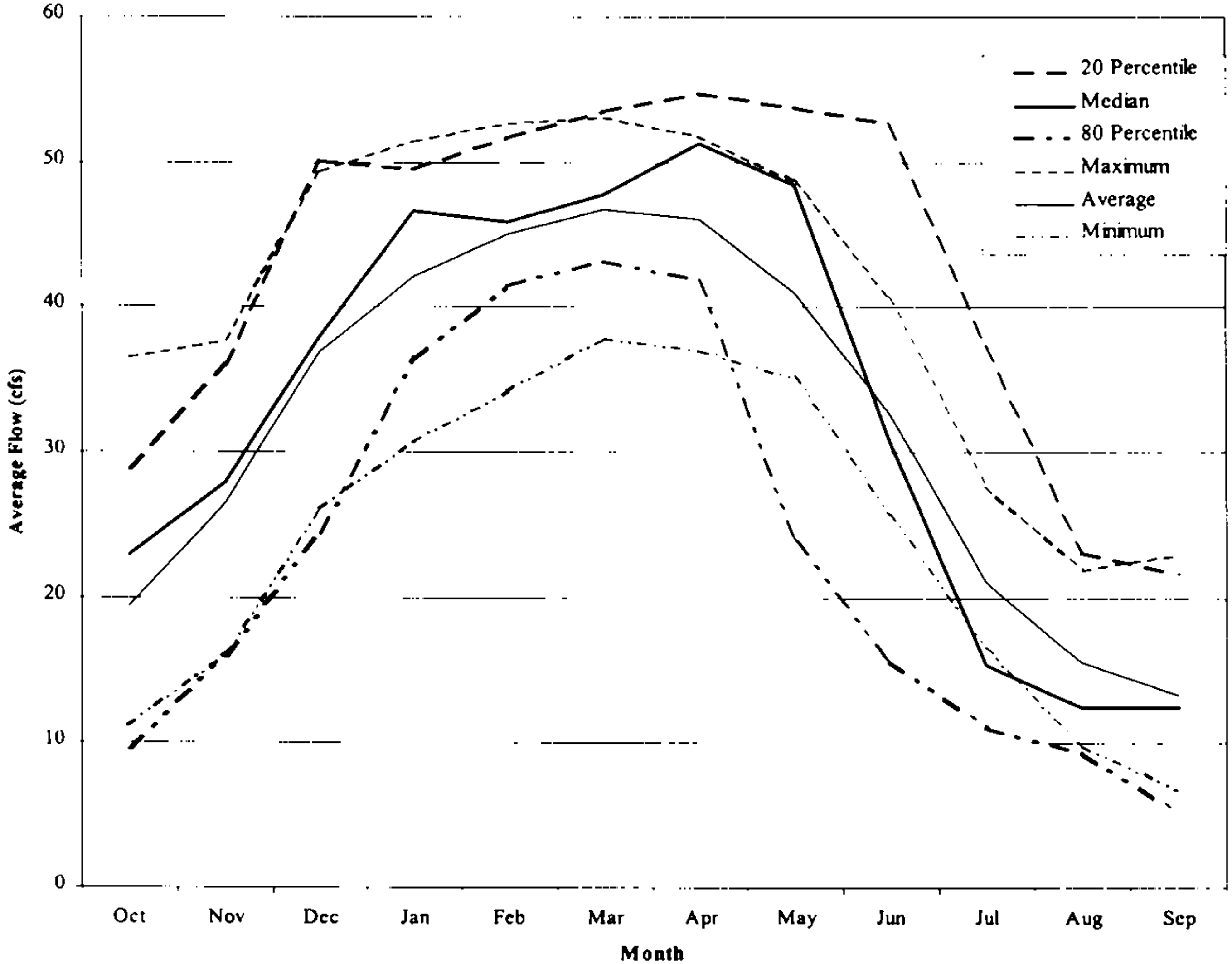

Figure 4.2-5. Exceedance of Average Monthly Diversions at South Cow Creek Diversion Dam (1981-1997).

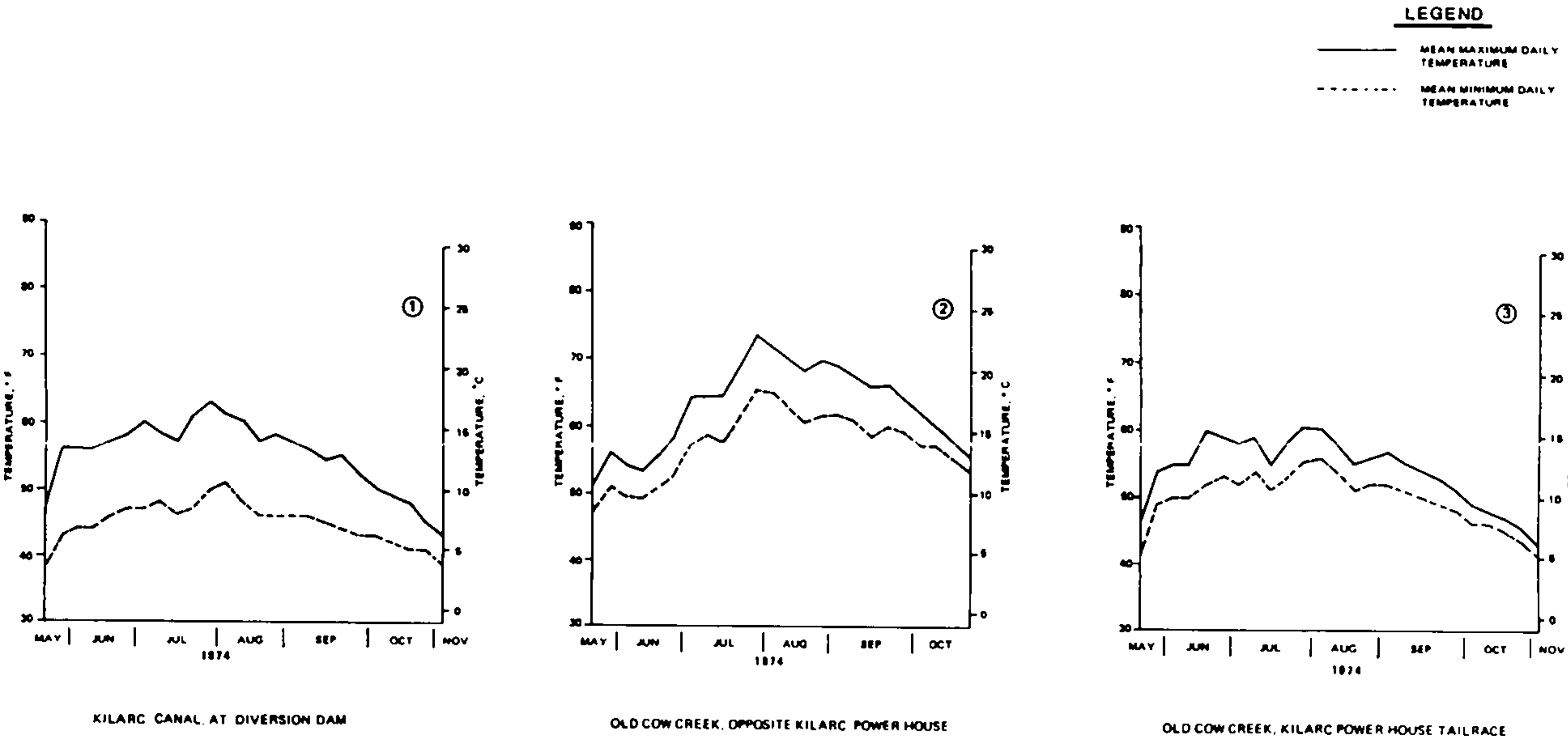

Figure 4.2-6. Temperature Fluctuations in Old Cow Creek, May through November 1974.

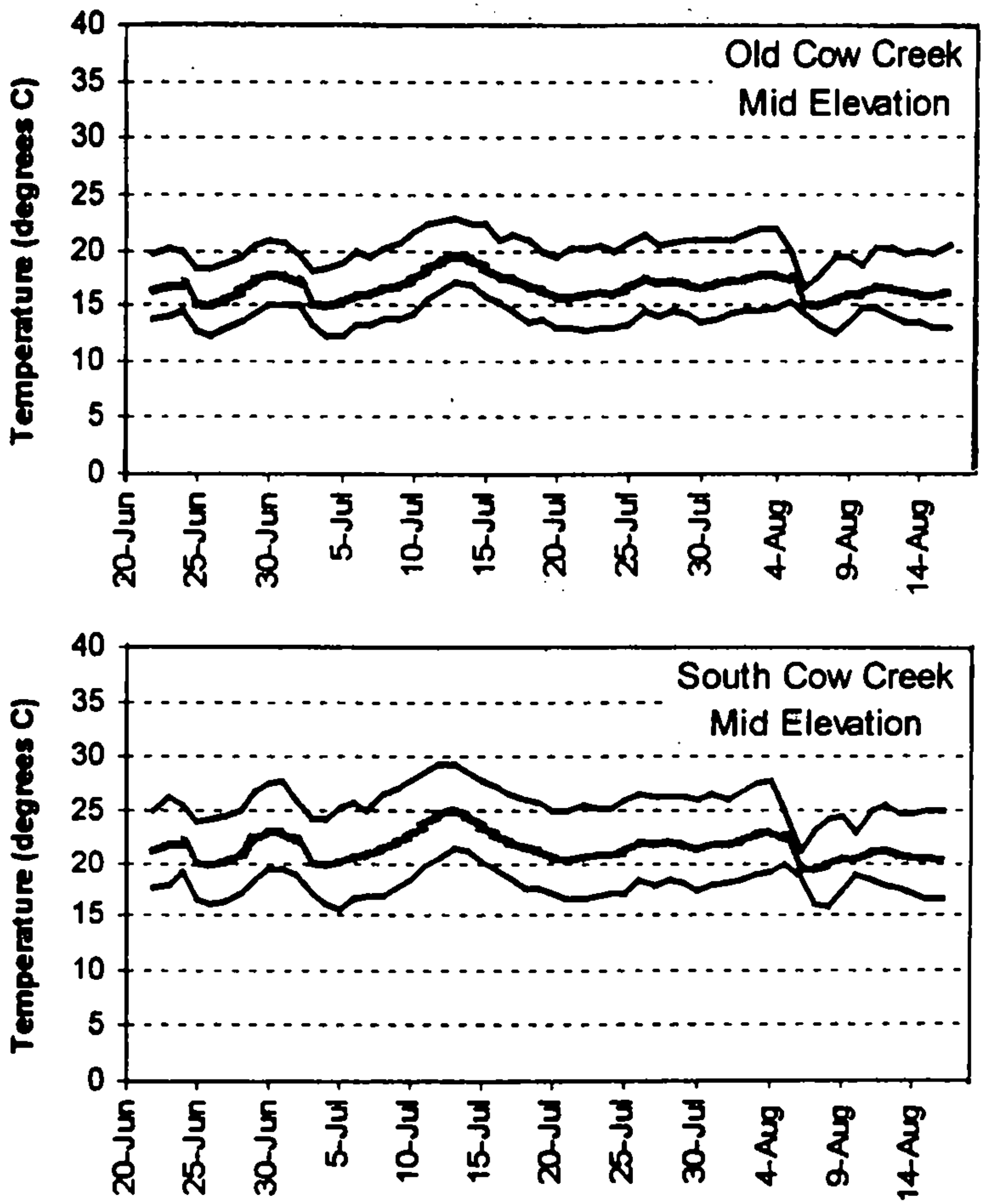

Figure 4.2-7. Temperature Fluctuations in Old Cow Creek and South Cow Creek, June through August 1999.

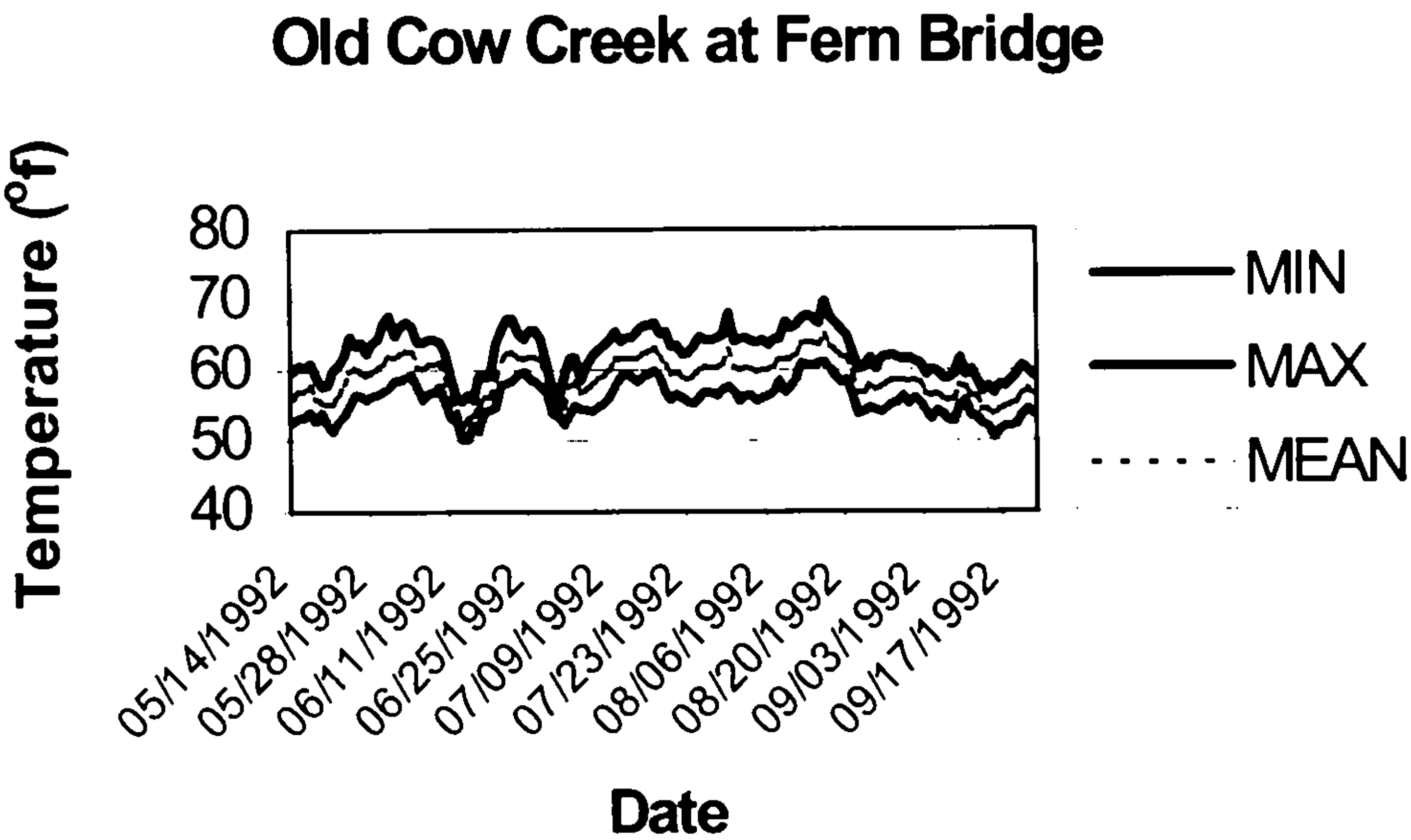

Figure 4.2-8a. **Temperature Fluctuations on Cow Creek and South Cow Creek May 14 to September 21 1992.**

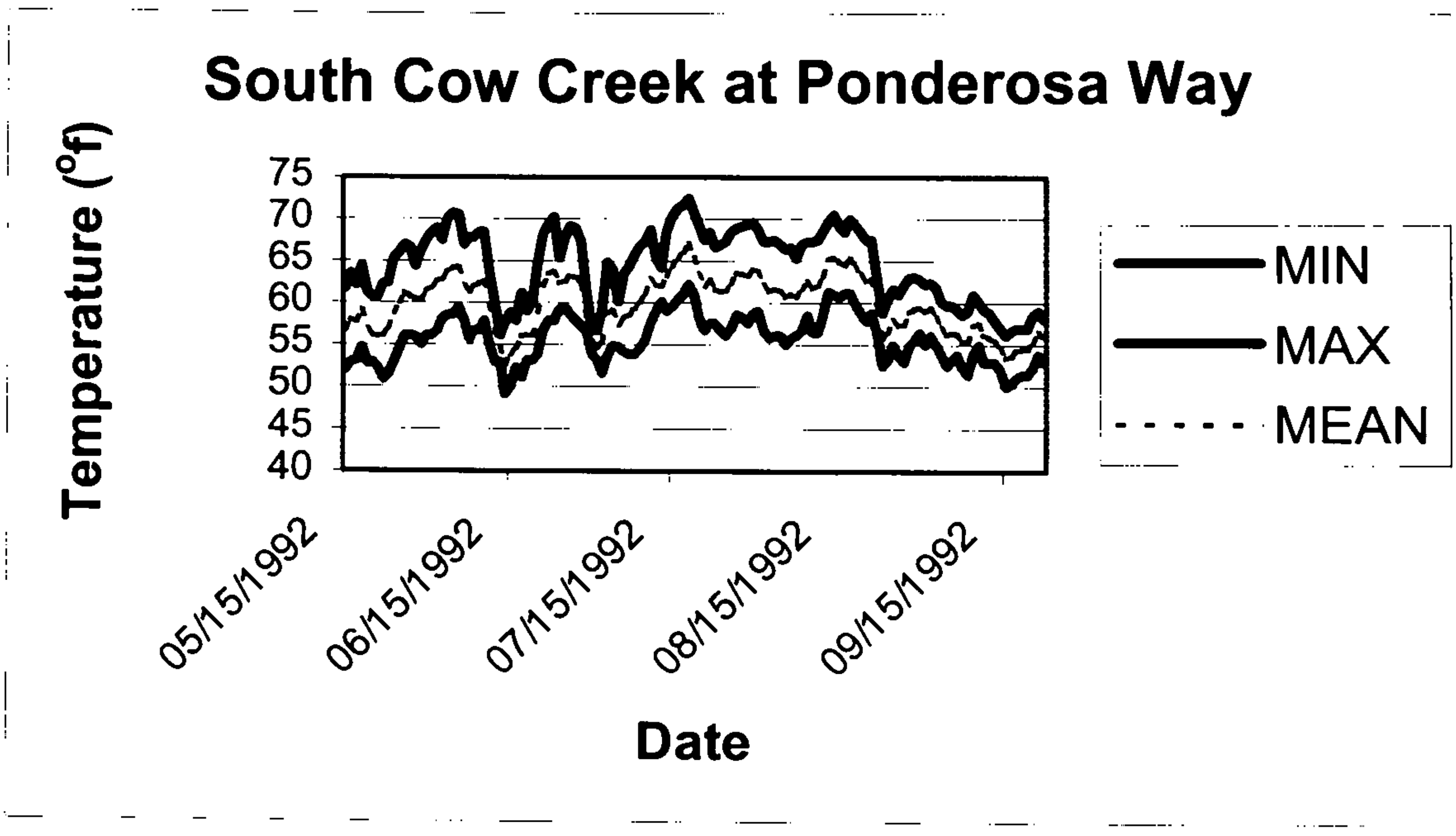

Figure 4.2-8b. Temperature Fluctuations on Cow Creek and South Cow Creek May 14 to September 21

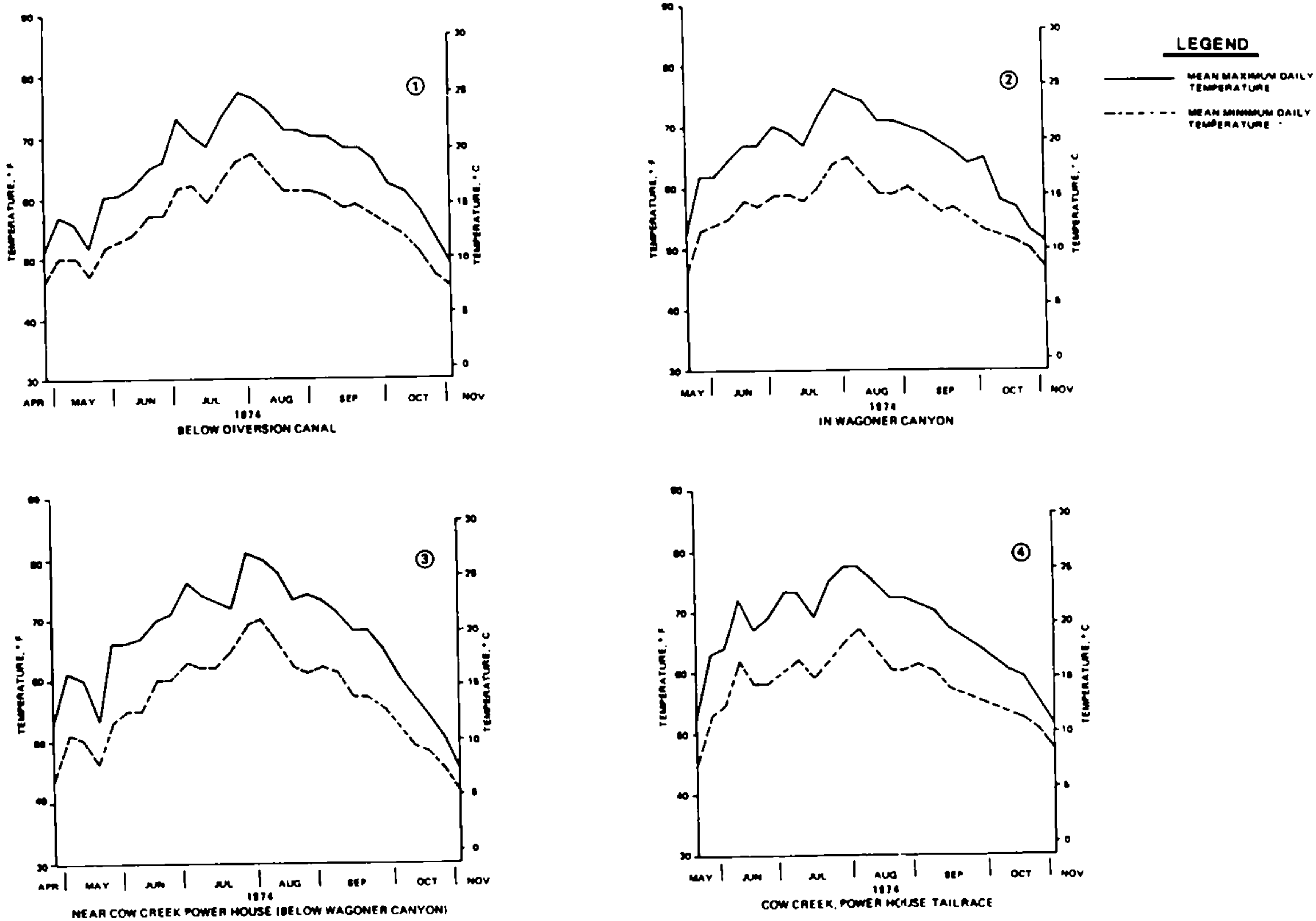

Figure 4.2-9. Temperature Fluctuations in South Cow Creek, April through November 1974.

4.3 Vegetation

4.3.1 Introduction

The Project Area has diverse flora and a variety of vegetation communities, which are a result of the varying topography, substrate, and elevations found in the watershed. Elevations range from approximately 820 ft at the Cow Creek Powerhouse to 3,900 ft at the North Canyon Creek Diversion Dam. Vegetation communities present within the Project Area include:

- Non-native grassland
- Agricultural lands
- Riparian forest (white alder and mixed)
- Blue oak-foothill pine woodland
- Sierran mixed coniferous forest
- Wetlands (freshwater marsh and seeps)

The following information on vegetation communities within the Project Area has been summarized from the Cow Creek Watershed Assessment prepared for Western Shasta Resource Conservation District and Cow Creek Watershed Management Group, prepared by SHN Consulting Engineers & Geologists, Inc. and Vestra Resources, Inc. (SHN 2001). The vegetation types are generally divided by elevation. The higher elevations support coniferous forests and the middle elevations support blue oak-foothill pine woodland. The lower elevations support non-native grassland and blue oak-foothill pine woodland.

4.3.2 Non-Native Grassland

Non-native grassland occurs at lower elevations and extends into openings within blue oak-foothill pine woodland in the foothill zone of the watershed. The foothill zone generally occurs below 2,500 ft in elevation.

Non-native annual grassland supports a variety of annual grasses and associated forbs. Dominant species include wild oats (*Avena* spp.), foxtail chess (*Bromus madritensis*), soft chess (*Bromus hordeaceus*), perennial ryegrass (*Lolium perenne*), dogtail grass (*Cynosurus echinatus*), and ripgut brome (*Bromus diandrus*). Annual and perennial forbs are common associates and include filaree (*Erodium* spp.), California poppy *(Eschscholzia californica)*, elegant brodiaea (*Brodiaea elegans*), and common brodiaea (*B. californica* var. *californica*).

Non-native annual grassland is characteristically invaded by exotic species such as yellow starthistle *(Centaurea solstitialis)*, medusahead grass *(Taeniatherum caput-medusae)*, Klamath weed *(Hypericum perforatum)*, Dalmation toadflax *(Linaria dalmatica)*, and bull thistle *(Cirsium vulgare)*.

4.3.3 Agricultural Lands

Portions of lands adjacent to the Project Area include agricultural lands that are predominately non-irrigated grassland and irrigated pasture for livestock. The composition of irrigated pasture varies by use and elevation in the watershed. They include perennial ryegrass, crop barley *(Hordeum vulgare)*, alfalfa *(Medicogo slaiva)*, rose clover *(Trifolium hirtum)*, and white clover (*Trifolium repens*). Much of the irrigated ground includes historic wet meadow areas of the upper foothills and forest areas.

Typical pasture seed mixes used in the watershed include combinations of orchard grass (Potomac) tetraploid perennial ryegrass, tetraploid annual ryegrass, Salina strawberry clover (*Trifolium fragiferum*), broad-leaf trefoil, Landino clover (*T. repens*), and tall fescue (*Festuca arundinacea*).

4.3.4 Riparian Forest Community

Two riparian forest communities are present within the Project Area. These include White Alder riparian forest and mixed riparian forest.

White Alder Riparian Forest. The white alder (*Alnus rhombifolia*) riparian forest is the primary riparian forest community found in the Cow Creek Watershed. This riparian forest is found along the sub-drainages within the watershed. Tree and shrub species are generally deciduous. Riparian vegetation is common along the edges of streams and creeks. White alder riparian is typically found from the valley floor into the lower coniferous forest and has an elevational range of 500 to 4,000 ft. The riparian corridor of this community is much narrower than other riparian communities common to the Sacramento Valley, due to the steep canyons, bedrock channels, and fast-flowing water common in the upper limits of the watershed. Common species include white alder, willow (*Salix* spp.), and valley oak. Secondary vegetation consists of blue oak (*Quercus doublassi)*, non-native annual grass, and buckbrush (*Ceanothus cuncatus)*.

Mixed Riparian Forest. The mixed riparian forest is likely the dominant riparian community along the lower reaches of the tributaries and the mainstream of Cow Creek. Today, remnant areas remain. Historically, this community contained western sycamore (*Plantanus racemosa*), Fremont cottonwood (*Populus fremontii*), yellow willow *(Salix lasiandra*), and California black walnut (*Juglans hindsii*). There is often an understory of box elder (*Acer negundo*), red willow (*S. laevigata*), and sandbar willow (*S. exigua*). Understory species include California blackberry (*Rubus ursinus*), mugwort (*Artemisia douglasiana*), love grass (*Eragrostis pectinacea* var. *petinacea*), blue elderberry (*Sambucus mexicana*), California mutton-willow (*Cephalanthus occidentalis*), mule fat *(Baccharis salicifolia*), California wild grape (*Vitis californica*), pipe vine (*Aristolochia californica*), and virgin's bower (*Clematis ligusticifolia*).

4.3.5 Blue Oak-Foothill Pine Woodland

There are four different sub-communities within this general community type, including Blue Oak Woodland, Foothill Pine Oak Woodland, Open Foothill Pine Woodland, and Non-Serpentine Foothill Pine Woodland. The four sub-communities have been grouped into Blue Oak-Foothill Pine Woodland, based on the similarities of the species within each sub-community. All four sub-communities consist of blue oak and foothill pine as the predominant species, with variations of the third primary species, whiteleaf manzanita (*Arctostaphylos viscida*), interior live oak (*Q. wislizenii* var. *wislizwnii*), and buckbrush.

This plant community occurs on foothill slopes in the watershed from the valley floor to over 3500 ft in elevation depending on aspect. The community is widely distributed and is found as a nearly continuous belt in the elevational band. The blue oak-foothill pine community is generally found on rocky or exposed shallow soil. The community is dominated by two overstory species, blue oak and gray pine *(Pinus sabiniana*). Species may develop mixed stands or may occur in relatively pure stands. Blue oak and foothill pine have a high tolerance for drought. Frequent fires favor the establishment of blue oak, which are stump sprouting species, over foothill pine. Foothill pine prefers to regenerate following fire and, due to the low release nature of its cone, is sometimes considered a semi-serotinous species. Foothill pine may regenerate as isolated individuals or in dense stands resulting from regeneration following fire.

The understory is now characterized by non-native annual grasses and forbs (non-native grassland section). In the absence of fire, a dense shrub community may develop including interior live oak, California buckeye (*Aesculus californica*), whiteleaf manzanita, poison oak (*Rhus siversiloba)*, and California redbud (*Cercis occidentialis*). These species will become decedent over time, without recurring fire and will lose their nutritional value for browse species such as deer. Drier, harsher sites tend to support chaparral and grass understory, and mesic sites are characterized by locally abundant occurrences of black oak (*Q. kelloggii*) and poison oak.

4.3.6 Sierran Mixed Conifer Forest

Sierran mixed conifer forest is the most common forest type in the watershed. Sierran mixed conifer forest is widely distributed within the watershed from 3,000 to 6,000 ft in elevation. This mixed conifer forest has replaced much of the area once dominated by ponderosa pine forest. Historically, the type was confined to moist sites having north-facing or east-facing slopes and well-drained soils. More recently, exclusion of fire has resulted in the conversion of ponderosa pine forests to mixed conifer forests. Ponderosa pine (*Pinus ponderosa*), incense cedar (*Calodedus decurrens*), Douglas fir (*Pseudotsuga menziessi*), and white fir (*Abies concolor*) are the shared dominant species in the tree overstory. Secondary species include sugar pine (*P. lambertiana*) and black oak.

4.3.7 Wetland Communities

Wetland communities include freshwater marsh or seeps that could occur adjacent to Old Cow Creek and South Fork Cow Creek. In addition, seeps may also be present adjacent to other Project facilities (e.g., Kilarc Powerhouse, Cow Creek Powerhouse, etc). Open water areas such as Project-related forebays are also present

Freshwater Marsh. Freshwater marsh occur along the edges of ponds and creeks located at lower elevations, including the Kilarc and Cow Creek forebays. This zone supports emergent (extending above the water) vegetation and algae, and is referred to as the lentic zone. Common freshwater marsh species include broad-leaved cattail *(Typha latifolia),* hard stemmed tule *(Scirpus aculus* var. *occidentalis*), emersed bur reed *(Sparganium emersum),* slender rush *(Juncus tenuis*), Mexican rush *(J. balticus* var. *mexicanus),* ample leaved sedge *(Caex ampifolia),* and leafy bracted dwarf rush *(J. capitatus).*

Seeps. Seeps or springs often occur in wet areas within non-native grasslands or meadows. These are usually associated with changes in geologic material, fractures, or faults. This wetland vegetation type is characterized by perennial herbaceous plant species that are associated with permanently moist or wet soil (Holland 1986), and consists of sedges (*Carex* spp.), rushes (*Juncus* spp.), and a variety of grass species. These areas are important to wildlife for water and food.

4.3.8 Sensitive Botanical Resources

4.3.8.1 Special-Status Plant Species

Special-status plant species are species that are legally protected under the State and Federal Endangered Species acts or other regulations, and species considered sufficiently rare by the scientific community so that they may qualify for official protection. Review of available literature and searches of the California Natural Diversity Database (CNDDB) and the California Native Plant Society's (CNPS) Inventory of Rare Plants during the preparation of the Cow Creek Assessment resulted in 15 special-status plant species that are either known to occur or that are suspected to occur in the Cow Creek Watershed (Table 4.3-1). Of these, only six are expected to occur in the Project Area based on habitat and elevation. A brief description of each of these six species is provided below.

Bogg's Lake Hedge-Hyssop (*Gratiola heterosepala*; SE and CNPS 1B). The Bogg's lake hedge-hyssop occurs at lake margins, edges of reservoirs, and stock ponds. It may occur along the edges of Kilarc and Cow Creek Forebays.

Butte Fritillary (*Fritillaeria eastwoodiae*; CSC and CNPS 3). The Butte fritillary occurs in openings on dry beaches and slopes in chaparral, woodland, and lower coniferous forests from 1,600 to 4,920 ft in elevation. It may occur on slopes in oak woodland and mixed conifer habitats in the Project Area.

Shasta Clarkia (*Clarkia borealis* ssp. *Arida*; CSC and CNPS 1B). The Shasta clarkia occurs in cismontane woodland and is endemic to Shasta County. It may occur in blue oak-foothill pine woodland habitat in the Project Area.

Ahart's Paronychia (*Paronychia ahartii*; CSC and CNPS 1B). The Ahart's paronychia occurs in well-drained rocky outcrops or volcanic uplands, annual grassland, or oak woodlands. It may occur in blue oak-foothill pine woodland habitat in the Project Area.

Shasta Snow Wreath (*Neviusia cliftonii*; CSC and CNPS 1B). The Shasta snow wreath occurs in forest and riparian woodland. It may occur in blue oak-foothill pine woodland in the Project Area.

Four Angled Spike Rush (*Eleocharis quadrangulata*; CSC and CNPS 2). The four angled spike rush occurs in freshwater wetlands and marsh habitats. It may occur in the Kilarc and Cow Creek forebays.

4.3.8.2 Sensitive Plant Communities

Sensitive habitats are defined by local, state, or federal agencies as those habitats that support special-status species, provide important habitat values for wildlife, represent areas of unusual or regionally-restricted habitat types, and/or provide high biological diversity. The following vegetation types occurring within the Project Region are considered by public agencies to be sensitive habitats:

- Wetland (freshwater marsh and seeps)
- Riparian forest
- Blue oak-foothill pine woodland

4.3.8.3 Wetland/Riparian

In general, the wetland and riparian communities are considered sensitive habitats due to their high wildlife value, limited distribution, and decreasing acreage statewide. These sensitive habitats have been significantly reduced from their historic distributions. Wetlands are a significant resource that are under the protection and jurisdiction of CDFG and the U.S. Army Corps of Engineers (ACOE), and are subject to a no net loss policy. At the State level, riparian plant communities are considered a sensitive habitat and have been identified by CDFG as a habitat of special concern (Wetlands Resource Policy, CDFG Commission, 1987).

4.3.8.4 Blue Oak Woodlands

Blue oak woodlands have been greatly reduced in extent throughout California by various activities. Blue oak woodland regeneration is considered a statewide problem. The reasons for poor blue oak regeneration are complex and are currently being researched. A number of factors including animal grazing, acorn depredation, plant competition, and environmental extremes can affect recruitment success, depending on site condition. As losses of blue oak woodlands continue, the relative importance of undeveloped stands will increase. In response to the decline of all oak woodland types, CDFG, CNPS, and the Nature Conservancy have identified the conservation of management of oak woodlands as major issues.

4.3.9 Exotic Pests

There are many different definitions of noxious weeds and plant pests. In general, they are non-native plants that have been introduced to North America and have spread to compete with native plant communities. Unlike native plant species, these non-native invaders may have no natural predators such as insects or diseases to control their numbers. There are hundreds of non-native plant pests that freely reproduce in North America. These weeds destroy wildlife habitat and native and artificial forage through increased groundwater consumption. Many of these plant species are not palatable and may even be toxic to native wildlife.

Plant pests are defined by law, regulation, and technical organizations, and are regulated by many different sources, which include the CDFA, USDA, and the CEPPC.

Table 4-3.2 presents a list of noxious weeds that occur in Shasta County and have been verified to occur in the Cow Creek Watershed. Table 4-3.3 presents a similar list of invasive pests.

4.3.10 Impacts Related to the Existing Project

4.3.10.1 Effects of Project Operations and Maintenance Activities on Special-Status Plant Species and the Spread of Noxious Weeds

Routine maintenance activities that may potentially impact botanical resources include regular clearing, trimming, and herbicide use for vegetation control at the Old Cow Creek and South Cow Creek diversions and Kilarc and Cow Creek Powerhouses. In addition, removal of vegetation from the Kilarc Main Canal and dredging of the Kilarc and Cow Creek forebays could also result in impacts to special-status plant populations. The potential presence of special status species will be evaluated as part of the relicensing studies.

Ongoing maintenance and operations could also result in the spread of noxious weeds.

4.3.10.2 Effects of Project Maintenance Activities on Riparian Communities.

Routine maintenance activities that occur at the Old Cow Creek and South Cow Creek diversion structures and vegetation removal that occurs adjacent to the access roads could result in removal of riparian vegetation. The extent and location of riparian vegetation in the Project Area will be determined as part of the relicensing studies.

4.3.10.3 Effects of Project Operation and Maintenance Activities on Wetland Areas

If wetland areas, including seeps or emergent marsh, are identified in areas where routine maintenance activities occur or adjacent to Project-diverted reaches, impacts to these habitats could potentially occur. Emergent marsh vegetation that is present in the Kilarc and Cow Creek forebays would be removed every 8 to 12 years during dredging of the forebays. Forebays are expected to be dredged within the next 10 years. The potential presence of these habitats will be determined as part of the relicensing studies.

4.3.11 References

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California Department of Fish and Game Commission. 1987. Wetlands Resource Policy. California Department of Fish and Game, Sacramento, California.

SHN Consulting Engineers & Geologists, Inc. and Vestra Resources, Inc. 2001. Cow Creek Watershed Assessment. Prepared for Western Shasta Resources Conservation District and Cow Creek Watershed Management Group. Skinner, M.W. and B.M. and Pavlik, 2000. Electronic Inventory of Rare and Endangered Vascular Plants of California. California Native Plant Society Special Publication Number 1. Sacramento, California.

TABLES

Table 4.3-1. Special-Status Plants.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Slender Orcutt Grass *(Orcuttia tenuis)*	FT	SE (1B)	Vernal pools underlain by volcanic substrate in grassland, blue oak woodland, and lower montane conifer forest.	Unlikely to occur. Vernal pools are not present within the Project Area.
Bogg's Lake Hedge-Hyssop *(Gratiola heterosepala)*	-	SE (1B)	Lake margins, edges of reservoirs, and stock ponds.	May occur along the edges of Kilarc Forebay and Cow Creek Forebay.
Butte Fritillary *(Fritillaeria eastwoodiae)*	-	CSC (3)	In openings on dry beaches and slopes in chaparral, woodland, and lower coniferous forests from 1600 to 4920 ft in elevation.	May occur on slopes in oak woodland and mixed conifer habitats in the Project Area.
Shasta Clarkia *(Clarkia borealis* ssp. *arida)*	-	CSC (1B)	Cismontane woodland, endemic to Shasta County.	May occur in blue oak-foothill pine woodland habitat in the Project Area.
Ahart's Paronychia *(Paronychia ahartii)*	-	CSC (1B)	Well-drained rocky outcrops or volcanic uplands, annual grassland, or oak woodlands.	May occur in blue oak-foothill pine woodland habitat in the Project Area.
Shasta Snow Wreath *(Neviusia cliftonii)*	-	CSC (1B)	Forest and riparian woodland.	May occur in blue-oak foothill pine woodland in the Project Area.

Table 4.3-1. Special-Status Plants (continued).

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Silky Cryptantha *(Cryptantha crinita)*	-	CSC (1B)	Gravelly soils usually found in non-wetland areas. Sand and gravel deposits associated with seasonal and, less frequently, perennial streams. Generally below 1000 ft elevation.	Unlikely to occur in the Project Area. Documented occurrence is outside of the Project Area.
Four Angled Spike Rush *(Eleocharis quadrangulata)*	-	CSC (2)	Freshwater wetlands and marsh habitats.	May occur in Kilarc and Cow Creek Forebays.
Henderson's Bent Grass *(Agrostis hendersonii)*	-	CSC (1B)	Valley and foothill grasslands in riparian, wet meadows, and seeps.	Unlikely to occur in the Project Area. Documented occurrence is outside of the Project Area.
Bellinger's Meadowfoam *(Limnanthes floccosa* ssp. *bellingeriana)*	-	CSC (1B)	Meadows, seeps, riparian, and cismontane woodland.	Unlikely to occur in the Project Area. Documented occurrence is outside of the Project Area.
Red Bluff Dwarf Rush *(Juncus leiospermus* var. *leiospermus)*	-	CSC (1B)	Found in the upper Sacramento Valley on the floor and lower foothill terraces from northern Butte, Tehama, and southern Shasta counties. Occurs at the edges of vernal pools and swales. Generally found between 300 to 1000 ft.	Unlikely to occur in the Project Area. Vernal pools and swales not within the Project Area.

Table 4.3-1. **Special-Status Plants (continued).**

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Legenere *(Legenere limosa)*	-	CSC (1B)	Vernal pools and seasonal marshes. Occurs on the drying clay mud of vernal pools and similar seasonal wetlands.	Unlikely to occur in the Project Area. Vernal pools and seasonal marshes not within the Project Area.
Red-flowered Lotus *(Lotus rubriflorus)*	-	CSC (1B)	Occurs in oak woodland and grasslands in Colusa and Stanislaus counties.	Unlikely due to limited distribution. Out of distribution range.
Sanford's Arrowhead *(Sagittaria sanfordii)*	-	CSC (1B)	Found in Tehama County on the east side of the Sacramento Valley, northeast of Red Bluff in grassland/oak woodlands. Occurs in shallow, standing, fresh water and sluggish waterways within the following: marshes, swamps, ponds, vernal pools and lakes, reservoirs, sloughs, ditches, canals, streams, and rivers at elevations from 10 to 2000 ft.	Unlikely to occur in the Project Area. Documented occurrence is outside the Project Area.
Long-stiped Campion *(Silene occidentalis* ssp. *longistipitata)*	-	CSC (1B)	Chaparral and coniferous forests from the high southern Cascade Ranges and Modoc Plateau to the northern High Sierra Nevada; 2300 to 7500 ft.	Unlikely to occur in the Project Area. Documented occurrence is outside Project Area.

Listings of species are frequently updated, with new plants being added or removed form categories at various times.

Table Key

***CNPS Status:**

List 1 B: These plants (predominately endemic) are rare through their range and are currently vulnerable of have a high potential for vulnerability due to limited of threatened habitat, few individuals per population, or a limited number of populations. List 1 B plants meet the definitions of Section 1901, Chapter 10 of the CDF&G code.

List 2: Rare, threatened, or endangered plant species in California, but more common elsewhere

List 3: This is a review of plants that lack sufficient data to assign them to another list

List 4: This is a watch list of plants with limited distribution in the state that have low vulnerability and threat at this time. These plants are uncommon, often significant locally, and should be monitored.

CNPS R-E-D- Code

To increase the refinement of assigning plants to categories. CNPS uses scheme that combines three complementary elements that are scored independently. These components are:

Rarity- which addresses the extent of the plant, both in terms of numbers of individuals and the nature and extent of distribution

Endangerment- Which embodies the perception of the plant's vulnerability to extinction for any reason

Distribution- which focuses on the overall range of the plant

R (Rarity)

1 –Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time.

2. –Distributed in limited number of occurrences, occasionally more if each occurrence is small.

3 --Distributed in one to several highly restricted occurrences, or present in such small numbers that it is seldom reported.

E (Endangerment)	**D (Distribution)**
1 – Not endangered.	1 – More or less widespread outside California
2 Endangered in a portion of its range.	2 – Rare outside California
3 – Endangered throughout its range.	3 – Endemic to California

***State List:**	***Federal List:**
SE = endangered	FE = endangered
SR = rare	FT =threatened
ST -- threatened	PE = Federally proposed endangered
	PT = Federal proposed threatened
	Candidate = sufficient data to support listing

****Habitat requirements and distribution of special-status plants were determined by reviewing information from Hickman (1993), Skinner and Pavlik (2000)**

Table 4.3-2. CDFA Noxious Weeds.

Rank	Latin Name	Common Name	Found in Shasta Co.	Verified in Cow Creek
A				
	Carduus nutans	musk thistle	X	
	Centaurea diffusa	diffuse knapweed	X	
	Centaurea maculosa	spotted knapweed	X	X
	Centaurea squarrosa	squarrose knapweed	X	X
	Chondrilla juncea	skeletonweed	X	
	Hydrilla verticillata	hydrilla	X	
	Linaria genistofolia ssp dalmatica	Dalmation toadflax	X	
	Onopordum acanthium	Scotch thistle		X
B				
	Acroptilon repens	Russian knapweed		
	Aegilops	goatgrass		
	Cardaria chalepensis	lens-podded hoarycress	X	
	Cardaria draba	heart-podded hoarycress	X	
	Cardaria pubescens	globe-podded hoarycress		
	Cirsium arvense	Canada thistle	X	
	Elytrigia repens	quackgrass	X	
	Isatis tinctoria	Dyer's woad	X	
	Lepidium latifolium	perennial peppercress	X	
	Lythrum salicaria	purple loosestrife	X	
	Salvia aethiopis	Mediterranean sage	X	X
C				
	Carduus pycnocephalus	Italian thistle	X	X
	Carduus tenuiflorus	slenderflower thistle	X	
	Centaurea solstitialis	yellow starthistle	X	X
	Convolvulus arvensis	field bindweed	X	
	Cuscata spp. except C. reflexa	dodder	X	
	Cynodon spp and hybrids	bermudagrass	X	X
	Cytisus scoparius	Scotch broom	X	X
	Genista monspessulana	French broom	X	
	Hypericum perforatum	Klamath weed	X	X
	Iva axillaris	poverty weed	X	
	Malvella leprosa	alkali mallow	X	
	Polygonum amphibium var. emersum	kelp	X	
	Salsola tragus	common Russian thistle	X	
	Sorghum halepense	Johnson grass	X	X
	Taeniatherum caput-medusae	medusahead	X	X
	Tribulus terrestris	puncturevine	X	X

Table 4.3-3. CalEPPC List of Invasive Pests.

Rank	Latin Name	Common Name	Found in Shasta Co.	Verified in Cow Creek
Red Alert: Species with potential to spread explosively; infestations currently restricted				
	Centaurea maculosa	spotted knapweed	X	
	Hydrilla verticillata	hydrilla	X	
	Lythrum salicaria	purple loosestrife	X	
List A-1 = Most Invasive Wildland Pest Plants; Widespread				
	Arundo donax	giant reed, arundo	X	X
	Bromus tectorum	cheat grass, downy brome	X	X
	Centaurea solstitialis	yellow starthistle	X	X
	Cortaderia selloana	pampas grass	X	X
	Cytisus scoparius	Scotch broom	X	X
	Genista monspessulana	French broom	X	
	Lepidium latifolium	perennial pepperweed, tall whitetop	X	
	Rubus discolor	Himalayan blackberry	X	X
	Taeniatherum	medusahead	X	X
	Tamarix chinensis, T. gallica, T. parviflora & T. ramosissima	tamarisk, salt cedar	X	X
List A-2 = Most Invasive Wildland Pest Plants; Regional				
	Ailanthus altissima	tree of heaven	X	X
	Cardaria draba	white-top, hoary cress	X	X
	Elaeagnus angustifolia	Russian olive	X	
	Ficus carica	edible fig	X	X
	Mentha pulegium	pennyroyal	X	
List B = Wildland Pest Plants of Lesser Invasiveness				
	Carduus pycnocephalus	Italian thistle	X	
	Centaurea melitensis	tocalote, Malta starthistle	X	
	Cirsium arvense	Canada thistle		X
	Cirsium vulgare	bull thistle	X	X
	Conium maculatum	poison hemlock	X	
	Hypericum perforatum	Klamath weed, St. John's wort	X	X
	Myriophyllum aquaticum	parrot's feather	X	
	Phalaris aquatica	Harding grass	X	X
	Robinia pseudoacacia	black locust	X	
	Spartium junceam	Spanish broom	X	
	Vinca major	periwinkle	X	X
Need more information				
	Descurainia sophia	flixweed, tansy mustard	X	
	Isatis tinctoria	dyers' woad	X	
	Ludwigia uruguayensis	water primrose	X	
	Pinus radiata cultivars	Monterey pine	X	
	Pyracantha angustifolia	pyracantha	X	X

Table 4.3-3. CalEPPC List of Invasive Pests (continued).

Rank	Latin Name	Common Name	Found in Shasta Co.	Verified in Cow Creek
	Salsola tragus	Russian thistle, tumbleweed	X	
	Salvia aethiopis	Mediterranean sage	X	X
Annual Grasses				
	Aegilops triuncialis	barbed goatgrass	X	
	Avena fatua	wild oat	X	
	Bromus diandrus	ripgut brome	X	

4.4 Aquatic Resources and Fisheries

4.4.1 Environment Affected by Existing Project

The Project has facilities in two subbasins of Cow Creek. The South Cow diversion on South Cow Creek affects South Cow Creek and Mill Creek, a tributary to South Cow Creek. The Kilarc diversion diverts water from Old Cow Creek and also has two small diversions on North and South Canyon Creeks. The bypass reaches of South Cow and Old Cow are similar in length, 3.9 mi on South Cow and 3.8 mi on Old Cow Creek. Both diversions use unlined canals to deliver the water to small forebays. The Kilarc Forebay is approximately 4 acres in surface area and the South Cow Forebay is approximately 1 acre in surface area. The Kilarc tailrace discharges directly into Old Cow Creek. The South Cow Creek tailrace discharges into Hooten Gulch approximately 1 mi upstream of its confluence with South Cow Creek.

4.4.2 Aquatic Species

4.4.2.1 Fish Abundance and Distribution in the Project Area

Cow Creek drainage supports a variety of anadromous and resident fishes. In the lower elevations of Cow Creek, anadromous fish, native minnow, and exotic species comprise the population. In the upper portions of Cow Creek resident trout, both native and exotic, are found. There are many passage barriers in the Cow Creek drainage caused by falls or steep streambed conditions which limit the extent of anadromous fish. The fish distribution and abundance are also affected by the low summer flow and high water temperatures typical of the Cow Creek drainage.

Cow Creek watershed supports a variety of species. Table 4.4-1 lists the species potentially found in the Project vicinity and their scientific names. Two runs of Chinook salmon (fall and late-fall-run) use the watershed along with winter run steelhead. Resident trout, both native and exotic, inhabit the watershed as well as a native minnow community and additional warmwater introduced species.

Brown trout were introduced to the Cow Creek watershed in 1931 by CDFG stocking, along with rainbow trout, in or around the Project vicinity. Brown trout have been stocked sporadically in the past, but stocking was discontinued in the 1980's. Green sunfish were introduced in

California in 1891 but there are no a records of actual introduction in the Cow Creek Watershed. Other exotic fish species that are found in other areas of the Cow Creek Watershed but have not been observed in the Project vicinity include brook trout, bluegill, smallmouth bass, largemouth bass, carp, white catfish, and bullhead (Alley 1978).

Not all watershed species have been found in the Project Streams. Fall run Chinook and steelhead are found in both South Cow and Old Cow Creeks as are rainbow, brown and brook trout. Other natives species found in South Cow and Old Cow include Sacramento sucker and riffle sculpin. Native fish found in other areas of the Cow Creek Watershed but which have not been reported in Old Cow or South Cow Creeks include Pacific lamprey, California roach, hardhead Sacramento pikeminow, speckled dace, and tule perch. The few surveys conducted in the Project vicinity are reported in Table 4.4-2.

The CFDG has conducted fall spawning surveys intermittently since 1953 to determine the number of fall-run Chinook salmon in the Cow Creek Watershed. The survey data are limited and sporadic. Spawning survey results from 1967 through 1991 estimate an annual average of 1,373 salmon in the Cow Creek drainage (Mills and Fisher 1994). The estimated Chinook salmon populations in Cow Creek ranged from 7,540 salmon in 1968 to 75 in 1990 (Mills and Fisher 1994).

South Cow Creek is managed for anadromous and resident fish with a focus on salmonids. Both Chinook salmon and steelhead are currently found in South Cow Creek. The South Cow Creek drainage contains 52 mi of potential anadromous fish habitat. Although no specific studies have been conducted to estimate the size of run in Cow Creek or its tributaries, in 1965, CDFG estimated the size of the annual runs as 950 fall-run Chinook salmon and 500 steelhead, CDFG notes that estimates today would be much lower (CDFG 2001). Chinook salmon have been reported to spawn predominately below Wagoner Canyon. Wagoner Canyon is steep and rocky and may provide an impediment to Chinook migrations. Healey (1965) noted that the majority of fall-run and late-fall run Chinook salmon spawn and rear downstream of Wagoner Canyon and Hooten Gulch (river mile (RM) 5.0). In the 1970s, the worst passage barrier was removed in the hopes of providing better access for fall-run Chinook salmon to upstream areas (SHN 2001).

Fall-run Chinook fingerlings have been planted in South Cow Creek near the South Cow Campgrounds, but adults have not been seen in the area (TRPA 1986).

The Licensee also conducted aerial spawning surveys of 13 mi of South Cow Creek from the confluence with Old Cow Creek to about 3 mi upstream of the South Cow Creek Diversion Dam (RM 9.5) in the fall of 1985, 1986, and 1987. The upstream extent of fall-run chinook salmon spawning was found to be below Hooten Gulch (CDFG unpublished data).

Steelhead have been found in the Project Area and have been observed passing through the fish ladder at the South Cow Creek Diversion (Moock and Steitz 1984). In South Cow Creek, steelhead spawning areas are mainly located upstream of Wagner Canyon. CDFG (2001) notes that most of the steelhead spawning activity in South Cow Creek probably occurs above the South Cow Creek Diversion. Healey (1974) reported that the best steelhead spawning habitat in South Cow creek occurs from approximately RM 10 to RM 15. Steelhead have been reported in South Cow Creek as far upstream as the South Cow Creek Campground. TRPA (1986) reported a few redds in South Cow Creek approximately 3 mi upstream from the South Cow Creek Diversion. They study also reported redds in Atkins Creek that they determined were most likely steelhead redds. Atkins Creek is located at RM 20 and is the highest point on South Cow Creek where steelhead have been reported.

In Old Cow Creek, anadromous fish have been reported as far upstream as Whitmore Falls (RM 11). Whitmore Falls has been thought to be a complete passage barrier to anadromous fish. Recent evaluation of the falls by engineers from NMFS and CDFG biologists suggest that the falls may be passable under certain conditions that accompany very high streamflows (Mangi, pers. comm.). No sightings of live anadromous fish or their carcasses have occurred upstream of Whitmore Falls (Harvey 1997). Chinook have been sighted in the pool below Whitmore Falls in the summer. The timing of the appearance of these fish is consistent with spring-run chinook salmon. Historically, Old Cow Creek has been managed as an anadromous stream downstream of Whitmore Falls and for resident trout upstream of Whitmore Falls.

Resident rainbow trout are found throughout Old Cow and South Cow Creeks wherever habitat conditions are suitable. In South Cow Creek, a fish survey conducted approximately 3 mi upstream of the Project Area reported abundant rainbow trout and lower numbers of brown trout. No information was provided on non-salmonid species. Table 4.4-3 provides the results of this 1985 survey.

Two studies have been conducted in Old Cow Creek drainage that provide information on fish resources in the Project vicinity. CDFG sampled Old Cow near the Kilarc Powerhouse in 1973. They reported resident rainbow and brown trout and riffle sculpin have been found in Old Cow Creek within the Project Area. CDFG also noted that the resident trout populations were in good condition with high abundances relative to stream size. Studies conducted for Olson Hydroelectric Project FERC 8361-Ca also found rainbow trout and riffle sculpin (TRPA 2002). Four stations were sampled, two upstream and two downstream of the diversion. Table 4.4-4 provides population estimates for each species reported in this study. The average abundance for rainbow trout from the stations downstream of the diversion was comparable to studies conducted by TRPA in 1984. There they found a fish density of 1,920 rainbow trout per mile. Although the 2001 estimate is lower than that of 1984, they are not significantly different statistically. Brown trout that were found in 1984, however, were absent from the 2001 sampling.

4.4.2.2 Sensitive Special Status Fish Species in the Project Area

Sensitive and special status fish species in the Project Area include the federal candidate and CDFG Species of Special Concern Central Valley Fall and Late-Fall Chinook Salmon ESU[1], and federally-threatened Central Valley Steelhead ESU. The winter-run Chinook is neither part of the present nor past range and distribution (NMFS 1997).

The Central Valley Spring-Run Chinook Salmon ESU was listed as a federally-threatened species on September 16th, 1999 (64 FR 50393) and State threatened on February 5th, 1999. The

[1] An Evolutionarily Significant Unit or "ESU" is a distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout.

ESU and federal designated Critical Habitat include all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries (65 FR 7819). The Cow Creek system is not part of the present range and distribution of Central Valley spring-run Chinook salmon from the best available information (CDFG 1998). Although adult spring-run Chinook salmon have been reported in South Cow Creek, CDFG does not believe South Cow Creek is suitable for spring-run due to warm summer temperatures and the lack of large holding pool habitat (e.g, deep bedrock pools) (USFWS 1998). Adult spring-run Chinook salmon require holding large bedrock pools (>6 ft) in mid-elevation habitat to sustain them to the fall (Moyle 2002). Spring run Chinook salmon did not significantly utilize Old Cow Creek because of Whitmore Falls, a natural barrier blocking migration to suitable spawning and rearing habitat in upstream areas of the watershed (Yoshiyama et al. 2001).

The Central Valley Fall and Late-Fall Chinook Salmon ESU was listed as a federal candidate species on September 16th, 1999 (64 FR 50393) and is a California Species of Special Concern (CDFG 1995). The National Marine Fisheries Service (NMFS) determined that listing was not warranted for this ESU at this time. However, the ESU is designated as a candidate for listing due to concerns over specific risk factors. The ESU includes all naturally spawned populations of fall and late-fall run Chinook salmon in the Sacramento and San Joaquin Rivers.

The Central Valley Steelhead ESU was listed as a federally threatened species on 19 March 1998 (63 FR 13347). The ESU and the designated Critical Habitat include all naturally-spawned populations of steelhead. Life history information and habitat requirements are presented in Section 4.4.2.4.

4.4.2.3 USFWS and CDFG Sensitive Species Not Present in the Project Area

River Lamprey (*Lampetra ayresi*)

River lamprey are distributed throughout the lower Sacramento-San Joaquin River system and are widely distributed along coastal streams (Moyle 2002). Little is known about their life history and they have not been observed or collected in large numbers (Moyle 2002). There is no known record of river lamprey occurring in the Cow Creek watershed, although there may be potential.

Green Sturgeon (*Acipsenser medirostris*)

Green sturgeon are an anadromous species that migrate up the Sacramento River as far as Red Bluff Diversion Dam (RM 243) (Moyle 2002). Principal spawning area for the Sacramento River may be the lower Feather River (Moyle 2002). Green sturgeon are not currently found, nor historically reported within the Project Area nor the Cow Creek Watershed.

Sacramento Winter-run Chinook Salmon *(Oncorhynchus tschytscha)*

Sacramento winter-run Chinook salmon historically migrated up the Sacramento River to spawn the upper reaches of the Sacramento River, the McCloud River and the lower Pit River (Moyle et al. 1989). No spawning occurred in small tributary streams. Presently, winter-run Chinook salmon spawning is limited to the Sacramento River 43.5 mi immediately downstream of Kenswick Dam (Moyle 2002). Winter-run Chinook salmon require cold (10 to 15°C), clear, spring-fed streams during the summer for incubation and fry to survive (Moyle 2002). Neither the Project Area, nor the Cow Creek Watershed is part of the present or past range for winter-run Chinook salmon (NMFS 1997).

Delta Smelt (*Hypomesus transpacificus*)

Delta smelt are principally found in the Sacramento-San Joaquin Delta, Suisun Marsh, Suisun Bay, and San Pablo Bay (Moyle 2002). Delta smelt may occur above Rio Vista on the Sacramento River, but are largely confined to the lower Delta. Delta smelt are not currently found nor historically reported within the Project Area or the Cow Creek Watershed.

Sacramento Splittail (*Pogonichthys macrolepidotus*)

Sacramento splittail are largely confined to the Sacramento–San Joaquin Delta, Suisun Bay, Suisun Marsh, Napa Marsh, the lower Napa River, the lower Petaluma River, and other parts of the San Francisco Estuary (Meng and Moyle 1995, Meng et al. 1994). Splittail were found in early surveys as far north as Redding (Rutter 1907) but today are limited as far upstream as Red Bluff Diversion Dam on the Sacramento River (RM 243) (Moyle 2002). Splittail are not currently found, nor historically, reported within the Project Area or the Cow Creek Watershed.

4.4.2.4 Management of Species

Anadromous Fish Species Management

Anadromous fish management, such as restoration or recovery actions, have been focused on other drainages in the Sacramento River system. Cow Creek Watershed has several challenges for anadromous fish. Much of the land is privately owned; water rights have been adjudicated and the stream system itself has low summer flow that may limit steelhead rearing opportunities in some areas and has numerous migration barriers that limit the extent of anadromy in the basin. The Cow Creek Watershed is briefly addressed in the USFWS Working Paper on Restoration (USFWS 1995) and in The Central Valley Improvement Act Tributary Production Enhancement Program (CH2MHill, 1998). Limiting factors identified in these reports include instream flow, water temperatures, adult passage, entrainment at diversion, impacts to riparian zones, and gravel mining. Nonetheless, Cow Creek has been identified as having good habitat conditions in portions of the drainage and may be a candidate for restoration actions. The CDFG's Steelhead Restoration and Management Plan (McEwan and Jackson 1996) states that Cow Creek contains adequate habitat and notes that steelhead can continue to access the upper portion of their historical range. Several important restoration activities are underway. A Watershed Group has formed and is working with the State and Federal resource agencies to characterize the conditions in the watershed and identify areas of potential improvement. Another action already in place is screening agricultural diversions to prevent entrainment of young salmonids.

Fish Planting Activities

CDFG has had a number of programs that planted fish in the Cow Creek Watershed to support various management activities. Fish planting programs were usually associated with management of resident trout fisheries or enhancement of anadromous fish resources. Species planted in the last 30 years include predominately catchable rainbow trout and Chinook salmon and steelhead fingerlings. Isolated or infrequent plantings were made of largemouth bass (1974 in Buckhorn Lake) and brown trout.

In the Project Area, CDFG has been stocking rainbow trout since 1951 for sport recreational fishing purposes. Most of the stocking for catchable rainbow trout in South Cow Creek is upstream of the Project Area near the Cow Creek Campgrounds (RM 19). Coleman National

Fish Hatchery (CNFH) has been planting steelhead fingerlings in South Cow Creek in the 1980s and 1990s. Fall-run Chinook fingerlings from CNFH were planted in the 1980s as well.

The types of species planted in Old Cow Creek were similar to those in South Cow Creek. However, fewer fish were planted in Old Cow Creek in recent years. Catchable rainbow trout have been planted near the Kilarc Powerhouse and fingerling Chinook salmon and steelhead were planted further downstream.

Currently, Kilarc Forebay is stocked twice a year with catchable rainbow trout to support a recreational fishery there. Anglers report catching large brown trout in the forebay even though no brown trout have been planted since the 1980s. No warmwater fish have been found in Kilarc Forebay.

4.4.2.5 Life Histories of Key Species

The following sections provide general information on the key species including their general distribution, life history strategy and habitat requirements. Table 4.4-5 provides the periodicity of life-history events for the species that are found in the Project Area. Although there is little site-specific information on the timing of important life history activities, the general periodicity chart gives an indication of when certain activities may occur. The information in Table 4.4-5 provides the general timing of life-history events. It reflects site-specific information where available and falls back on more general information where no site-specific data are available. Timing in tributaries can vary from the general watershed timing, as life-history events can be adapted to site- specific conditions.

4.4.2.6 Anadromous Fish Species

Central Valley Fall and Late-Fall Run Chinook Salmon ESU (*Oncorhynchus tshawytscha*)

Distribution: Central Valley fall and late-fall run Chinook salmon historically spawned in the Valley floor and foothill reaches (Rutter 1904). Presently, fall run Chinook salmon spawn in low gradient portions of most Central Valley streams (typically to an upper limit of 1,000 ft of elevation). Late-fall-run chinook salmon are mainly found in the Sacramento River, and most spawning and juvenile rearing occurs from Red Bluff upstream to Keswick Dam. Historically late-fall chinook salmon spawned in the upper Sacramento and major tributaries. Fall-run Chinook salmon occur in the South Fork Cow Creek up to Wagoner Canyon (Cow Creek Powerhouse) (Yoshiyama et al. 2001). Late-fall Chinook salmon have been observed by aerial surveys within the portions of the Cow Creek drainage below Millville, but not in Old Cow or South Cow Creeks (Healey 1965).

Adult Run Timing: Central Valley fall-run Chinook salmon migrate to their spawning grounds after the first series of rains, approximately early October through late December, in the low-gradient sections of the river (Vogel and Marine 1991). The fall rains increase stream flow and cool water temperatures. Late-fall-run Chinook salmon migrate at the same time as fall run Chinook salmon, from October through February (Vogel and Marine 1991). The great majority of late-fall Chinook salmon appear to spawn in the mainstem of the Sacramento River (CDFG 1995). In the past, fall and late-fall Chinook salmon were a mixture of age classes ranging from 2 to 5 years old. At the present time, the spawners are about equally divided between 3 and 4 year-old fish. While migrating and holding in the river, fall and late-fall Chinook do not feed, relying instead on stored body fat reserves for maintenance.

Reproduction: Central Valley fall and late-fall Chinook salmon spawn soon after they enter their natal streams (Yoshiyama et al. 2001). Fall Chinook spawn from early October through late December (Vogel and Marine 1991). Late-fall Chinook salmon spawn in January through March, although it may extend into April in some years (CDFG 1995).

Chinook salmon spawning typically occurs in swift, relatively shallow riffles or along edges of fast runs where there is an abundance of loose gravel. The preferred stream temperature for Chinook salmon spawning is generally 11°C, with a range of 5.6 to 13.3°C (Vogel and Marine 1991). Eggs are laid in large depressions (redds) hollowed out in gravel beds. An average female Chinook salmon produces 3,000 to 6,000 eggs, depending on the size of fish (SHN 2001). The eggs are fertilized by the male and buried in the gravel by the female. The adults die within a few days after spawning. The embryos hatch following a 3 to 4 month incubation period and the alevins (sac-fry) remain in the gravel for another 2 to 3 weeks (CDFG 1995). Once their yolk sac is absorbed, the fry emerge and begin feeding on a variety of terrestrial and aquatic insects (Moyle 2002). All fall and late-fall Chinook salmon fry emerge by early June (CDFG 1995).

Juvenile Rearing, Smolt Size, and Migration: Fall and late-fall Chinook salmon fry disperse downstream after emerging (Moyle 2002). Chinook salmon fry prefer a shallow, silty bottom along the stream edge but move to deeper, swifter water as they mature (Moyle 2002). Juveniles migrate downstream in the spring when flows begin to decline and water temperatures begin to increase. Fall Chinook salmon seldom spend more than 3 to 4 weeks in freshwater before migrating downstream toward the Sacramento-San Joaquin Delta (Moyle 2002). Late-fall Chinook salmon juveniles hold in the river for nearly a year before moving out to sea the following December through March (CDFG 1995). Once in the ocean, salmon are largely piscivorous and grow rapidly. Fall and late-fall run fish typically remain off the California coast during their ocean migration (Myers et al. 1998).

Central Valley Spring-Run Salmon ESU (*Oncorhynchus tshawytscha*)

Distribution: Little is know about the spring-run Chinook salmon populations in the Cow Creek Watershed. The best available information is that Cow Creek is not part of the present range and distribution of spring-run Chinook salmon in the Central Valley (CDFG 1998). There is some anecdotal information that South Fork Cow Creek may have been part of the historic range and distribution of spring-run Chinook salmon.

Adult Run Timing: Adult Central Valley spring-run Chinook salmon enter rivers as immature fish in the spring and early summer March through May. Spring Chinook salmon gonads mature during the summer holding period (Marcotte 1984).

Reproduction: Spring-run Chinook salmon spawning occurs from late August through October (Moyle 1989). See fall and late-fall-run Chinook salmon section above for additional information.

Juvenile Rearing, and Smolt Size, and Migration: Juvenile spring-run Chinook salmon rear in stream 3 to 15 months, depending on flow conditions (Moyle 2002). Juveniles typically emigrate in March through May (Moyle 1989). See Fall and Late-Fall-Run Chinook salmon section for additional information.

Central Valley Steelhead ESU (*Oncorhynchus mykiss*)

Distribution: Central Valley steelhead ESU inhabit the Sacramento and San Joaquin Rivers and their tributaries. Central Valley steelhead are winter-run fish meaning they return to fresh water in autumn or winter, migrate to spawning areas, and spawn in late winter or spring (Meehan and Bjornn 1991). Central Valley steelhead are present in South Cow Creek at and upstream of the Project Area. In South Cow Creek, the best steelhead spawning habitat is located 1.5 mi downstream of the South Cow Creek Diversion Dam to 3.5 mi upstream of the diversion dam (Healey 1974). Adult steelhead have been observed upstream of the Project Area at the South Cow Creek Campground road crossing and in Atkins Creek.

Adult Migration: Central Valley steelhead typically migrate to marine waters after spending 2 years in freshwater. Steelhead then reside in marine waters for typically 2 or 3 years prior to returning to their natal stream to spawn as 4 or 5 year olds. Steelhead enter freshwater from July through May with peaks in September and February (McEwan and Jackson 1996). Central Valley steelhead are ocean maturing, meaning they enter fresh water with well-developed gonads and spawn shortly after river entry.

***Reproduction*:** Central Valley steelhead spawn from late January and extend into April (McEwan and Jackson 1996). Unlike other Pacific salmon, steelhead are capable of spawning more than once before they die. Steelhead prefer to spawn in cool, clear well-oxygenated streams with suitable depth, current velocity, and gravel size (Reiser and Bjornn 1979). Female steelhead contain approximately 2,000 eggs per kilogram of body weight (Moyle 2002).

Steelhead spawn for the first time after spending 2 to 3 years in freshwater and 1 to 2 years in salt water (Moyle 2002). Steelhead adults, constitute 83 percent first time spawners, 14 percent second-time spawners, 2 percent third-time spawners, and 1 percent fourth-time spawners in the upper Sacramento (Hallock 1989). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females. Steelhead spawn once a year but may skip a year between spawnings. Steelhead eggs incubate for 1.5 to 4 months, depending on water temperature, before hatching.

Steelhead reproduction is described in greater detail in the rainbow trout section below.

Juvenile Rearing, Smolt Size, and Migration: Following yolk sac absorption, steelhead fry emerge from the gravel and begin actively feeding. Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects (Moyle 2002). Central Valley steelhead rear in fresh water for at least one year before emigrating to the ocean. Juvenile emigration occurs during the spring and early summer months (SHN 2001).

4.4.2.7 Native Resident Fish Species

Rainbow Trout (*Oncorhynchus mykiss*)

Distribution and Habitat: Rainbow trout native distribution extends along the Pacific Coast from southwestern Alaska to Northern Mexico and east to the Rocky Mountains (Needham and Gard 1959). Rainbow trout are now widely distributed throughout the world due to fish cultural practices. They are able to live under a wide range of temperature conditions and fare well in lakes, reservoirs, and streams. Preferred rainbow trout habitat is cool, clear, swift flowing permanent streams, where riffles tend to predominate over pools (Moyle 2002). Rainbow trout are able to tolerate water temperatures from 0 to 28°C, but optimum temperature for growth is between 13 to 21°C (McAfee 1966, Moyle 2002).

Reproduction: Rainbow trout maturity varies from 1 to 5 years, but they usually mature by the second or third year (McAfee 1966, Moyle 2002). Spawning takes place in early spring from February through June (Moyle 2002). Fecundity varies from 200 to 9,000 eggs per female, depending on the size of the fish (McAffee 1966). Rainbow trout spawn in gravel riffles with a moderate gradient or at the tail end of a pool (McAfee 1966). Rainbow trout spawn once a year but may skip a year between spawnings. Rainbow trout egg incubation depends on water temperature, with an average of 80 days at 4.4°C to 19 days at 15.6°C (Emboy 1934). Rainbow trout fry emerge from the gravel 2 to 3 weeks after absorbing their yolk sacs and move to quiet edge water next to the shore (Moyle 2002).

Diet: Rainbow trout diet consists mainly of drift and bottom invertebrates however they are generally opportunistic feeders (Moyle 2002).

California Roach (*Lavinia symmetricus*)

Distribution and Habitat: California roach are found throughout the Sacramento-San Joaquin drainage system (Moyle 2002). They are generally found in small, warm intermittent streams, and dense populations are frequently found in isolated pools (Moyle 2002, Moyle et al. 1982). California roach are most abundant in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams (Moyle 2002). Roach are tolerant of relatively high temperatures (30-35°C) and low oxygen levels (1-2 ppm) (Taylor et al. 1988). However, they are habitat generalists, also being found in cold, well-aerated clear "trout" streams (Taylor et al. 1988), in human-modified habitats and in the main channels of rivers (Moyle 2002; Moyle and Daniels 1982).

Reproduction: California roach become mature after 1 to 3 years (Fry 1936; Barnes 1957). Spawning occurs from March through June, when water temperature reaches approximately 16°C (Fry 1936; Murphy 1943). Prior to spawning, the California roach congregate in small pools in groups of 15 to 50 fish. During the spawning season, schools of fish move into shallow areas with moderate flow and gravel/rubble substrate (Moyle 2002). Females deposit adhesive eggs in the substrate interstices and the eggs are fertilized by attendant males. Typically, 250 to 900 eggs are produced by a female and the eggs hatch within 2 to 3 days (Moyle 2002). California roach juveniles move into the deeper pools and main body of a creek. Growth is seasonal, with rapid growth during the early summer (Fry 1936). They often share these areas with juvenile Sacramento sucker, Sacramento pikeminnow, and threespine stickleback. California roach generally live 3 years, although a few may live a year or two longer (Moyle 2002). Roach are important forage fish and are often used as bait fish by fishermen (Barnes 1957).

Diet: California roach are omnivores. The major food items of juvenile roach include diatoms, filamentous algae, crustaceans, and small aquatic insects (Fite 1973). During the winter their diet consists largely of diatoms and other unicellular algae.

Sacramento Sucker (*Catostomus occidentalis*)

Distribution and Habitat: Sacramento sucker is widely distributed in the Sacramento-San Joaquin River drainage system in a wide variety of waters, from cold, rapidly-flowing streams to warm, nearly stagnant sloughs (Moyle 2002). Sacramento sucker seem to be most abundant in clear, cool streams, especially in the pools at moderate elevations from 200 to 600 m (Moyle 2002). Adults tend to be independent and likely to be found in large bodies of water, while juveniles school and are most abundant in tributary streams. Sacramento sucker are usually associated with pikeminnow, hardhead, and California roach and trout (Moyle 2002).

Reproduction: Sacramento sucker spawning occurs in the fourth or fifth year (Moyle 2002). Spawning generally takes place over gravel riffles between late February and early June, depending on the warming of creek water. Sacramento sucker eggs are broadcast over gravel and adhere to a depression in gravel created by the female (Moyle 2002). Sacramento sucker fecundity increases with the size of the female. Eggs hatch in three to four weeks and fry are washed into warm shallows where they occur in large schools.

Forage: The food habitat of Sacramento sucker is algae, detritus, and invertebrates. They generally browse on the bottom of deep pools during the day, and move up into riffles to forage in the evening (Moyle 2002).

Riffle Sculpin (*Cottus gulosus*)

Distribution and Habitat: The riffle sculpin is widely distributed throughout the Sacramento-San Joaquin River drainage system. Riffle sculpin are typically found in headwater or upper reaches of streams where riffles predominate (Moyle 2002).

Reproduction: Riffle sculpin mature by the end of the second year and spawn in late February to April on the underside of rocks in swift riffles or inside cavities of woody debris (Moyle

2002). Riffle sculpin produce 104 to 449 eggs depending on the size of fish (Bond 1963; Millikan 1968). Male riffle sculpin guard the nest, not feeding, until fry emerge (Moyle 2002). Riffle sculpin eggs hatch in 11 to 24 days depending on water temperature (Moyle 2002). After absorbing the yolk sac, at about 6 mm total length (TL), the riffle sculpin fry assume a benthic existence (Millikan 1968). Most growth occurs in the spring and summer. During their first summer, riffle sculpin grow about 6 mm per month reaching 25 to 45 mm standard length (SL) by the end of the growing season. Two-year-old fish average 40 to 50 mm SL and 3-year-old fish, 50 to 60 SL. Riffle sculpins seldom live longer that 4 years (Moyle 2002).

Forage: Riffle sculpin are an opportunistic bottom feeder, feeding on mainly benthic invertebrates (Moyle 2002).

4.4.2.8 Exotic Fish Species

Brown trout (*Salmo trutta*)

Distribution and Habitat Requirements: Brown trout, native to Europe and western Asia, were introduced in California in 1894 (Staley 1966). Brown trout are present in most trout waters in the state. Adult brown trout are largely bottom-oriented pool dwellers but younger, smaller trout are as likely to be found in riffles as in pools (Moyle 2002). The optimum habitat for brown trout is a medium- to large-sized, slightly alkaline, clear stream with both swift riffles and large deep pools. They are able to tolerate water temperatures near freezing to over 27°C.

Reproduction: Brown trout mature in their second or third year, but may not spawn until seven years (Moyle 2002). Spawning takes place in the late fall or early winter, November and December, when stream flows are normally low (Staley 1966). Brown trout spawning habitat require small to large gravel (1 7.5 cm) riffles at the tail of a pool (Stuart 1953). Selection of a spawning site does not occur until water temperatures have dropped to 6 to 10°C (Frost and Brown 1967). Brown trout eggs hatch in 4 to 21 weeks, typically 7 to 8 weeks depending on water temperature (Moyle 2002). Brown trout fry live in quiet waters close to shore, feeding among woody debris, aquatic or overhanging vegetation (Moyle 2002).

Diet: Brown trout are drift and bottom invertebrate feeders like most other trout. Adult brown trout fed on fish and active invertebrates, such as crayfish and dragonfly larva (Staley 1966).

Green sunfish (*Lepomis cyanellus*)

Distribution and Habitat: Green sunfish are native to the Mississippi drainage (Moyle 2002). They were accidentally introduced to California in 1891 (McKechnie and Tharratt 1966). Green sunfish have a high tolerance for warm water, low oxygen, and high alkalinity and often inhabit streams that have been disturbed by man (Moyle 2002). Green sunfish are abundant in intermittent streams that have warm, turbid, muddy bottomed pools with aquatic plants (Moyle and Nichols 1973).

Reproduction: Green sunfish mature at 2 years old and approximately 8 cm long (McKechnie and Tharratt 1966). They spawn from May through August, peaking in June, when water temperatures rise above 15.6°C (McKechnie and Tharratt 1966). Green sunfish produce from 2,000 to 10,000 eggs, depending on size of the female (Moyle 2002).

Diet: Green sunfish are opportunistic predators on large active invertebrates and small fish (Sigler and Miller 1963). Smaller fish feed mostly on crustaceans and aquatic insect larvae. Adults may prey on mosquitofish (*Gambusia affinis*), small sunfish (*Centracids*), and California roach (Moyle 2002).

4.4.3 Impacts Related to the Existing Project

Potential impacts to aquatic species may be related to passage issues at the diversions, changes in streamflow in the bypass reach, discharge of water from Project tailraces, and maintenance activities that may introduce sediment or hazardous materials into waterways. Since no new features or operations are being considered, the evaluation of the existing Project will provide an assessment of ongoing Project impacts.

4.4.3.1 Habitat and Instream Flows

The flow regime at Project facilities is influenced by other water uses within the Old Cow and South Cow Creeks upstream from the Licensee's diversions. Water use is primarily for agricultural irrigation, stock water, or other hydroelectric projects. Section 4.2, Water Use and Quality provides information on other water uses.

In 1978, the Licensee conducted a streamflow evaluation study for South Cow Creek downstream of the South Cow Diversion Dam using the Waters Method (1976). The Waters Method was a precursor to the Instream Flow Incremental Method (IFIM) and uses a similar study design. Notable differences are that it relies on an empirical relationship rather than hydraulic modeling and it uses "nose" velocities rather than mean column velocities to develop habitat relationships. The study evaluated the relationship between stream flow and three types of habitat: food producing habitat, resting habitat, and spawning habitat. Flows evaluated were 4, 7, 15, and 22 cfs. The results indicate that resting habitat increases slowly with increase in stream flow, spawning habitat increases rapidly with increasing streamflow, and food producing habitat also increases with flow but less sharply than spawning habitat. The analysis of the Project indicated that the Diversion bypassed 65 to 80 percent of the flow from December through May when steelhead and rainbow trout would be spawning and young fry would be emerging. During June the diversion released about half of the inflow and met the instream flow requirements of 4 cfs in July through October (Licensee, unpublished data).

The Licensee evaluated the Old Cow Diversion and found that 50 to 60 percent of the inflow was bypassed during the December through May period. This is the period when rainbow and brown trout are spawning. The analysis showed that 35 percent of the flow was bypassed in June and the instream flows were bypassed in the months of August, September, and October. When the bypass flow is the primarily instream flow, there is a section of stream between the Kilarc Diversion and the release point that is watered only by seepage. This section of stream is approximately 100 ft long where poor quality habitat is available during the summer months.

TRPA conducted an instream flow assessment of Old Cow Creek for the proposed Mega Renewables Tucker Project FERC No.8681-001 located upstream of the Kilarc Diversion Canal during the spring of 1985. This study indicated that suitable conditions for rainbow and brown trout spawning were found at flows from 55 cfs to 130 cfs and suitable rearing flow were found at flows less than 20 cfs.

4.4.3.2 Stream Temperatures

The Project area near South Cow Creek Diversion Dam is also subject to high stream temperatures. The Licensee compiled the weekly mean minimum and maximum water temperatures for several stations in 1974. Stream temperatures upstream of the South Cow Creek Diversion reached weekly mean minimums of 68° F in late July and early August. The mean maximum temperatures are above 70° F in July and August and reached a high of 78° F in late July. South Cow Creek in Wagnoner Canyon shows a similar pattern but at slightly lower temperatures. Weekly mean minimum temperatures do not exceed 65° F while maximums reach 76° F. After August, there is a distinct decline in water temperatures related to cooling air temperatures. The water temperature data indicates that temperatures in this reach are too high to provide suitable rearing habitat for steelhead or resident trout. These water temperatures were observed during lower flow releases in 1974.

The Project Area near the Kilarc Diversion on Old Cow Creek has lower water temperatures than South Cow Creek. The maximum weekly temperatures at the diversion were usually below 60°F and the minimum weekly temperatures were generally below 50°F. At the downstream end of the bypass reach, minimum weekly temperatures were usually less than 65° F and the maximum temperatures were less than 70° F. One week had a maximum of 73° F and a minimum of 65° F. Water temperatures here are suitable for resident trout throughout the year.

4.4.3.3 Passage/Entrainment

Passage and entrainment are important factors to consider for water diversions. The opportunity of the structure to impede passage or entrain fish and the risk to populations from entrainment will be evaluated. Passage of anadromous fish is critical to the completion of their life history and most of the focus has been on the South Cow Creek facilities to address passage for salmon and steelhead. In 1984, a fish ladder and fish screen were installed on the South Cow Diversion. As a part of the monitoring program for these facilities the Licensee conducted a study to evaluate their functionality. Adult steelhead were reported to pass through the ladder. No Chinook salmon were observed. An experiment was conducted with young steelhead from the Coleman National Fish Hatchery to determine the success of downstream migrant passage. This evaluation showed that the screens and ladder provided adequate passage and protection for anadromous fish at this facility.

Although it is not known if steelhead use Mill Creek, steelhead can pass Mill Creek diversion even though there are no special passage facilities. The diversion dam is only 2.5 ft high and adult steelhead can easily pass over the dam during their migration period. If young steelhead or other fish were entrained in the Mill Creek diversion, they would be transported to South Cow Creek just upstream of the Cow Creek Diversion. The Mill Creek Canal enters South Cow Creek approximately 500 ft upstream from the natural confluence of Mill and South Cow Creeks. The young would then be protected from entrainment by the fish screens at the South Cow Diversion.

On Old Cow Creek, the diversion incorporates a trash rack, but no fish screens are in place. Resident trout may travel from Old Cow Creek, into the Kilarc Main Canal and on to the Kilarc Forebay. The canal is unlined and stream-like in character. The forebay supports a recreational fishery, which is supported in part by fish entering the forebay from Old Cow Creek. Kilarc Forebay supports a brown trout fishery that is probably dependent on fish from Old Cow Creek but mainly relies on fish planting.

The small diversions on Canyon Creek may also entrain fish, if fish are present. These streams are intermittent and in the summer flow levels may not be sufficient to support fish populations. Fish entrained here would pass through the Canyon Canal and into the Kilarc Main Canal, which exits into the Kilarc Forebay.

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TABLES

Table 4.4-1. Fish Species Present in the Cow Creek Watershed and the Project Area.

Species	Cow Creek Watershed [a]	Project Area Old Cow Creek [b]	Project Area South Cow Creek [b]
Pacific lamprey *Lampetra tridentata*	X		
Common carp *Cyprinus carpio*	X		
Hitch *Lavinia exilicauda*	X		
California roach *Lavinia symmetricus*	X		
Hardhead *Mylopharodon conocephalus*	X		
Sacramento pikeminnow *Pychocheilus grandis*	X		
Speckled dace *Rhinichthys osculus*	X		
Sacramento sucker *Catostomus occidentalis*	X		X
Bullheads *Ameiurus spp.*	X		
White catfish *Ameiurus catus*			
Prickly sculpin *Cottus asper*	X		
Riffle sculpin *Cottus gulosus*	X		X
Chinook salmon (Fall-run) *Oncorhynchus tshawytscha*	X		X
Chinook salmon (Late-fall-run) *Oncorhynchus tshawytscha*	X		
Chinook salmon (Spring-run) *Oncorhynchus tshawytscha*	X		?
Rainbow trout (Resident) *Oncorhynchus mykiss*	X	X	X
Rainbow trout (Steelhead) *Oncorhynchus mykiss*	X		X
Brown trout *Salmo trutta*	X	X	X
Brook trout *Salvelinus fontinalis*	X		

Table 4.4-1. Fish Species Present in the Cow Creek Watershed and the Project Area (continued).

Species	Cow Creek Watershed [a]	Project Area Old Cow Creek [b]	Project Area South Cow Creek [b]
Green sunfish *Lepomis cyanellus*	X		X
Bluegill *Lepomis macrochirus*	X		
Largemouth bass *Micropterus salmoides*	X		
Smallmouth bass *Micropterus dolomieu*	X		
Tule perch *Hysterocarpus traski*	X		

[a] The Cow Creek watershed includes Little Cow Creek, Oak Run Creek, Clover Creek, Old Cow Creek, and South Cow Creek downstream of Project Area (below Hooten Gulch.

[b] Project Area includes bypass reaches, diversions, canals, and forebays.

Source: Alley et al., 1977; Alley 1978, SHN 2001.

Table 4.4-2. Summary of Fish Surveys in the Project Vicinity.

Project Vicinity Location	Date	Methods	Fish
Old Cow Creek Facilities			
Lower and Upper Whitmore Falls	23 July 1997	Snorkel survey	One 67cm adult female Chinook salmon at the Upper Falls and one between the Falls.
Lower and Upper Whitmore Falls	Sept 1991 and Summer 1992	Snorkel survey	No fish.
Upstream of the existing intake of the Kilarc Powerhouse (RM 21)	Mid-1970s	Electrofishing survey by CDFG	Rainbow trout, brown trout and riffle sculpin "trout populations large for the stream size."
Near Olsen hydroelectric Project Diversion	January 2001	Electrofishing survey by TRPA	Rainbow trout and riffle sculpin.
South Cow Creek Facilities			
13 mi of South Cow Creek upstream - Old Cow Creek confluence to 3 mi of Diversion Dam	1986-1988	Aerial spawning surveys by Licensee	Fall-run Chinook salmon
South Cow Creek Fish Ladder and Fish Screen	1984	Trapping study by Licensee	Steelhead
South Cow Creek	Sporadic since 1953	Spawning surveys by CDFG	Fall-run Chinook salmon
Cow Creek Powerhouse on South Cow Creek	15 May 1974	One set - 17 hour standard selective gillnet by CDFG	Steelhead, rainbow trout, brown trout Sacramento sucker, and green sunfish
Cow Creek Powerhouse - Base of Wagoner Canyon	N/A	Direct observations by CDFG	Fall-run Chinook salmon - spawning
Upstream of Mill Creek Canal on South Cow Creek	1974	Direct observations by a CDFG Warden	Steelhead

Table 4.4-3. Estimates of Trout Populations in South Cow Creek from a 1985 Survey by TRPA.

Species	Reach 1 Fish per Mile	Reach 2 Fish per Mile	Average Fish per Mile
Rainbow Trout (All Sizes)	10,263	6,168	8,215
Rainbow Trout (>90 mm)	2,553	2,048	2,305
Brown Trout (All Sizes)	768	617	6,93
Brown Trout (>90 mm)	174	198	186

Note: rainbow trout numbers also include juvenile steelhead

Table 4.4-4. Population Estimates for Old Cow Creek Stations Downstream from Olsen Hydroelectric Project as Sampled by TRPA in January 2001.

Old Cow Creek Electrofishing Survey	Study Site Length	Rainbow Trout Fish per Mile	Riffle Sculpin Fish per Mile
Reach 1	196 ft	1670	7193
Reach 2	192 ft	1678	6683
Average of Upstream Stations		1674	6938
Reach 3	190 ft	1779	8115
Reach 4	195 ft	1922	6580
Average of Downstream Stations		1851	7348

Table 4.4.5. Phenology for Selected Fish Species Found within the Cow Creek Watershed.

Fish Species Life Phase	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Fall Chinook Salmon												
Adult Migration	■	■	▨									▨
Spawning	▨■	■	■▨									
Incubation and Rearing	■	■	■	■	■	▨						
Juvenile Outmigration				▨	■	■	▨	▨				
Late-Fall Chinook Salmon												
Adult Migration		▨	■	■	■	▨	▨					
Spawning			▨	▨	■	▨	▨					
Incubation and Rearing				■	■	■	■	■	■▨	▨		
Juvenile Outmigration	■	■▨	▨							▨	▨	■
Spring Chinook Salmon												
Adult Migration						▨	▨	■	■	▨	▨	▨
Spawning	■▨										▨	▨■
Incubation and Rearing			■	■	■	■						
Juvenile Outmigration	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Steelhead												
Adult Migration	▨	■	■	■	■	▨	▨					
Spawning				▨	■	■▨	▨					
Incubation and Rearing	■	■	■	■	■	■	■	■	■	■	■	■
Juvenile Outmigration					▨	▨■	■	▨	▨			
Adult Outmigration							■	■	■			
Rainbow Trout												
Spawning				▨	■	■	▨					
Incubation and Rearing					■	■	■	■▨	▨			
Adult/Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■

Table 4.4.5. Phenology for Selected Fish Species Found within the Cow Creek Watershed (continued).

Fish Species / Life Phase	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Brown Trout												
Spawning	Possible	Peak	Peak	Possible								
Incubation and Rearing	Possible	Peak	Peak	Peak	Possible							
Adult/Juvenile Rearing	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
Sacramento Sucker												
Spawning					Possible	Possible	Peak	Peak	Possible			
Adult/Juvenile Rearing	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
California Roach												
Spawning						Possible	Peak	Peak	Possible			
Adult/Juvenile Rearing	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
Green Sunfish												
Spawning								Possible	Peak	Peak/Possible	Possible	
Adult/Juvenile Rearing	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
Riffle Sculpin												
Spawning					Possible/Peak	Peak	Peak/Possible					
Adult/Juvenile Rearing	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak

Possible = *Possible occurrence*

Peak = *Period of peak use*

4.5 Wildlife

4.5.1 Environment Affected by Existing Project

The Project Region contains five vegetation communities and their associated wildlife habitats, which support a diversity of wildlife. For a detailed discussion of vegetation communities within the Project Area, see Section 4.3. Five wildlife habitats are present within the Project Area, including irrigated pasture, valley foothill riparian, blue oak-foothill pine woodland, Sierran mixed conifer, and cliffs and rock outcrops. Wildlife habitats were classified according to the Wildlife Habitat Relationship (WHR) System (Mayer and Laudenslayer 1988). The diversity of wildlife found within each wildlife habitat is dependent on the vegetation present.

4.5.2 Wildlife Species

The following subsections discuss the amphibians, reptiles, birds, mammals, and big game expected to occur in the Project Area. Information regarding wildlife species known or expected to occur in the Project Area has been obtained from the Cow Creek Watershed Assessment prepared for the Western Shasta Resource Conservation District and the Cow Creek Watershed Management Group and the CNDDB (SHN 2001; CDFG 2000a).

4.5.2.1 Amphibians

Amphibians expected to occur in the Project Area include Pacific treefrog (*Hyla regilla*), bullfrog (*Rana catesbeiana*), and western toad (*Bufo boreas*). All species of amphibians require water or cool moist areas for reproduction. Riparian communities support the highest levels of amphibian species in richness and diversity in California. Streamside pools and low-flow shallows can provide breeding habitat for a variety of species of frogs, toads, and newts. Other species of salamanders and newts will utilize adjacent moist, terrestrial habitats underneath fallen logs and leaf litter.

4.5.2.2 Reptiles

Reptiles commonly found in wildlife habitats present in the Project Area include western fence lizard (*Sceloporus occidentalis*), northern alligator lizard (*Gerrhonotus coeruleus*), and western skink (*Eumeces skiltonianus*). Snakes likely to occur in the Project Area include the common garter snake (*Thamnophis sirtalis*), western rattlesnake (*Crotalus viridis*), western aquatic garter snake (*T. couchii*), striped racer (*Masticophis lateralis*), and gopher snake (*Pituophis melanoleucus*).

4.5.2.3 Birds

Birds are the most abundant vertebrates in the Project Area. Barn swallows (*Hirundo rustica*), western bluebird (*Sialia mexicana*), western meadowlark (*Sturnella neglecta*), American robin (*Turdus migratorius*), Canada goose (*Branta canadensis*), American kestrel (*Falco sparverius*), and turkey vulture (*Cathartes aura*) are found in non-native grasslands and agricultural lands.

Winter wren (*Troglodytes troglodytes*), Swainson's thrush (*Catharus ustulatus*), and song sparrow (*Melospiza melodia*) are more abundant in riparian habitats. American dipper (*Cinclus mexicanus*), great blue heron (*Ardea herodias*), belted kingfisher (*Ceryle alcyon*), and various species of waterfowl utilize the near shore areas of rivers and creeks for foraging and nesting. Swifts, swallows, and flycatchers can be found foraging over open water habitats. Red-shouldered hawks (*Buteo lineatus*) utilize riparian trees for nesting.

Blue oak-foothill pine woodlands provide significant habitats for many birds and mammals. Important habitat features of oak woodlands include acorn production and the presence of cavity-bearing trees. Acorns provide an important seasonal food source. Cavity-nesting birds depend on the natural cavities associated with mature oak trees for nesting. These cavities receive high levels of use by woodpeckers, owls, tree swallows (*Tachycineta bicolor*), and purple martin (*Progne subis*). The insects associated with oaks are prey for several birds such as bushtit (*Psaltriparus minimus*), kinglets (*Regulus* spp.), and warblers. California towhee (*Pipilo crissalis*) and sparrows will forage in the understory of blue oak-foothill pine woodlands. Bird species found in the mixed conifer forest include the hairy woodpecker (*Picoides villosus*), sharp-shinned hawk (*Accipiter striatus*), and brown creeper (*Certhia americana*).

Non-native bird species that occur in the Project Area include brown-headed cowbird (*Molthrus ater*), wild turkey (*Meleagris gallopavo*), ring-necked pheasant (*Phasianus colchicus*), and chuckar (*Alectoris chuckar*).

4.5.2.4 Mammals

A number of small mammals are common to the Project vicinity. Common bat species include long-tailed myotis (*Myotis evotis*), California myotis (*M. californicus*), and hoary bat (*Lasiurus cinereus*). Other small mammals expected to occur include California vole (*Microtus californicus*), western harvest mouse (*Reithroclontomys megalotis*), California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), western spotted skunk (*Spilogale gracilus*), weasel species (*Mustela* spp.), northern flying squirrel (*Glaucomys sabrinus*), Douglas' squirrel (*Tamiasciurus douglasii*), broad-footed mole (*Scapanus latimanus*), dusty-footed woodrat (*Neotoma fuscipes*), deer mouse (*Peromyscus* spp.), raccoon (*Procyon lotor*), and opossum (*Didelphis virginiana*). Larger mammals in the Project vicinity include coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), and mountain lion (*Felis concolor*).

4.5.2.5 Big Game

The big game species in the Project vicinity include: black-tailed deer (*Odocoileus hemionus columbianus*), black bear (*Ursus americanus*), and feral pigs (*Sus scrofa*). The Cow Creek Watershed is part of the Cascade-North Sierra Nevada Deer Assessment Unit (DAU), one of 11 statewide units that assess deer habitat status, population trends, and issues surrounding deer management. Within this DAU, CDFG has estimated that deer populations have decreased from 100,000 in 1952 to 25,000 in 1996. The decline in numbers of animals is thought to be primarily due to loss of early successional habitat in deer summer range. The number of black bears in Shasta County in 1998 was estimated to be approximately 180 (SHN 2001). The number of feral pigs in the Project Area is not known, but they have been observed in the Whitmore area.

4.5.3 Special-Status Wildlife Species

Animal species may be considered sensitive due to declining populations, vulnerability to habitat change, or restricted distribution. Certain sensitive species have been listed as threatened or endangered by the USFWS or by the CDFG and are protected by the Federal or State Endangered Species Acts. Other species have been identified as Species of Special Concern by the CDFG. Table 4.5-1 includes a list of special-status wildlife species, including common and scientific names, state and/or federal status, habitat requirements, and potential for occurrence in the Project Area. Special-status wildlife species that were determined not to be present, and/or for which appropriate habitat is not present in the Project Area, are not discussed further in this document. Special-status species that are known to occur or for which appropriate habitat is present in the Project Area are discussed in the following sections: Invertebrates, Amphibians and Reptiles, Birds, and Mammals. Information on distribution and habitat requirements included in this report is adapted from *California's Wildlife Volumes I-III* (Zeiner et al. 1988; 1990a; and 1990b).

4.5.3.1 Invertebrates

Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) (FT). This species is associated with various species of elderberry (*Sambucus* spp.). The valley elderberry longhorn beetle (VELB) generally occurs along waterways and in floodplains that support remnant stands of riparian vegetation. Both larvae and adult VELB feed on elderberries. Larvae feed internally on the pith of the trunk and larger branches, while adult beetles appear to feed externally on elderberry flowers and foliage. Prior to metamorphosing into the adult life stage, VELB larvae chew an exit hole in the elderberry trunk, through which the adult beetle later exits the plant. Appropriate habitat is present in elderberry shrubs present within the Project Area.

4.5.3.2 Amphibians and Reptiles

California red-legged frog (*Rana aurora draytonii*) (FT and CSC). California red-legged frog habitat is characterized by dense, shrubby riparian vegetation associated with deep, still, or slow-moving water (USFWS 1997). Shrubby riparian vegetation dominated by arroyo willow, cattails, and bulrushes are preferred habitats. Appropriate habitat for California red-legged frog may be present in Old Cow Creek and South Fork Cow Creek. The Project Area is located approximately 30 mi from USFWS designated critical habitat for this species (e.g., Unit 6). The Project Area is located within the Recovery Unit but is not within a Core recovery area. The nearest Core recovery area is approximately 12 mi from the Project site (e.g., Unit 13).

Foothill yellow-legged frog (*Rana boylii*) (FSC and CSC). The foothill yellow-legged frog occurs in the Coast Ranges from the Oregon border south to the Transverse Mountains in Los Angeles County, in most of northern California west of the Cascade crest, and along the western flank of the Sierra south to Kern County from MSL to 6,000 ft above MSL in the Sierra. The foothill yellow-legged frog is found in or near rocky streams in a variety of habitats, including valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow types. Breeding and egg laying usually await the end of spring flooding and may commence any time from mid-March to May, depending on local water conditions. The breeding season at any locality is usually about 2 weeks for most populations. Females deposit eggs in clusters of 200 to 300. They hatch in about 5 days. Tadpoles transform in 3 to 4 months. The reduction in the population of this species may be due to predation by the bullfrog (Zeiner et al. 1988). Appropriate habitat may be present in Old Cow Creek and South Fork Cow Creek.

Northwestern pond turtle (*Clemmys marmorata marmorata*) (FSC, CSC, and CFP). The western pond turtle is uncommon to common in suitable aquatic habitat throughout California, west of the Sierra-Cascade crest from MSL to 6,000 ft above MSL. It is associated with permanent or nearly permanent water in a wide variety of habitat types. Pond turtles require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks. Three to 11 eggs are laid from March to August depending on local conditions. The incubation period for eggs ranges from 73 to 80 days. Sexual maturity is attained in about eight years. Appropriate habitat is present in the Kilarc and Cow Creek Forebays where emergent vegetation and basking sites are present.

4.5.3.3 Birds

Northern goshawk (*Accipiter gentilis*) (FSC and CSC). Northern goshawks inhabit middle- to high-elevation, mature, dense coniferous forests throughout the east and west sides of the Sierra. During winter, it occurs in the foothills, in northern deserts, in pinyon-juniper woodland, and in low-elevation riparian habitats. This species breeds in the North Coast Ranges through the Sierra Nevada, Klamath, Cascade, and Warner Mountains and possibly in the Mount Pinos, San Jacinto, San Bernardino, and White Mountains. It remains yearlong in breeding areas as a scarce to uncommon resident. Optimal habitat contains trees for nesting, a closed canopy (>50%) for protection and thermal cover, and open spaces allowing maneuverability. It prefers middle and higher elevations and mature, dense conifer forests. They feed mostly on birds, using snags and dead treetops as observation platforms. Northern goshawks usually nest on north slopes, near water, in the densest parts of stands, but close to openings. Breeding occurs from April to June. Average clutch size is three eggs. Incubation lasts 36 to 41 days. Young usually fledge by 45 days. This species may forage in riparian, blue oak-foothill pine woodland, or mixed conifer habitat in the Project Area. This species may also breed near streams or forebays in the Project Area.

Sharp-shinned hawk (*Accipiter striatus*) (CSC). This species is a fairly common migrant and winter resident throughout California, except in areas with deep snow. There are few breeding records for the Cascades and Sierra Nevada. It probably breeds in the south Coast Ranges and at scattered locations in the Transverse and Peninsular Ranges and it may no longer breed in the southern Sierra Nevada. The sharp-shinned hawk breeds in ponderosa pine, black oak, riparian deciduous, mixed conifer, and Jeffrey pine habitats and prefers, but is not restricted to, riparian habitats. North facing slopes with perches are critical requirements. All habitats except alpine, open prairie, and bare desert are used in winter. They eat mostly small birds, but also small mammals, insects, reptiles, and amphibians. They usually nest in dense and small-tree coniferous stands, which are cool, moist, well shaded, with little ground cover, and near water. Its nests are a platform or cup in dense foliage against the trunk or in the main crotch of a tree. It breeds from April through August with a peak from late May to July. Clutch size averages four to five eggs. Incubation lasts 34 to 35 days. Fledging occurs at about 60 days. This species may forage or nest in riparian or mixed conifer forest in the Project Area.

Golden eagle (*Aquila chrysaetos*) (CSC and CFP). This species is an uncommon permanent resident and migrant throughout California up to 11,500 ft above MSL, except the center of the Central Valley. It is more common in southern rather than in northern California. Typical habitat includes rolling foothills, mountain areas, sage-juniper flats, and desert. It nests on cliffs of all heights and in large trees in open areas in rugged, open habitats with canyons and escarpments. Large platform nests are built of sticks, twigs, and greenery. The golden eagle eats mostly rabbits and rodents, but also takes other mammals, birds, reptiles, and some carrion. Breeding occurs from late January through August with a peak from March through July. Clutch size averages two eggs, which are laid early February to mid-May. Incubation lasts 43 to 45 days, and the nestling period usually lasts 65 to 70 days. This species may breed or forage in grasslands, oak woodland, or mixed conifer forest in the Project Area.

Bald eagle (*Haliaeetus leucocephalus*) (FT – proposed for delisting on 7/26/99, SE, and CFP). This species is a permanent resident and uncommon winter migrant in California. It is now restricted to breeding mostly in Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Trinity counties. About half of the wintering population is in the Klamath Basin. It is more common at lower elevations and is not found in the high Sierra Nevada. The bald eagle is fairly common as a local winter migrant at a few favored inland waters in southern California. Largest numbers occur at Big Bear Lake, Cachuma Lake, Lake Matthews, Nacimiento Reservoir, San Antonio Reservoir, and along the Colorado River. Bald eagles are typically found in coniferous forest habitats with large, old growth trees near permanent water sources such as lakes, rivers, or ocean shorelines. They require large bodies of water with abundant fish and adjacent snags or other perches for foraging. Bald eagles prey mainly on fish and occasionally on small mammals or birds, by swooping from a perch or from mid-flight. Nests are found in large, old growth, or dominant trees, especially ponderosa pine with an open branchwork, usually 50 to 200 ft above the ground. It breeds February through July, with peak activity from March to June. Clutch size is usually two. Incubation usually lasts 34 to 36 days. In the Project Area, the bald eagle is known to occur at Kilarc Forebay, where adults have been observed roosting on a snag adjacent to the forebay. Juveniles have also been observed nearby. The species may also nest nearby.

American peregrine falcon (*Falco peregrinus americana*) (Former FE – delisted on 8/20/99, SE, and CFP). This species is a very uncommon breeding resident and uncommon migrant. Active nesting sites are known along the coast north of Santa Barbara, in the Sierra Nevada, and in other mountains of northern California. In winter, it is found inland throughout the Central Valley and occasionally on the Channel Islands. Migrants occur along the coast and in the western Sierra Nevada in spring and fall. Breeding mostly occurs in woodland, forest, and coastal habitats near wetlands, lakes, rivers, or other water or on high cliffs, banks, dunes, and mounds. Riparian areas and coastal and inland wetlands are important habitats yearlong, especially in non-breeding seasons. The nest is a scrape on a depression or ledge in an open site. The American peregrine falcon will also nest on human-made structures and occasionally uses tree or snag cavities or old nests of other raptors. They feed on a variety of birds and occasionally take mammals, insects, and fish. Breeding occurs from early March to late August. Clutch size averages three to four eggs. Incubation lasts about 32 days. This species may forage in or near Kilarc or Cow Creek Forebays and in stream habitat in the Project Area.

California Spotted Owl (*Strix occidentalis californicus*) (CSC and FSC). The California spotted owl occurs in dense, old growth, multi-layered mixed conifer, redwood, Douglas fir, and oak woodland habitats, from MSL up to approximately 7,600 ft above MSL. It is known to occur within the Sierra National Forest. They prefer large trees and high canopy cover for nesting and foraging areas. Nesting habitat contains a dense canopy cover (>70%) with medium to large trees and a multi-storied structure. Nests are located in cavities or broken treetops. Nesting season occurs from February to September. The California spotted owl may forage and breed in mixed conifer and blue oak-foothill pine woodland in the Project Area.

Lewis's woodpecker (*Melanerpes lewis*) (CSC). The Lewis's woodpecker is an uncommon, local winter resident occurring in open oak savannahs, broken deciduous, and coniferous habitats. It is found along the eastern slopes of the Coast Ranges south to San Luis Obispo County and also winters in the Central Valley, Modoc Plateau, and the Transverse and other ranges in southern California. It breeds locally along eastern slopes of the Coast Ranges and in the Sierra Nevada, Warner Mountains, Klamath Mountains, and in the Cascade Range. It excavates a nest cavity in a snag or dead part of a live tree, usually 5 to 80 ft above ground. It usually nests in sycamore, cottonwood, oak, or conifer trees. It may nest near other pairs. Breeding occurs from early May through July, with a peak in late May and early June. Clutch size is four to nine, usually six or seven, incubation lasts 13 or 14 days, and fledging occurs at 28 to 34 days. The male incubates and broods at night, and the female during the day. The pair bond may be permanent. This species may forage or breed in oak woodland and mixed conifer habitats in the Project Area.

Loggerhead shrike (*Lanius ludovicianus*) (CSC). The loggerhead shrike is a common resident and winter visitor in lowlands and foothills throughout California. It prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches. Its highest density occurs in open-canopied valley foothill hardwood, valley foothill hardwood-conifer, valley foothill riparian, pinyon-juniper, juniper, desert riparian, and Joshua tree habitats. It occurs only rarely in heavily urbanized areas, but is often found in open cropland. It builds its nest on a stable branch in a densely-foliaged shrub or tree, usually well-concealed. Nest height is 1.3 to 50 ft above ground. It lays eggs from March into May, and young become independent in July or August. The loggerhead shrike is a monogamous, solitary nester with a clutch size of four to eight. Incubation lasts 14 to 15 days. Altricial young are tended by both parents and leave the nest at 18 to 19 days. This species may forage in oak woodlands or riparian habitat in the Project Area. This species may also breed in oak woodlands in the Project Area.

Vaux's swift (*Chaetura vauxi*) (FSC and CSC). Vaux's swift is a summer resident of northern California, breeding fairly commonly in the Coast Range, in the Sierra Nevada, and possibly in the Cascade Range. They prefer redwood and Douglas fir habitats with nest-sites in large hollow trees and snags, especially tall, burned-out stubs. They are a fairly common migrant throughout most of the state in April, May, August, and September. They feed high in the air over most terrain and habitats and also feed commonly at lower levels in forest openings, above burns, and especially above rivers and lakes. Vaux's swift nest in redwood, Douglas-fir, and occasionally other coniferous forests. The nest is typically built on the vertical inner wall of a large, hollow tree or snag, especially tall stubs charred by fire. This species enters the nesting tree from the top or through cracks in the side, and almost always locates the nest near the bottom of a cavity, regardless of the height of the entrance. The Vaux's swift occasionally nests in chimneys and buildings. Breeding occurs from early May to mid-August and is a solitary nester. Clutch size is three to seven eggs, usually four to five, and incubation lasts 18 to 20 days. Altricial young are tended by both parents and leave the nesting tree at about 28 days. This species may forage and breed in mixed conifer forest near streams and forebays in the Project Area.

Willow flycatcher (*Empidonax traillii*) (SE). The little willow flycatcher is a rare to locally uncommon, summer resident in wet meadow and montane riparian habitats from 2,000 to 8,000 ft above MSL in the Sierra Nevada and Cascade Range. It most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows. It is a common spring (mid-May to early June) and fall (mid-August to early September) migrant at lower elevations, primarily in riparian habitats throughout the state exclusive of the North Coast. An open, cup nest is placed in an upright fork of a willow or other shrub, or occasionally on a horizontal limb, at a height of 1.5 to 10 ft. It is monogamous with peak egg laying in June. Incubation lasts 12 to 13 days, and clutch size averages three to four eggs. It is probably single-brooded. Both sexes care for altricial young. Fledging age is 13 to 14 days. This species may forage in wet meadow and riparian habitat in the Project Area.

Hermit warbler (*Dendroica occidentalis*) (FSC). The hermit warbler is a fairly common to common, summer visitor and migrant and a rare but regular visitor in winter. It breeds in major mountain ranges from the San Gabriel and San Bernardino Mountains northward, excluding coastal ranges south of Santa Cruz County. It is a common spring and fall migrant in mountains, an uncommon to fairly common visitor in lowlands in spring, and a rare to uncommon migrant in the fall. It breeds in mature ponderosa pine, montane hardwood-conifer, mixed conifer, Douglas fir, redwood, red fir, and Jeffrey pine habitats. In migration and winter, it also occurs in valley foothill hardwood habitat and in stands of planted pines. It builds its nest 25 to 125 ft above ground in a conifer. The nest is often well out on a horizontal branch. It breeds from late April into early July with peak activity in June, and lays three to five eggs, usually four. This species may breed in mixed conifer forests near the Project Area. It may forage in mixed conifer and oak-pine woodland in the Project Area.

Lawrence's goldfinch (*Carduelis lawrencei*) (FSC). The Lawrence's goldfinch is highly erratic and localized in occurrence. It is rather common along the western edge of southern deserts, fairly common but erratic from year to year in Santa Clara County, and on the coastal slope from Monterey County south, and uncommon in foothills surrounding the Central Valley. It is migratory and present mostly from April through September. It breeds in open oak or other arid woodlands and chaparral, near water. It rarely breeds along the immediate coast. Typical habitats include valley foothill hardwood, valley foothill hardwood-conifer, and, in southern California, desert riparian, palm oasis, pinyon-juniper, and lower montane habitats. Nearby herbaceous habitats are often used for feeding. It winters erratically in southern coastal lowlands and along the Colorado River Valley. Small numbers also winter in northern California. It builds its nest in the dense foliage of a tree or shrub and prefers to nest in an oak, but also uses cypress or cedar, riparian thickets, and other species. The breeding season begins in late March or early April. Lawrence's goldfinch is a monogamous breeder and lays three to six eggs per clutch, usually four or five. Incubation lasts 12 to 13 days. Altricial young are tended by both parents and leave the nest at about 11 days. This species may forage and breed in oak woodland or blue oak-foothill pine woodlands near streams or forebays in the Project Area.

California thrasher (*Toxostoma redivivum*) (FSC). The California thrasher is a common resident of foothills and lowlands in cismontane California, occupying moderate to dense chaparral habitats and, less commonly, extensive thickets in young or open valley foothill riparian habitat. In southern California, it occurs in montane chaparral up to 6,600 ft above MSL. It avoids dense tree canopy. Generally, it occurs from the Mexican border north to Shasta, Trinity, and southern Humboldt counties, and into the Shasta Valley of Siskiyou County. It builds its nest well inside a large shrub or scrubby tree, usually 2 to 5 ft above ground. The breeding season lasts from early December into early August with a peak from mid-April to mid-June. The species is apparently a monogamous, solitary nester. Clutch size is two to four, usually three. It frequently raises two broods each year. Incubation lasts 14 days and is conducted by both parents. Altricial young are tended by both parents and leave the nest at 12 to 14 days. This species may forage or breed in riparian habitats in the Project Area.

4.5.3.4 Mammals

Pale Townsend's big-eared bat (*Corynorhinus townsendii pallenscens*) (FSC and CSC). This species is found throughout California, but the details of its distribution are not well known. It is found in all but subalpine and alpine habitats and may be found at any season throughout its range. It is most abundant in mesic habitats and requires caves, mines, tunnels, buildings, or other human-made structures for roosting. Most mating occurs from November to February, but many females are inseminated before hibernation begins. Sperm is stored until ovulation occurs in spring. Gestation lasts 56 to 100 days, depending on temperature, size of the hibernating cluster, and time in hibernation. Births occur in May and June, peaking in late May. A single litter of one is produced annually. Young are weaned in six weeks and fly in 2.5 to 3 weeks after birth. The maternity group begins to break up in August. This species may occur in the Project Area at Project facilities including powerhouses and tunnels.

Small-footed myotis bat (*Myotis ciliolabrum*) (FSC and CSC). The small-footed myotis ranges from British Columbia and Saskatchewan to the Southwestern United States and prefers areas where it associates with cliffs, talus fields, and steep riverbanks. Roosts tend to be in rock crevices, cliff faces, and in talus formations. Maternity roosts are found in similar sites and have been observed in buildings. Mating takes place in the fall. Usually one young is born in the summer (June to July), although twins are known to occur. Lactating females have been observed from June through August. The small-footed myotis forages over water, rock formations and along cliffs. The diet of this species consists of moths, flies, beetles, and bugs. This species may occur in the Project Area at Project facilities including powerhouses and tunnels.

Long-eared myotis bat (*Myotis evotis*) (FSC and CSC). The long-eared myotis is a year-round resident in California, occurring in mixed hardwood/conifer forest and montane conifer forest in northern California, and in pinyon-juniper, mesquite scrub, and pine/oak woodland in southern California. Its distribution is broad, but it is not usually found in large numbers. It typically roosts singly or in small groups in hollow trees, under exfoliating bark, crevices in rock outcrops, and occasionally in mines, caves, and buildings during the day. Roost sites in these structures tend to be cryptic (e.g., in crevices and fissures). Night roosts are in caves, mines, bridges, building, and rock crevices. It is presumed to be non-migratory, and to hibernate locally in caves. A single young is born per year between June and July. Females may form small maternity colonies with less than 40 individuals. The long-eared myotis feeds on moths, flies, and small beetles. It forages along rivers and streams, over ponds, and within cluttered forests. This species may occur in the Project Area at Project facilities including powerhouses and tunnels.

Fringed myotis bat (*Myotis thysanodes*) (FSC and CSC). The fringed myotis is found in western North America from British Columbia to Veracruz and Chiapas. Over most of its range this species occurs at mid-elevations, but it has been found at high elevations in New Mexico and was found in the Sequoia National Forest above 6,000 ft above MSL. Along the west coast, this bat is found at low elevations and is associated with redwood forests. Maternity colonies are large, up to 300 individuals and are in caves, mines, and buildings. Males roost separate from the maternity colonies. Night roosts are in similar features. Only one young per year is common. Little is known of the reproductive cycle of this species. This species primarily eats beetles (73% of its diet), moths, flies, leafhoppers, lacewings, crickets, and harvestmen. This species may occur in the Project Area on Project facilities including powerhouses and tunnels.

Long-legged myotis bat (*Myotis volans*) (FSC and CSC). Long-legged myotis inhabits western North America from Southeast Alaska to Central Mexico, and is found in an elevational range from MSL to 12,000 ft above MSL. It is primarily a coniferous forest bat although it may also be found in riparian and desert habitats. Maternity colonies can be up to 300 individuals. Maternity roosts are found in buildings, rock crevices, and under exfoliating bark. Males roost singly or in small numbers in rock crevices, buildings, and under tree bark. Night roosts are under bridges, in caves and mines, and in buildings. In the northern portion of their range, the species commonly hibernates. It is unknown whether this bat migrates in the portion of its range where winters are less severe. Mating takes place in the fall and sperm is stored over winter. Ovulation and fertilization takes place from March to May and parturition occurs from May to August. There is extensive variation in the timing of reproductive activity in this species. The species feeds primarily on moths. This species may occur in the Project Area at Project facilities including powerhouses and tunnels.

Yuma myotis bat (*Myotis yumanensis*) (FSC and CSC). Yuma myotis is a year-round resident in most of California at lower elevations in a wide variety of habitats from coast to mid-elevation. It is very tolerant of human habitation and survives in urbanized environments. Day roosts are in buildings, trees, mines, caves, bridges, and rock crevices. Night roosts are in buildings, bridges, and other man-made structures. It is presumed to be non-migratory and hibernates in winter, but no large winter aggregations have been reported. A single young is born per year between June and July. Females form large maternity colonies of 200 to several thousand individuals. Males roost singly or in small groups. The Yuma myotis feeds on emergent aquatic insects, such as caddisflies and midges. Foraging occurs directly over the surface of still water ponds, reservoirs, or pools in streams and rivers. This species may occur in the Project Area at Project facilities including powerhouses and tunnels.

Ring-tailed cat (*Bassariscus astutus*) (CFP). The ring-tailed cat is a widely distributed, common to uncommon permanent resident. It occurs in various riparian habitats, and in brush stands of most forest and shrub habitats, at low to middle elevations. Little additional information is available on distribution and relative abundance among habitats. It nests in rock recesses, hollow trees, logs, snags, abandoned burrows, or woodrat nests. Young are born in May and June in one litter per year. A litter averages three young and ranges from one to five. Gestation lasts 40 to 50 days. Females may drive males away three to four days prior to giving birth. The ring-tailed cat may occur in forested areas in the Project Area.

4.5.4 Impacts Related to the Existing Project

The information gathered during proposed studies will be used to identify potential on-going Project impacts to wildlife resources within the Project Area. The operation of the Project facilities will be assessed to determine if they are significantly impacting wildlife resources, especially special-status species, game species, and raptors protected under Section 3503.5 of the Fish and Game Code. Impacts to wildlife resources will be assessed in accordance with Section 4.51(f)(3) of the Commissions regulations. Because the Project does not include construction of new facilities or the implementation of new operations and maintenance practices, this impact analysis will be based on an analysis of current Project operations and maintenance practices.

4.5.4.1 Effects of Project Operations and Maintenance Activities on Wildlife

Routine maintenance activities that may potentially impact wildlife resources include regular clearing, trimming, and herbicide use for vegetation control at the Old Cow Creek and South Cow Creek Diversions and Kilarc and Cow Creek Powerhouses; and rodenticide use and trapping for rodent control in the Kilarc and Cow Creek Powerhouses. However, the potential negative impacts are not expected to be significant because these activities occur infrequently in the Project Area and the Licensee has instituted several programs (e.g., Bird and Raptor Protection Program and Environmental Training Program) to minimize any potential impacts.

The Licensee also removes selected vegetation from the Project canals and dredges the Kilarc and Cow Creek Forebays. Dredging of the forebays occurs approximately every 8 to 12 years and consists of mechanical removal of sediment buildup and associated emergent vegetation that has established over time. Vegetation removed from the Project canals and dredging of the forebays could potentially result in impacts to western pond turtles from removal of appropriate habitat or in indirect impacts to bald eagles that are known to forage at the Kilarc Forebay.

4.5.4.2 Effects of Project Operation and Maintenance Activities on Raptors

Potential disturbance to raptors and bats may occur when maintenance activities take place adjacent to nesting raptors. The raptor nesting season occurs from approximately February through September. However, because maintenance activities are infrequent and the disturbance would be temporary and short-term, these potential impacts to raptors and bats would not be considered significant.

4.5.4.3 Effects of Project Operations and Maintenance Activities on Amphibians

There are two special-status amphibian species with the potential to occur in the Project Area. Potential Project-related impacts to these special-status amphibians from continued operation and maintenance of the Project include changes in water flows from water diversion, vegetation removal through Project maintenance and operation, and modified water quality and water temperatures. Project diversions may impact amphibians by reducing flow through potential spawning areas or by tadpole entrainment at diversion facilities.

4.5.4.4 Effects of Project Operations and Maintenance Activities on Special-Status Bats

Several bat species (e.g., Pale Townsend's big-eared bat, small-footed myotis, long-eared myotis bat, fringed myotis bat, long-legged myotis bat, and Yuma myotis bat) could potentially forage and roost in the Project Area. Roosting opportunities are present in the Kilarc and Cow Creek Powerhouses and in the Kilarc Main Canal tunnel. Because vegetation removal is minimal and limited to areas adjacent to Project facilities, impacts to special-status bat species would not be considered significant. Bats may potentially roost in the Kilarc Main Canal tunnel and in the Powerhouse and may potentially be disturbed by operation and maintenance activities.

4.5.4.5 Effects of Project Operations and Maintenance Activities on Riparian Nesting Birds

Riparian nesting birds could potentially nest within the limited riparian habitat present in the Project Area. There may be some loss of habitat or loss of nests if riparian vegetation is trimmed or cleared around the Old Cow Creek Diversion, South Cow Creek Diversion, Kilarc Main Canal and the powerhouses. Nesting birds may also potentially be disturbed by operations and maintenance activities in riparian habitat.

4.5.5 References

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TABLES

Table 4.5-1. Special Status Wildlife Species.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Invertebrates				
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	FE	-	Elderberry shrubs throughout the Central Valley and foothills below 3000 ft elevation.	May occur. Appropriate habitat is present in elderberry shrubs within the Project Area.
Vernal pool fairy shrimp (*Branchinecta lynchi*)	FT	-	Central Valley vernal pools, swales, slumps, basalt flow depressions. Up to 950 ft in elevation.	Unlikely to occur. No appropriate habitat present within the Project Area.
California *linderiella* fairy shrimp	-	CSC	Central Valley vernal pools, swales, slumps, and basalt flow depressions.	Unlikely to occur. No appropriate habitat present within the Project Area.
Shasta Crayfish (*Pacifastacus fortis*)	-	FE	Generally occur in cool, spring-fed headwaters characterized by clean, volcanic cobbles and boulders overlying sand or gravel substrates.	Unlikely to occur in the Project Area. Project Area located outside of species' documented distribution.
Amphibians				
California red-legged frog (*Rana aurora draytonii*)	FT	-	Breeds in quiet streams and permanent, deep, cool ponds with overhanging and emergent vegetation below 4,000 ft elevation. Known to occur adjacent to breeding habitats in riparian areas and heavily vegetated streamside shorelines, and non-native grasslands.	May occur. Appropriate habitat may be present in the south fork of Cow Creek and Old Cow Creek. The site is not within the Critical Habitat (Closest is Unit 6, about 30 mi). Within Recovery Unit Boundary, but not in Core Recovery Area (Closest is Unit 13, about 12 mi).

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Foothill yellow-legged frog (*Rana boylii*)	Proposed	CSC	Breeds in rocky streams with cool, clear water in a variety of habitats, including valley and foothill oak woodland, riparian forest, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadows; occurs at elevations ranging from 0 to 6,000 ft.	May occur. Appropriate habitat may be present in the south fork of Cow Creek and Old Cow Creek.
Shasta salamander (*Hydromantes shastae*)	-	ST	Primarily inhabits isolated limestone formations and caves in volcanic and other rock outcroppings, and under woody debris on the surface during wet weather in mixed pine-hardwood stands.	Unlikely to occur. No appropriate habitat present within the Project Area.
Western spadefoot toad (*Scaphiopus hammondii*)	-	CSC	Requires vernal pools and seasonal wetlands below 4,500 ft that lack predators for breeding. Also occurs in grassland habitat and occasionally in valley-foothill oak woodlands and orchards.	Unlikely to occur. No appropriate habitat is present within the Project Area.
Reptiles				
Northwestern pond turtle (*Clemmys marmorata marmorata*)	FSC	CSC	Perennial wetlands and slow moving creeks and ponds with overhanging vegetation up to 6,000 ft; suitable basking sites such as logs and rocks above the waterline.	May occur. Appropriate habitat is present in the Kilarc and Cow Creek Forebays.
Birds				
Bald eagle (*Haliaeetus leucocephalus*)	FT	SE	Year-round in Shasta County. Occurs in low to mid-range elevations of the Sierra Nevada. Nests in large, old-growth or dominant live tree with open branches. Perches in large trees, snags or broken-topped trees near water for foraging.	Known to occur at Kilarc Forebay. Bald eagles observed roosting on a snag next to the Kilarc Forebay. May nest nearby. Juveniles have been observed nearby.
California spotted owl (*Strix occidentalis californicus*)	proposed	CSC	Occurs in lower elevation (1,000 – 2,000 ft) coniferous forests, mixtures of conifers and hardwoods, and in foothill riparian/hardwood forests, in the western Sierra Nevada.	May forage and breed in mixed conifer and blue oak-foothill pine woodland in the Project Area

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
American peregrine falcon (*Falco peregrinus americana*)	-	SE	Breeds near wetlands, lakes, and rivers on high cliffs and banks.	Known to occur and has nested in the Cow Creek Watershed (SHN 2001). May forage in or near Kilarc or Cow Creek Forebays and in stream habitat in Project Area.
Golden eagle (*Aquila chrysaetos*)	-	CSC	Habitat is typically rolling foothills, mountain areas, and sage juniper flats. Grasslands and early successional forest.	May breed or forage in grasslands, oak woodland, or mixed conifer forest in Project Area.
Osprey (*Pandion haliaetus*)	-	CSC	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats. Known to breed near Shasta Lake.	Unlikely to occur in the Project Area due to a lack of large open water bodies.
Swainson's Hawk (*Buteo swainsoni*)	-	ST	Breeding resident and migrant in the Central Valley, Klamath Basin, Northeastern Plateau, Lassen County, and Mojave Dessert. Require large, open grasslands with abundant prey in association with suitable nest trees. Nests in mature riparian forest, groves of oaks, mature roadside trees.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Sharp-shinned Hawk (*Accipiter striatus*)	-	CSC	Mid-elevation habitats. Roosts in intermediate to high-canopy forest. Nests in dense, even-aged, single-layered forest canopy. Winters in woodlands. Prefers, but not restricted to, riparian habitats. All habitats except alpine, open prairie, and bare dessert used in winter.	May forage in riparian habitat or nest in mixed conifer forest in the Project Area.
Ferruginous hawk (*Buteo regalis*)	-	CSC	Forages in grasslands, sagebrush flats, desert scrub, low foothills, and pinyon-juniper in the Modoc Plateau, Central Valley, and Coast Ranges; breeds in the Great Basin and northern plains states.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Northern Goshawk (*Accipiter gentilis*)	-	CSC	Prefers middle to high elevation, mature, dense conifer forests for foraging and nesting. Casual in foothills during winter, northern deserts in pinyon-juniper woodland, and low elevation riparian habitats. Nests on north-facing slopes near water.	May forage in riparian, oak woodland, or mixed conifer habitat in Project Area. May breed near steams or forebays in the Project Area.
White-tailed kite (*Elanus leucurus*)	-	CSC	Coastal and valley lowlands. Herbaceous and open stages of most habitats; grasslands and agricultural areas are used for foraging; typically nests in tops of dense oak, willow, or other tree stands adjacent to open areas and agricultural fields.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Short-earred owl (*Asio flammeus*)	-	CSC	Occurs in open areas with few trees, such as annual and perennial grasslands, prairies, dunes, meadows, irrigated lands, and saline and fresh emergent wetlands. Requires elevated sites for perching and dense vegetation for roosting. Not found in high mountains.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Western burrowing owl (*Athene cunicularia hypugaea*)	FSC	CSC	Grasslands, oak woodlands, and ponderosa pine habitat, up to 5300 ft.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Tri-colored blackbird (*Agelaius tricolor*)	-	CSC	Breeds near freshwater, preferably in emergent wetland with tall dense cattails or tules, but also in thickets of willow, blackberry, wild rose, and tall herbs. Feeds in grassland and cropland habitats. Found throughout the Central Valley and on the coast.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Lawrence's goldfinch (*Carduelis lawrencei*)	-	CSC	Occurs in valley foothill hardwood and valley foothill hardwood-conifer. Breeds in open oak or other arid woodland and chaparral, near water.	May forage and breed in oak woodland or oak-pine woodlands near streams or forebays in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Vaux's swift (*Chaetura vauxi*)	-	CSC	Prefers redwood and Douglas fir habitats with nest sites in large, hollow trees and snags, especially tall, burned-out stubs. Forages over moist terrain and habitats, preferring rivers and lakes. Summer resident of northern California.	May forage and breed in mixed conifer forest near streams and forebays in the Project Area.
Black tern (*Chlidonias niger*)	-	CSC	Summer range in the Central Valley and Northeastern Plateau of California near wet meadows, wetlands, and other freshwater habitats. Restricted to freshwater habitat while breeding.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Black swift (*Cypseloides niger*)	-	CSC	Breeds very locally in Sierra Nevada and Cascade Ranges. Nests in moist crevices or caves, or on cliffs near waterfalls in deep canyons. Forages widely over many habitats; seems to avoid arid regions. Known from the high elevations of the Sierra National Forest.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Hermit warbler (*Dendroica occidentalis*)	FSC		Breeds in major mountain ranges from San Gabriel and San Bernardino mountains northward (excluding coastal ranges south of Santa Cruz). Breeds in mature ponderosa pine, montane hardwood-conifer, mixed conifer, Douglas fir, redwood, red fir, and Jeffrey pine habitats. Avoids areas with a high deciduous volume; absent from riparian areas and clearcuts.	May breed in mixed conifer forests near the Project Area. May forage in mixed conifer and oak-pine woodland in the Project Area.
Willow flycatcher (Empidonax traillii)	-	SE	Wet meadow and montane riparian habitats from 2,000 to 8,000 ft. Breeding seldom occurs below 5,000 ft (Valentine, pers. com.). Most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows.	May forage in wet meadow and riparian habitat in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Loggerhead shrike (*Lanius ludovicianus*)	-	CSC	Open habitats with sparse shrubs and trees (or other suitable perch sites) and bare ground and/or low, sparse herbaceous cover; oak woodlands for nesting. Found in lowlands and foothills throughout California.	May forage in oak woodlands or riparian habitat in the Project Area. May breed in oak woodlands in the Project Area.
Lewis' woodpecker (*Melanerpes lewis*)	-	CSC	Winter resident in open oak savannahs, broken deciduous, and coniferous habitats with brushy understory. Uses logged and burned areas. Winters in the Central Valley, Modoc Plateau, and the Transverse and other Ranges in Southern California. Breeds locally along eastern slopes of the Coast Ranges, and in Sierra Nevada, Warner Mts., Klamath Mts., and in the Cascade Range.	May forage or breed in oak woodland and mixed conifer habitats in the Project Area.
Long-billed curlew (*Numenius americanus*)	-	CSC	Found in wet meadow habitat in northeastern California in Siskiyou, Modoc, and Lassen Counties. Winter visitor along the California coast and in the Central and Imperial valleys.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
White-faced ibis (*Plegadis chihi*)	-	CSC	Uncommon summer resident in sections of Southern California, rare visitor in the Central Valley. Nests in dense, fresh emergent wetland. Forages in shallow water or muddy fields.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Bank swallow (*Riparia riparia*)	-	ST	Migrant found primarily in riparian and other lowland habitats in California west of the deserts. Requires vertical banks and cliffs with fine-textured or sandy soils near streams, rivers, ponds, lakes, and the ocean for nesting. Feeds primarily over riparian areas during breeding season and over grassland and cropland during migration.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Rufous hummingbird (*Selasphorus rufus*)	-	CSC	Utilizes riparian areas, open woodlands, chaparral, mountain meadows, and other habitats rich in nectar-producing flowers. Uses valley foothill hardwood, valley foothill hardwood-conifer, riparian, and chaparral habitats in migration. Breeds in Oregon and Washington and the Trinity Mountains of Trinity and Humboldt counties.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	Candidate	-	Valley foothill and desert riparian habitats in scattered locations in California; breeds along the Colorado River, Sacramento and Owens valleys, South Fork of the Kern River, Santa Ana River, and the Amargosa River.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Grasshopper sparrow (*Ammodramus savannarum*)	FSC	-	Uncommon and local summer resident and breeder in foothills and lowlands west of the Cascade-Sierra Nevada crest from Mendocino and Trinity Counties. South to San Diego County. Occurs in dry, dense grasslands.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
California thrasher (*Toxostoma redivivum*)	FSC	-	Common resident of foothills and lowlands in cismontane California. Occupies moderate to dense chaparral habitats and, less commonly, extensive thickets in young or open valley foothill riparian habitat.	May forage or breed in riparian habitats in the Project Area.
Aleutian Canada goose (*Branta canadensis leucopareia*)	D	-	Utilize pastures and grain fields along the coasts of Oregon and northern California, and in California's Central Valley. It is presumed that the geese migrate between the Aleutian Islands and wintering grounds in Oregon and California by flying non-stop over the North Pacific Ocean.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Mammals				
California wolverine (*Gulo gulo luteus*)	-	ST	Mixed conifer, red fir, and lodgepole habitats, and probably sub-alpine conifer, alpine dwarf shrub, wet meadow, and montane riparian habitats. Occurs in Sierra Nevada from 4,300 to 10,800 ft. Majority of recorded sightings are found above 8,000-ft elevation.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Sierra Nevada red fox (*Vulpes vulpes necator*)	-	CSC	Occurs throughout the Sierra Nevada at elevations above 7,000 ft in forests interspersed with meadows or alpine forests. Open areas are used for hunting, forested habitats for cover and reproduction.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Pacific fisher (*Martes pennanti pacifica*)	-	Proposed	Suitable habitat consists of large areas of mature, dense forest, red fir, lodgepole pine, ponderosa pine, mixed conifer, and Jeffery pine forests with snags and greater than 50% canopy closure. Known from 4,000 to 8,000 ft elevations.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Pine marten (*Martes americana*)	-	CSC	Known from the high elevation forested plant communities. Optimal habitats are various mixed evergreen forests with more than 40% crown closure and large trees and snags for den sites. Most commonly found in red fir and lodgepole pine forests between 4,000 and 10,600 ft elevation.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Ring-tailed cat (*Bassariscus astutus*)	-	CFP	Widely distributed, occurs in various riparian habitats, and in brush stands of most forest and shrub habitats, at low to middle elevations. Little information available on distribution and relative abundance among habitats.	May occur in forested areas near facilities in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Pale Townsend's big-earred bat (*Corynorhinus townsendii pallescens*)	FSC	CSC	Throughout California, but the details of its distribution are not well known. All but subalpine and alpine habitats. Most abundant in mesic habitats and requires caves, mines, tunnels, buildings, or other human-made structures for roosting.	May occur in Project facilities such powerhouses and tunnels in the Project Area.
Spotted bat (*Euderma maculatum*)	FSC	CSC	Habitats range from arid deserts and grasslands through mixed conifer forests up to 10,600 ft. Prefers sites with adequate roosting habitat, such as cliffs. Often limited by the availability of cliff habitat. Feeds over water and along marshes.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Small-footed myotis bat (*Myotis ciliolabrum*)	FSC	CSC	Ranges from British Columbia and Saskatchewan to the Southwestern United States Prefers areas where it associates with cliffs, talus fields, and steep riverbanks. Roosts tend to be in rock crevices, cliff faces, and in talus formations. Maternity roosts are found in similar sites and have been observed in buildings.	May occur in Project facilities such powerhouses and tunnels in the Project Area.
Long-eared myotis bat (*Myotis evotis*)	FSC	CSC	Year-round resident in California, occurring in mixed hardwood/conifer forest and montane conifer forest in northern California, and in pinyon-juniper, mesquite scrub, and pine/oak woodland in southern California. Typically roosts singly or in small groups in hollow trees, under exfoliating bark, crevices in rock outcrops, and occasionally in mines, caves, and buildings during the day.	May occur in Project facilities such powerhouses and tunnels in the Project Area.
Fringed myotis bat (*Myotis thysanodes*)	FSC	CSC	Western North America from British Columbia to Veracruz and Chiapas. Typically occurs at mid-elevations. Along the west coast, found at low elevations and is associated with redwood forests. Maternity colonies are in caves, mines, and buildings.	May occur in Project facilities such powerhouses and tunnels in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Long-legged myotis bat (*Myotis volans*)	FSC	CSC	Western North America from southeast Alaska to Central Mexico from sea level to 12,000 m. Primarily coniferous forest, but also riparian and desert habitats. Maternity roosts are found in buildings, rock crevices, and under exfoliating bark. Males roost singly or in small numbers in rock crevices, buildings, and under tree bark. Night roosts are under bridges, in caves and mines, and in buildings.	May occur in Project facilities such powerhouses and tunnels in the Project Area.
Yuma myotis bat (*Myotis yumanensis*)	FSC	CSC	Year-round resident in most of California at lower elevations in a wide variety of habitats from coast to mid-elevation. Very tolerant of human habitation and survives in urbanized environments. Day roosts are in buildings, trees, mines, caves, bridges, and rock crevices. Night roosts are in buildings, bridges, and other man-made structures.	May occur in Project facilities such powerhouses and tunnels in the Project Area.

FT = Federally Threatened

FE = Federally Endangered

FSC = Federal Species of Special Concern

ST = State Threatened

SE = State Endangered

CSC = State Species of Special Concern

CFP = California Fully Protected

D = Delisted

4.6 Historical and Archaeological Resources

4.6.1 Environment Affected by Existing Project

4.6.1.1 Prehistory

The prehistory of the Southern Cascade Range includes the geographical area from the Fall River Valley south to the eastern edge of the Sacramento Valley (Moratto 1984). The Study Area lies within the Cascade Mountains physiographic and geologic province. The southern portion of the Cascades support diversified plant communities including Sierran and Upper Montane forests, sagebrush steppe and juniper-shrub savanna, blue oak-digger pine forest, and northern ponderosa pine forest. The topography for this region varies from areas of mountainous, steep-sided ridges to rolling, densely-forested hills, all within view of the two well-known volcanic peaks of Lassen and Mt. Shasta.

The Study Area lies within the territory occupied at the time of European contact by the Central Yana people. The Yana have been separated into four divisions, the Northern, Central, Southern and Yahi, primarily because of linguistic variations. Very few early sites (over 10,000 years old) are known to exist in the Southern Cascades. The majority of evidence for early occupation in this region comes from sites dating between 7,500 to 5,000 years B.P. (Before Present) (Chartkoff and Chartkoff 1984). The artifact assemblages for this period reflect a subsistence pattern that utilized a variety of tool types but very few tools typically associated with acorn processing. Hildebrandt and Hayes (1983) postulate that the lack of acorn processing tools indicates a "forager approach to subsistence-settlement organization".

Artifactual materials found in Shasta County with dates ranging between 5,000 and 3,000 B.P. have been identified as belonging to the Squaw Creek Period. During this time, the mobile forager subsistence strategy of the Borax Lake Pattern persisted but with the addition of several new tools including square-stemmed Borax Lake points, heavy-duty scrapers, milling slabs, and ovoid flake tools (Moratto 1984; Chartkoff and Chartkoff 1984).

Evidence points to the introduction of an entirely new pattern sometime between 4,000 and 1,700 B.P. which has been identified as the Whiskeytown Pattern. This pattern revolved around congregation at lower elevation base camps during fall and winter and dispersal into smaller foraging groups during the rest of the year (Moratto 1984:447-449; Basgall and Hildebrandt 1989).

Approximately 2,000 years B.P., along the Pit River, a shift occurred in obsidian sources. The shift was from obsidian obtained at Medicine Lake to lower quality Tuscan and Buck Mountain obsidians. The shift seems to indicate expansion in reliance on local resources and reduced mobility. Around 1,800 B.P. the appearance of a new suite of archeological traits, originally deemed the Shasta Complex but now assigned to the Redding Aspect of the Augustine Pattern, denotes increased sedentism and reliance on stored provisions including acorns and salmon (Basgall and Hildebrandt 1989).

4.6.1.2 Ethnography

At the time of European contact, the Yana occupied the upper Sacramento River Valley, the foothills of the southern Cascades, and east to the northern Sierra Nevada mountains. Linguistically, Yana is a Hokan language although it is grammatically divergent from the other languages in the Hokan language family.

The land included in the Central Yana territory encompassed a wide range of elevations (300 to 10,000 ft above MSL) and various habitats with large numbers of natural resources. The primary components of the Yana subsistence base were game animals, especially deer and rabbits, and acorns, which were harvested in the fall, dried, and stored for the winter months. Fishing salmon with spears and harpoons was an important secondary subsistence strategy (Johnson 1978).

Central Yana villages were primarily located in the lower reaches of the foothills. The upland areas were utilized during the late spring and early fall for acorn gathering and collecting spring bulbs and tender roots. Dwellings were substantial, earth-covered, multi-family structures. Evidence exists of trade networks with neighboring tribes, however, the Central Yana devoted the majority of their time to procuring food rather than gathering and preparing raw materials for trade.

Gold was discovered in Shasta County in 1848 along Clear Creek, which is located southwest of Redding. Miners, followed by merchants, farmers and ranchers, quickly moved into the area to seek their fortunes. Skirmishes between Yana populations and European settlers led to a number of massacres between 1847 and 1867. The massacres reduced the Yana population to less than 100 individuals. Following the depletion of the gold deposits, the miners and other recent arrivals turned to ranching, farming, and the lumber industry.

In the mid-1860s, copper was discovered in Shasta County leading to another spurt of population growth and helping to establish Shasta County as one of the leading copper mining and smelting regions of the United States. By 1906, five copper smelters were located within Shasta County; specific to the project, the Afterthought and Donkey Mines and the Ingot smelter were located within the Cow Creek Watershed. The copper-refining process produced sulfur emissions that denuded the surrounding hillsides and damaged vegetation in regions as far south as Tehama County. Many smelters stopped processing when legal challenges from the Forest Service and local farmers sought to have the smelters closed (Kyle 1990; Rawls and Walton 1998).

Settlements in Shasta County continued to develop especially in the Fall River area. By 1872, lumber, flour, and planing mills were in operation and the town of Fall City had all the ingredients to become a major industrial city. Natural resources in the form of abundant water and lumber, as well as good soil for growing grains and pastureland for cattle grazing were readily available and plentiful. However, the area lacked an efficient and economical means of transportation. Persistent efforts on the part of local businessmen failed to obtain a railroad route from Redding to Goose Lake via the Fall River Valley. In the 1890s, industrialization of hydropower developed when small individually-owned power and light companies began developing urban electrical facilities. Owing to their steep gradients, the Pit and Fall Rivers were considered prime locations for hydropower generation. In 1890 and 1897, two small hydroelectric plants were constructed on the Fall River to supply the town of McArthur and Fall City with power. In the early 1900s, the Licensee began purchasing the water rights and property of numerous local hydroelectric owners and construction began on a network of hydroelectric plants, tunnels, diversion dams, and transmission lines that would eventually provide power state-wide.

4.6.2 History of the Kilarc-Cow Plant

The South Cow Creek hydroelectric system was constructed in 1907 and was purchased by the Licensee from the Northern California Power Company in 1919. The hydroelectric system was originally part of a series of small hydroelectric power generating plants constructed in 1900-1901 by San Francisco financier H. H. Noble. Initially the system was built to supply electricity for copper mining activities but when the Tehama Electric Power Company in Red Bluff was destroyed by fire, an additional supply of electricity was needed to meet the needs of the burgeoning city of Red Bluff. To meet these needs, a new corporation, named the Northern California Power Company was formed. Through construction of new hydroelectric systems and acquisition of small hydroelectric generating systems, including South Cow Creek, the company increased in size and significance. Following the Licensee acquisition of the Northern California Power Company in October 1919, upgrades in the form of a new rock-filled, timber-crib diversion dam (1923-1930), conversion to a semi-automatic facility (1930), a new transformer (1957), and new generators and conversion of the wood penstock to steel pipe (1983) were implemented. In recent years, major work was undertaken, including modifications to the intake structure, inclusion of fish ladders, and automatic sluice gates (Shoup 1989).

4.6.3 Results of the Record Search and Summary of Known Cultural Resources

A record search was conducted by Frank E. Bayham at the Northeast Center of the California Historical Resources Information System at Chico, California on May 20, 2002. The following is a summary of the cultural resources identified within an approximately 1/8-mi radius of the FERC project boundary. There are no cultural resource sites within the Project boundaries that are listed on or have been determined to meet the criteria for formal evaluation for listing on the National Register of Historic Places or the California Inventory of Historic Places.

4.6.3.1 Sites Recorded Within Project Area

A total of three historic cultural resource sites have been formally recorded within the Project Area. These include an historic timber crib diversion dam with seven related features and two historic water conveyance ditches. All of the previously recorded sites are depicted in Table 4.6-1

No prehistoric sites have been recorded within the Project Area.

Following is a brief summary of the sites.

CA-SHA-1764-H

Recorded in 1989, the site consists of an historic timber-crib diversion dam and related features. The original rock dam at this location was constructed in 1907. The existing dam was built in the 1920s and includes seven features; the main diversion dam; the intake structure and fish ladder; the conduit transporting water to South Cow Creek Powerhouse; an overflow sluice gate; a stream crossing table; a smaller diversion dam and ditch; and a concrete retaining wall.

P-45-003241-H

Recorded in 2001, the site consists of a water conveyance ditch measuring approximately 1.5 m wide and 1 m deep. The ditch runs from an unnamed tributary of Old Cow Creek southeast towards Kilarc ditch.

P-45-003242-H

Recorded in 2001, the site consists of the Tocher water conveyance ditch measuring approximately 1.5 m wide and 1 m deep. The ditch runs from an unnamed tributary of Old Cow Creek west towards the Twin Valley Ranch.

No additional sites have been formally recorded within the Project Area. However, four unrecorded sites have been reported within the Project Area.

1) Three obsidian flakes were observed during a field inspection for the Kilarc Reservoir Timber Sale near the Kilarc Penstock.
2) A single mano was observed during a survey for the Replacement of Old Cow Creek Bridge near the Kilarc Powerhouse
3) A rock wall segment was observed during a survey for the Replacement of Old Cow Creek Bridge near the Kilarc Powerhouse.
4) A concrete Licensee wing dam, utilized to divert water into a canal for transportation to the Kilarc Powerhouse, was located during a survey for the Tucker Power Project.

4.6.3.2 Sites Reported Adjacent or Within 1/8-mile of the Project

A total of two cultural resources sites have been recorded within 1/8-mi of the Project Area. One of the sites is prehistoric and the other has both historic and prehistoric components. The prehistoric site consists of a prehistoric village site and the prehistoric component of the historic Phillips Homestead site is a lithic scatter. Following is a brief description of these sites. These sites are depicted in Table 4.6-2.

CA-SHA-166

Recorded in 1958 this site consists of 11 to 12 house pits and two midden areas, one on top of steep hill at the beginning of a canyon and the second at the top of the canyon. Artifacts include obsidian debitage (flakes). The site is reported as being "historically known to have been a refuge during [the] 1850s".

CA-SHA-2541/H

Recorded in 1990, this site has both prehistoric and historic components, a small lithic scatter and the remains of the Phillips Homestead. The main components of the Phillips Homestead are a possible well location, foundation ditch system, and several exotic fruit trees. In addition, there are numerous artifacts including lavender glass fragments, square nails, ceramic sherds, and bed springs.

Additionally, there are three bridges (#6C-3 6C-14, and 6C-44) that are listed in the Caltrans Local Bridge Survey as not eligible for the National Register of Historic Places. One of these bridges, 6C-3, is located within Project boundaries, and the other two are identified as being located on Cow Creek, but have no more specific locational information.

No additional sites have been recorded within 1/8-mi of the Project. However, five unrecorded cultural resources have been reported within 1/8-mi of the Project Area. These resources include ditch remnants, hand hewn cedar stumps, apple trees, decayed cedar posts, and cedar rails.

4.6.3.3 Previous Archaeological Investigations within the Project Area

Records on file with the Northeast Information Center indicate that five cultural resource studies have been conducted within the Project and four within a 1/8-mi radius. The majority of the studies are near Kilarc Powerhouse, penstock, and reservoir. Less than 3 percent of the lands within the Project Area has been subject to cultural resource investigations. Table 4.6-3 summarizes the studies completed within the Project Area and within a 1/8-mi radius.

4.6.3.4 Proposed Historic and Archaeological Studies

Cultural resource studies for the Project will be conducted in compliance with all applicable federal regulations. Applicable statutes and guidelines include Hydroelectric Relicensing Regulations under the Federal Power Act (18CFR, Parts 4 and 6), the National Historic Preservation Act of 1966 (P.L. 89-655; STAT 915, U.S.C. 470), as amended, Protection of Historic Properties (36 CFR 800), National Register of Historic Places (36 CFR Part 60), Uniform Rules and Regulations: Archaeological Resources Protection Act of 1979 (43 CFR Part 7), and the Native American Religious Freedom Act (P.L. 95-341).

As discussed previously, portions of the lands within the Project Area have been subject to cultural resources investigations over the last twenty years. However, many of these studies were not undertaken according to current professional survey standards and are therefore not acceptable for the current Project Area. Any areas within the current Project Area of Potential Effects (APE) that have not been examined within the last five years will be subject to an intensive cultural resources survey using current survey methods. The proposed APE for the current Project is defined as the accessible area within the FERC project boundaries. Surveys undertaken within the last five years may be considered adequate to provide cultural resources inventory information for the current relicensing project.

Many of the site records produced during previous investigations may require updating to current standards. To accomplish this task, a qualified archaeologist will visit all known sites within the proposed Project APE. At that time, any site records that are found to be lacking information will either be updated or re-recorded using the current archaeological record forms and all applicable attachments.

As part of the above survey and site recordation tasks, any and all Project-related impacts will be noted. Once all of the sites within the proposed Project APE have been documented and all site impacts have been identified, four reports will be prepared. These reports are:

1. A report of the results of the archaeological survey and a description of all Project-related impacts;
2. A report that addresses all known Traditional Cultural Places within the Project APE. This report will also gather other important ethnographic information. As part of the research conducted to prepare the report, tribal members and elders may need to be interviewed regarding past use of the area by the indigenous people;
3. A National Register of Historic Places evaluation of all identified cultural resource sites identified within the Project APE;
4. A National Register of Historic Places evaluation of the Kilarc-Cow Creek Hydroelectric facilities. If any portion of the system has been previously evaluated for it's NRHP eligibility within the last 10 years, this evaluation will be considered sufficient for the current relicensing.

The Licensee then proposes to prepare the following Draft documents for the FERC:

1. A Programmatic Agreement (PA) that will address management of identified NRHP-eligible resources; and
2. A Historic Properties Management Plan (HPMP) required by the stipulations of the PA, that will call for the avoidance or protection of specified cultural resources and traditional cultural places whenever possible.

In situations where the PA is not applicable or where ongoing impacts are occurring that cannot be feasibly avoided, the following studies will then be conducted on historical and archaeological resources:

1. Conduct the field evaluation and archival research necessary to evaluate the NRHP eligibility of affected prehistoric sites in consultation with the FERC, the SHPO, the ACHP, and the Pit River Tribe of California and the Redding Rancheria Tribe.
2. Complete ethnographic, prehistoric, and historic overviews of the project area that will establish a detailed historic context within which the affected sites can be evaluated.
3. Determine potential effects upon all significant cultural resources sites (both prehistoric and historic) and traditional cultural properties;

Upon completion of these studies, the Licensee will complete the Historic Properties Management Plan (HPMP), which will identify management recommendations based on the site significance assessments and impact evaluations. This HPMP will remain in effect throughout the term of the new license.

4.6.4 Impacts Related to the Existing Project

No modifications to the existing Project facilities are proposed as part of the current relicensing process. Therefore, expected effects to known historical and archaeological resources associated with the Project Area are confined to those resulting from on-going operation and maintenance. These can be divided into two types: repair, replacement, or removal of existing Project facilities, and earth-disturbing actions (e.g., access road grading, erosion).

Mitigation measures will emphasize early planning to identify potential impacts and select alternatives that will avoid or minimize the impacts. For unavoidable impacts, the mitigation measures will vary with the nature of the cultural resource. Impacts to standing structures may be mitigated through detailed photography and recording of architectural attributes, combined with a careful review of historic records, historic architectural plans and photographs related to the design, construction, operation, and maintenance of the structure. Impacts to archaeological sites may be mitigated by preservation in place, including site capping, or carefully-planned data recovery excavations. Under the newly revised 36 CFR 800 regulations, data recovery excavations are considered an adverse impact, so attempts will be made to minimize use of this management technique. Procedures for mitigating impacts to Traditional Cultural Properties will be negotiated with concerned tribal representatives on an individual case-by-case basis.

Both Native American tribes and agencies may have interest in reviewing the cultural resource reports. It is expected that Native American tribes who historically used the area, retain concern regarding any prehistoric archaeological resources, native plants, and animals located in the Project Area. Therefore, the Licensee will consult with representatives of the appropriate Indian tribes to understand these concerns and identify measures to protect resources with heritage value.

4.6.5 References

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Jensen and Associates. 1990. Report on Historical and Archaeological Resources, Tucker Power Project near Whitmore (I.C. Report # SH-L-358).

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TABLES

Table 4.6-1. Sites Previously Recorded within the Project Area.

Site Number	Type	Description	Location
CA-SHA-1764-H	Historic	Timber Crib Diversion Dam	On South Cow Creek, approximately 250 ft south of the confluence with Mill Creek.
P-45-003241-H	Historic	Water conveyance ditch.	From an unnamed tributary of Old Cow Creek southeast towards Kilarc ditch.
P-45-003242-H	Historic	Water conveyance ditch.	From an unnamed tributary of Old Cow Creek west towards the Twin Valley Ranch.

Table 4.6-2. Sites Previously Recorded within 1/8-mile of the Project Area.

Site Number	Type	Description	Location
CA-SHA-166	Prehistoric	House pits and two midden sites.	Approximately 20-30 feet from South Cow Creek, in the NE ¼ of the NW ¼ of Section 6.
CA-SHA-2541/H	Historic and Pre-historic	Phillips Homestead location and a small lithic scatter.	Approximately 1,000 ft north/northwest of the confluence of South Cow Creek and Mill Creek.

Table 4.6-3. Previous Cultural Resource Investigations within the Project Area and a 1/8-Mile Radius.

Manuscript #	Author	Type	Reason For Survey	Resources within FERC Project Boundary
SH-L-694	Vaughn 1995	Survey	Replacement of Old Cow Creek Bridge	Unrecorded rock wall and mano
K00-105 & K00211/THP# 2-01-060-SHA-(4)	Dethero 2001	Survey	Addendum for the Cow Chips THP	P-45-003241-H and P-45-003242-H; and 5 unrecorded resources
THP#2-89-97	Foster 1989	Survey	Field Inspection for the Sha/Kilarc Reservoir Timber Sale	Three unrecorded flakes noted within Project Area.
I.C. #1343	Salzman 1984	Survey	Proposed Group Picnic Area, Kilarc Forebay	None
SH-L-358	Jensen 1986	Survey	Tucker Power Project	Unrecorded concrete wing dam.
Investigations within 1/8-mile radius				
THP/THP #K95-330/THP#2-96-1990SHA(4)	Chapman 1996	Survey	Big Cow THP	None
VMP#24-010/011-83	Foster 1984	Survey	CDF Inspection for Atkins VMP	None
I.C.#SH-L-356	Hamusek 1989	Survey	THP#2-89-87	None
Atkins VMP Project	Jenkins 1990	Survey	CDF Inspection for Atkins VMP Project	CA-SHA-2541/H

4.7 Recreational Resources

4.7.1 Introduction

The Project Area lies within the Cow Creek Watershed which provides a wide variety of outdoor recreation opportunities, including sightseeing, camping, hiking, hunting, fishing, whitewater boating, horseback riding, and nature appreciation. Most of the recreation occurs on private timberlands, Kilarc Forebay, and Latour State Forest lands in the upper watershed. Except at a few limited points, recreational access is extremely limited in the lower watershed due to the predominance of private land (SHN 2001).

4.7.2 Regional Recreation Opportunities

Shasta County is known for its recreational opportunities that are provided by the area's scenic mountains, lakes, and rivers. Recreational attractions include Shasta Lake, Whiskeytown Lake, Mt. Shasta, Whiskeytown-Shasta-Trinity National Recreation Area, Lassen National Forest, Castle Crags State Park, Pacific Crest Trail, Potem Falls, McArthur-Burney Falls Memorial State Park, Hatchet Creek Falls, and Montgomery Creek Falls, as well as a variety of streams, like Hat Creek and the Sacramento River. Outstanding fishing lakes include Lake McCloud, Shasta Lake, Iron Canyon Reservoir, Big Lake, Baum Lake, and Keswick Lake. Nearby hiking areas include Trinity Divide Country, Lassen Park, and the Thousand Lakes Wildness Area (www.shastacascade.org/shasta/shpage.htm).

Interstate Highway 5 links the County to these recreation areas. California State Route 44, a major highway from Redding, passes through Cow Creek Watershed and the Cascade and Sierra Ranges to connect with U.S. Highway 395 east of Susanville, California. An estimated 6,766,700 visitor days of recreation occurred in Shasta County in 1998 (SHN 2001).

4.7.2.1 Recreation Opportunities within the Project Area

Recreation opportunities within the Project Area are extremely limited due to restricted access through privately-held lands. Many Project facilities are accessed through private lands. The Licensee has developed a recreation site within the Project Area at Kilarc Forebay, a day-use picnic area that offers fishing in Kilarc Forebay.

The Licensee has developed two public picnic areas on the northeastern side of Kilarc Forebay. The picnic areas serve the public and local communities as day-use recreation resources year around. The easternmost facility includes eight picnic tables, four barbecue pedestals, two vault toilets and a parking area. The picnic facility located at the forebay is considered a first-come, first-served group area and it also includes a parking area, eight picnic tables, and four barbecue pedestals. Direct access to the two vault toilets at the eastern picnic area is afforded from the group area by way of a short trail. A footbridge was constructed across the entrance of Kilarc Main Canal to provide unrestricted public access around the forebay. The Licensee estimates that 1,120 visitor days per year are spent at the Kilarc Forebay (SHN 2001). This is a very small percentage of visitor days within Shasta County.

Fishing opportunities are provided at the Kilarc Forebay, which is planted with trout by the CDFG. Catchable rainbow trout are stocked twice a year at the forebay. The forebay also supports a brown trout fishery and large brown trout have been captured here. Fishing is from the shore. The Licensee maintains a path around the forebay. Other fishing opportunities within the Project Area are limited due to lack of access over private land.

4.7.2.2 Recreation Opportunities within Cow Creek Watershed

Although recreation opportunities within the Project Area are limited, expanded recreational opportunities do exist within the Project vicinity (Cow Creek Watershed). In comparison, however, to the opportunities provided within Shasta County, the Cow Creek Watershed is not a major recreation area.

Camping and Picnicking. The upper watershed has seven developed public campsites, and one developed day-use area, managed by Latour State Forest. There are two sites located in the South Cow Creek Watershed: South Cow Creek Campground and Old Station Campground. There are two developed sites at Old Cow Creek Campground. The developed campsites all have vault toilets, barbecues, picnic tables, and fire rings. South Cow and Old Cow Campgrounds have continuous weekend occupancy from June through October.

Fishing. Trout fishing is a recreational activity at many of the campgrounds within the watershed. The CDFG plants trout in the summer at the Ponderosa Way bridges on Old Cow and South Cow Creeks and a South Cow Campground. Fishing does occur in upper reaches of the Cow Creek Watershed, but access is very difficult due to steep slopes and thick brush, so angling use is low in these areas (SHN 2001).

Hunting. Hunting for deer, dove, quail, and turkey is a popular seasonal activity in portions of the Cow Creek Watershed. Much of the hunting is done on privately-held timberlands or in the Latour State Forest. Since 1970, there has been a hunting lease, covering a gated area from South Cow Creek to Bear Creek, on timberland managed by WM Beaty & Associates. This lease is on a year-to-year permit, and is patrolled by the lessor. There is also hunting in the Latour State Forest, which is regulated by the CDFG, with restrictions within 1/4 mi from the State Forest Headquarters and all campgrounds (SHN 2001).

Winter Sports. Snowmobiling is a popular winter activity within the watershed, particularly on Latour State Forest lands (SHN 2001).

Whitewater Boating. This is one of the few recreational activities in the lower portion of the watershed. Cow Creek and Little Cow Creek present a gentle 5-mi, Class I-II spring-season boating run for kayaks and canoes. Boaters will usually begin their run at Old Highway 44 and go down to Highway 44 or Deschutes Road. This is a short easy run and in the summer season, inner-tubers use this section. More adventurous whitewater enthusiasts use other sections on Cedar Creek and Little Cow Creek in winter during high flows. Low flows during summer limit other opportunities throughout the watershed.

4.7.3 Impacts Related to the Existing Project

Potential impacts resulting from the ongoing operation and maintenance of the Project on recreation resources and opportunities include the following:

1. Project-related restrictions to access that might limit recreation opportunities or degrade the experience;

2. Recreation related conflicts between the project and the goals and objectives of applicable federal, state and local agency comprehensive plans;
3. Project-related safety concerns relative to recreation use in and around project facilities and areas.

The Potential for Project-related impacts on recreation resource and opportunities will be evaluated and the results presented in the Exhibit E.

4.7.4 References

SHN Consulting Engineers & Geologists, Inc. and Vestra Resources, Inc. (SHN 2001). November 2001. Cow Creek Watershed Assessment. Prepared for Western Shasta Resource Conservation District and Cow Creek Watershed Management Group.

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4.8 Land Management and Aesthetics

4.8.1 Existing Land Use

The Project is located in Shasta County, approximately 30 mi east of the City of Redding, near the rural communities of Millville and Whitmore. Redding, with a population of 80,865, is the largest city in Shasta County. Millville has a population of 610 and Whitmore has a population of 824. Land uses within the Project vicinity include rural residential, grazing, timber harvest, and some limited recreation.

Land uses within the lower South Cow Creek watershed consist primarily of grazing and rural residential uses, with some private lands managed for timber harvesting. Land use in the upper South Cow Creek watershed is primarily managed for timber harvest. Land use in the immediate vicinity of the Cow Creek Powerhouse and associated facilities is primarily cattle grazing, with smaller portions in private timber, and rural residential.

The Old Cow Creek watershed consists primarily of lands utilized for cattle grazing (private). Lands in the immediate vicinity of the Kilarc Powerhouse and associated facilities are primarily managed for timber harvest, with some smaller portions used for cattle grazing.

4.8.2 Land Management

Of the total 187.13 acres within the Kilarc-Cow Project boundary, 18.86 acres are patented lands subject to Section 24 of the FPA, 117.36 acres are lands owned by the Licensee, and 50.91 acres are privately owned under the jurisdiction of Shasta County. Public lands in the Project Region include Latour State Forest and Lassen National Forest.

Commercial timberlands, although privately owned, have individual land management planning documents that outline goals and objectives for the various properties. These specify timber harvest levels, vegetation and stocking plans, wildlife management plans, and limited public use. While these plans vary by owner/manager, all must conform to requirements for commercial timberlands outlined by the State Board of Forestry, administered through California Department of Forestry (CDF).

Lands uses on privately-owned lands vary from residential to agriculture and grazing. While individuals hold these properties, development and use is overseen by Shasta County through the Board of Supervisors and the County General Plan. The Shasta County General Land Use Plan (General Plan) is the official document adopted by Shasta County, which makes general, long-range policies of how future development within the county should take place, addressing both private and public owned land resources.

Although not within the Project Area, public lands within the upper South Cow Creek and Old Cow Creek Watersheds also influence management of lands in the lower watershed areas. The Latour State Forest is located upstream from the Cow Creek Powerhouse within the upper South Cow Creek Watershed. Lassen National Forest is approximately 5 mi from the Kilarc Forebay.

4.8.3 Impacts Related to the Existing Project

Potential land use impacts related to the existing Project include:

1. Possible inconsistency between comprehensive plans (General Plan, timber plans, and Latour State Forest Management Plan) and the Projects management plans.
2. Project facilities that possibly restrict or limit public access.

3. Conflicts with the Management of the Project's recreational resources and opportunities and recreation demand.

These potential impacts will be addressed in the Exhibit E.

4.9 Protective Measures, Mitigation, Enhancement Measures

4.9.1 Water Use and Quality

The Project is operated in compliance with applicable Federal, State, and local regulations pertaining to the protection and beneficial used of Project waters. There are no discharges that exceed water quality objectives for waters of the Project Area. The Licensee maintains an instream flow release in accordance with the terms and conditions of the Project FERC license.

4.9.2 Vegetation

Licensee will identify operational and routine maintenance activities that may result in impacts to botanical resources within the Project Area. Evaluation of potential or existing impacts will focus on special-status plant species, riparian communities, and wetlands areas.

4.9.3 Aquatic Resources

The Licensee currently operates the Project to provide minimum instream flows downstream of the Kilarc Main Canal Diversion Dam on Old Cow Creek, and downstream of the South Cow Creek Diversion Dam on South Cow Creek. These instream flows were developed in consultation with the CDFG in 1984. At South Cow Diversion Dam the Licensee maintains a minimum flow of 4 cfs in normal and wet years. To ensure compliance with the FERC License, the Licensee typically sets a target flow slightly above the required minimum release. In Dry years, a minimum instream flow of 2 cfs is required. In 2001, the most recent dry year, the Licensee set the target flow at 4 cfs to ensure compliance and to maintain habitat for steelhead that may be present in Cow Creek.

In addition, the Licensee conducts its maintenance program using BMPs. The canals are rarely dewatered, however, when dewatering is necessary, care is taken to lower water levels slowly to allow fish to evacuate the canal. During routine maintenance, the Kilarc Canal contains between

2 and 5 cfs. If the Kilarc Canal needs to be dewatered, it is conducted in October or November (cooler months); the fish remain in the refuge pools during this time. If an emergency requires dewatering in summer months, a fish rescue will be conducted, moving fish to Project Streams or the forebay. When conducting road maintenance, the Licensee is careful to ensure that sediment and other waste materials are not deposited in stream channels or stockpiled in such a way as to minimize the potential for erosion or transport to Project waterbodies. When pesticides are applied to Project facilities, aquatic-safe pesticides are used near water bodies. Equipment is operated to avoid the release of hazardous materials to sensitive habitats.

4.9.3.1 Sensitive Resources

Chinook salmon are a Federal-candidate species and steelhead trout are listed as Federally Threatened. To provide protection and passage for these species, the Licensee operates and maintains fish passage facilities at the South Cow Creek Diversion Dam. These include a fish ladder and a continuously-cleaned, fixed-panel screen. These facilities provide protection for anadromous fish migrating past the South Cow Creek Diversion Dam.

4.9.4 Wildlife

There are several programs in place to protect wildlife species and their habitats. The Licensee has developed a Bird and Raptor Protection Program to reduce potential impacts associated with transmission facilities. This program provides uniform procedures associated with the design and operation of electric facilities to ensure protected, threatened, and endangered bird species are protected from electrocution to the greatest extent possible. Protection measures include insulated jumper wires and bird/animal guards for equipment insulator bushings or building lines to conform with standard raptor-safe primary construction and wildlife protection wood pole distribution line designs. Transmission line design is continually evaluated to assess the risk to protected, threatened, and endangered species through information obtained from periodic patrols and outage reports. Any lines or poles that appear to present a problem are evaluated to determine if corrective action is needed. Nests are left undisturbed unless they pose an operational hazard. In such a case, a licensed Technical and Ecological Services biologist is consulted to remove or relocate the nest.

Another program designed to reduce or avoid potential impacts is the Environmental Training Program. The Licensee's technicians and line-workers attend environmental training meetings on a regular as well as an as-needed basis. These meetings are conducted in the field on a job-specific basis to review appropriate maintenance protocols in environmentally sensitive areas. These meetings also include a review of background material, permit conditions, and instructions on how to avoid significant impacts to biological resources.

The Wildlife Resource section of the Exhibit E will first describe the distribution and abundance of wildlife resources known or anticipated to occur within the Project Area. These descriptions will emphasize wildlife use of the areas adjacent to Project facilities that might be affected by continued operation and maintenance.

4.9.5 Historical and Archaeological Resources

The Licensee will summarize the cultural resources within the Project Area, as well as the cultural resources adjacent to the FERC license boundary, that may be adversely effected by the ongoing operation and maintenance. If adverse effects are identified, the Licensee will develop methods for avoidance and/or mitigation that would reduce potential effects to a less than significant level. The Licensee will evaluate the need for the development of a Cultural Resource Management Plan.

4.9.6 Recreation

Recreation opportunities that exist within the Kilarc-Cow Creek Project Area have been developed. The small amount of land owned by the Licensee and the preponderance of private land closed to public use limits additional recreational development. The Licensee recently upgraded the facilities at Kilarc Forebay to include a footbridge across the Kilarc canal. The construction of the bridge completed the footpath around the Forebay, which improved access for anglers and other recreationists.

4.9.7 Land Use and Aesthetics

Mitigation measures will be identified after full land use analysis and aesthetic assessments have been completed.

KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR
FIRST STAGE OF CONSULTATION

5.0 STREAMFLOW AND WATER REGIME INFORMATION

18 CFR § 16.8 (b) First stage consultation.

(1) A potential applicant must provide each of the appropriate resource agencies and Indian tribes, listed in paragraph (a)(1) of this section, and the Commission with the following information:

(v) Streamflow and water regime information, both existing and proposed, including drainage area, natural flow periodicity, monthly flow rates and durations, mean flow figures illustrating the mean daily streamflow curve for each month of the year at the point of diversion or impoundment, with location of the stream gauging station, the method used to generate the streamflow data provided, and copies of all records used to derive the flow data used in the applicant's engineering calculations;

KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR
FIRST STAGE OF CONSULTATION

5.0 HYDROLOGY

5.1 Introduction

The Cow Creek Watershed is located on the east side of the Sacramento Valley near Redding, California. Cow Creek enters the Sacramento River south of Redding near Anderson, California. The Sacramento River flow at its confluence with Cow Creek is regulated by Shasta and Keswick Dams, located on the Sacramento River upstream of Cow Creek.

The Cow Creek Watershed is westerly-facing and varies in elevation from 400 ft above MSL to about 7,000 ft above MSL. Cow Creek is one of the larger tributaries to the Sacramento River, upstream of the Feather River and downstream of Lake Shasta.

The watershed is on the western flanks of the Cascade Mountain Range. The area was shaped by volcanic activity to the east and the north, with the most recent activity, the eruption of Mt. Lassen, in 1915. The porous rock of the lava formations provides a conduit for groundwater flow and storage (State Water Rights Board 1965). Burney Falls, located northeast of Cow Creek is a prime example of the movement of groundwater through the subsurface lava rock; groundwater emerges from the subsurface to provide surface water flow. This groundwater movement provides a year-round baseflow in many local streams. However, during critically dry years, like 1977, base flow in Cow Creek is minimal (less than one cfs measured at the Millville Gage).

This section of the First Stage Consultation Package describes the surface water resources of the Cow Creek Watershed. All available data are used in the description of the hydrology.

5.2 Watershed Description

The Cow Creek Watershed is 425 sq. mi. in area, as measured at the Millville Gage (License No. 606 and USGS No. 11374000), about 3 mi upstream of the Sacramento River (Figure 5-1). The median watershed elevation is about 1,800 ft above MSL and 10 percent is located above 5,000 ft above MSL and accumulates a seasonal wintertime snowpack (Figure 5-2).

The watershed is comprised of Cow Creek and several tributaries. Cow Creek extends from the Sacramento River to river mile 16 where South Cow Creek and Old Cow Creek converge. South Cow Creek, the southern-most of the two tributaries, is about 79 sq. mi. in size and ranges in elevation from about 550 ft to 6,740 ft above MSL. There are numerous points where water is diverted from South Cow Creek and its tributaries, including the diversion for the South Cow Creek Powerhouse.

Old Cow Creek extends from its confluence with South Cow Creek at an elevation of 550 ft to the headwaters at an elevation of 7,050 ft. The upper elevations of the watershed receive snow and accumulate a winter snowpack (Kogut pers. comm.). Many water users divert water from Old Cow Creek, including the diversion for the Kilarc Powerhouse.

Clover Creek is a 55 sq. mi. watershed immediately north of Old Cow Creek. Clover Creek enters Cow Creek near Millville, about 3 mi downstream of the Old Cow/South Cow confluence. The watershed ranges in elevation from 460 ft to 6,800 ft above MSL at Clover Mountain.

Oak Run Creek is north of Clover Creek and enters Cow Creek about 1 ½ mi downstream of Clover Creek near Palo Cedro. This 42 sq. mi. watershed ranges in elevation from 430 ft to 4,490 ft above MSL. There are several diversions from Oak Run Creek.

North of Oak Run Creek is Little Cow Creek. Little Cow Creek (also known as North Cow Creek) enters Cow Creek about 0.5 mi downstream of Oak Run Creek. The watershed is about 142 sq. mi. in area and ranges in elevation from about 420 ft to 6,810 ft above MSL. Various water uses divert water from Little Cow Creek.

These tributaries are relatively steep in the upper watersheds, and less steep in the western portions of the watersheds, near Palo Cedro. The channel slope of each of these tributaries is shown in Figure 5-3.

5.3 Precipitation

Rainfall is measured at several gages located in the Cow Creek Watershed and in nearby watersheds (Figure 5-4, Table 5-1). The rainfall varies from a maximum in winter months (November to March) to the minimum in summer months (July and August). A plot of the average monthly rainfall demonstrates this pattern of wet winters and dry summers (Figure 5-5a through 5-5c).

Total annual rainfall depth has varied from a minimum of 19.47 in (1977) to 65.07 in (1998) at Volta, located to the south of the Cow Creek Watershed. On a monthly basis, the total rainfall depth at Volta ranges from 0 in, which occurs in most summers, to 15.87 in which occurred in January of 1995. Daily rainfall depths range from 0 in to 3.56 in (November 1965). The Licensee maintains rain gages within the watershed at Kilarc Powerhouse and Round Mountain.

5.4 Water Uses

Water is diverted from the springs and creeks of the Cow Creek Watershed to serve agricultural, domestic, and power production needs. Conflicts between water users resulted in the adjudication of water rights on Little Cow Creek in 1932, Oak Run Creek in 1932, Clover Creek in 1937, and the Old Cow/South Cow Creek system in 1969. The adjudication of Little Cow, Oak Run, and Clover Creeks identified 116, 23, and 26 water rights, respectively. The adjudication of water rights on the Old Cow/South Cow Creek system established 116 water rights on these two streams (including Cow Creek below the confluence of South Cow and Old Cow Creeks) (SHN 2001).

Many of the diversions use unlined canals to convey the water from the creek to the place of use. Along the canal, water is lost to evaporation, transpiration by plants, and seepage. Although the fate of the seepage has not been studied, it may return to the creek through the groundwater and therefore is not lost to the system. Canal seepage was estimated in German Ditch to be 1.1 cfs/mi (Water Rights Board 1965).

The Licensee diverts water from Old Cow Creek and South Cow Creek for power generation. These are non-consumptive uses of water because the water is returned to the creek after passing through the turbine. There is a domestic spring at Kilarc Powerhouse that provides water to the caretaker house and is a consumptive use. The Kilarc Canal diverts water in the upstream reaches of Old Cow Creek and conveys the water to the Kilarc Forebay. From there, the water enters the Kilarc Powerhouse penstock where it drops about 1,192 ft to the powerhouse and then returns to the river. Flows in about 3.8 mi of Old Cow Creek are affected by this diversion. The South Cow Creek Canal diverts water just upstream of Mill Creek. Several other water uses divert water upstream of this diversion. The water is conveyed to South Cow Creek forebay and then into the penstock where it drops 715 ft to the powerhouse. About 3.9 mi of South Cow Creek are affected by this diversion.

There are other non-Licensee hydropower diversions in the watershed. The Olson Power Plant diverts water from Old Cow Creek 1.2 mi downstream of the Kilarc Powerhouse. Water is diverted to the powerhouse and a minimum instream flow of 30 cfs is maintained downstream of the diversion.

The Tocher water right diverts water from Canyon Creek, a tributary to Old Cow Creek. The Licensee also has water rights on Canyon Creek and cannot divert water unless the Tocher water right is satisfied.

5.5 Hydrology

Streamflow is currently measured at several locations in the watershed (Table 5-2). In addition, there are several stream gages that were operated in previous years but have been discontinued (Table 5-2). Both daily streamflow and peak flow are measured and recorded by the USGS some of which are operated by the USGS, others by the Licensee and supervised by USGS. Flow data were also collected at additional locations in 1964 by various parties to support the adjudication (Table 5-3). The Licensee also monitors flow at other locations for operational purposes. The streamflow data and a representative graph of flow measured at each station are presented in Appendix A.

The measured flow in the Cow Creek Watershed is influenced by the upstream diversions. Because of the nature of the predominant water use (irrigated pasture), this use is expected to be highest in the summer. Therefore, the measured summer flows would be higher in the absence of these diversions.

Daily flows in the Cow Creek watershed display a wide range of flow regimes. The daily flow tends to reach peak levels in the winter and experience minimum levels in the summer. During drought periods, the measured daily flow at Millville has dropped below 1 cfs. Flood flows are discussed below.

The measured flows in the watershed for selected days in 1964 were collected as part of the adjudication. The measurements were taken at numerous locations in the watershed and provided extensive coverage of the hydrology of the watershed. These flow measurements demonstrate the relationship between the diversions and tributary flows.

5.5.1 Average Monthly Flow

Average monthly flow reaches a peak between January and February as measured at the USGS stations (Figure 5-6). The maximum monthly flow of Cow Creek at Millville is 1,759 and 1,707 cfs for January and February, respectively (Table 5-4). The average monthly is lowest in July, August, and September, with 65, 39, and 49 cfs, respectively. The monthly average flow for median wet and dry months is shown as Figure 5-7.

5.5.2 Total Flow

The total annual flow from the watershed is a measure of the watershed runoff and helps distinguish between wet, average, and dry years. The total annual flow is influenced by the consumptive use associated with domestic and agricultural use that divert water from the creeks. Hydropower diversions do not influence the total annual flow except for losses to canal evaporation or seepage to the groundwater. The long-term record of flow for the basin is the

USGS gage at Millville and provides 51 years of data. The total annual flow per water year has ranged from a low of 48,392 af in 1977 to 1,182,636 af in 1998. The median annual flow is 497,000 af (Figure 5-8, Table 5-5).

5.5.3 Peak Flow

Instantaneous peak flow measurements have been recorded or estimated at several USGS gages during floods. The flood measurements have been summarized in Table 5-6. The peak flood flows for the gage on Cow Creek at Millville provides 51 years of maximum annual flows and ranges from 48,700 cfs, measured in 1981 to 1,270 cfs measured in 1977. The median flood flow is about 22,900 cfs (Figure 5-9).

5.5.4 Minimum Instream Flow

Minimum instream flow requirements are stated for several points within the Cow Creek Watershed. The minimum instream flow requirement for Old Cow Creek downstream of the Kilarc Diversion is 2 cfs. This flow is achieved through the release of water from the Kilarc Canal about 50 ft downstream of the diversion. The Licensee maintains a weir to release diverted water back to the creek and flow is monitored at this point. USGS Station No. 11372325 is the record of this release.

There is also a minimum instream flow downstream of South Cow Creek diversion. The minimum instream flow of 4 cfs is maintained through a release from the South Cow Creek Canal through the fish ladder at the diversion dam. The minimum instream flow reduces to 2 cfs during dry years. The Licensee monitors flow at this station and the USGS reports the flow as Station No. 11272080.

There is a minimum instream flow requirement of 30 cfs downstream of the non-Licensee Olson Powerhouse diversion on Old Cow Creek. The flow is monitored at this location and the data reported as USGS Station No. 11372350.

Because of the water rights priority established in the adjudication, there are flow requirements at various points in the watershed that reflect the superior downstream water rights. That is, a water user can not divert water in excess of the users water rights or if the diversion will cause a shortage to water rights downstream that are senior.

Table 5-1. Precipitation Gages in the Cow Creek Watershed

Precipitation Gage Number	Gage Name
4544	Kilarc Powerhouse
8175	Shingletown 2 E
9390	Volta Powerhouse
7581	Round Mountain PG&E
1149	Buckhorn
5311	Manzanita Lake
7296	Redding Fire Station 2

Table 5-2. **Flow Monitoring Stations in the Cow Creek Watershed**

Station Number	Station Name	Latitude	Longitude	Area (mi^2)	Starting Date	Ending Date
USGS-reported Stations						
11374000	Cow Creek near Millville, CA	40°30'20"	122°13'55"	425	1949	Present
11373200	Oak Run Creek near Oak Run, CA	40°41'25"	122°02'35"	11	1957	1966
11372200	South Cow Creek near Millville, CA	40°32'55"	122°05'30"	77.3	1956	1972
11373300	Little Cow Creek near Ingot, CA	40°44'45"	122°03'40"	60.8	1957	1965
11372700	Clover Creek near Oak Run, CA			19	1957	1959
11272080 (CB133)	South Cow Creek Canal Diversion to South Cow Creek, near Whitmore	40°35'35"	121°58'53"	NA	1984	Present
11372325 (CB132)	Kilarc Canal Diversion to Old Cow Creek, near Whitmore, CA	40°41'13"	121°48'27"	NA	1983	Present
11372350	Old Cow Creek below Diversion to Olson Power Plant, near Whitmore	40°40'10"	121°53'27"	32.6	1990[1]	Present
11372330	Olson Power Plant near Whitmore, CA	40°38'20"	121°55'27"	NA	1990[1]	Present
11372500	Cow creek at Millville	40°32'40"	122°10'30"	166	1912[4]	1914
11373000	Clover Creek at Millville	40°30'10"	122°11'00"	52.5	1912[4]	1914
11373500	Little Cow Creek at Palo Cedro	40°33'50"	122°13'40"	145	1912[4]	1914

Table 5-2. **Flow Monitoring Stations in the Cow Creek Watershed (continued)**

Station Number	Station Name	Latitude	Longitude	Area (mi^2)	Starting Date	Ending Date
Non-USGS-reported Stations						
CB87	Kilarc Powerhouse[2]	*	*	NA	1975	Present
CB88	Cow Creek Powerhouse[2]	*	*	NA	1974	Present
CB2	Kilarc Diversion[2]	*	*	NA	1981	2001
CB4	South Cow Creek Diversion[2]	*	*	NA	1981	1997
NA	Glendenning Creek, below confluence with Bear Gulch[3]	*	*	*	May 1964	October 1964
NA	S. Cow Creek above German Ditch[3]	*	*	*	June 1964	October 1964
NA	Atkins Creek at Bateman Rd[3]	*	*	*	May 1964	October 1964
NA	Mill Creek at Mill Creek Road[3]	*	*	*	May 1964	September 1964
NA	Cow Creek below Confluence of Old Cow and S. Cow Creeks[3]	*	*	*	May 1964	October 1964
NA	Kilarc Powerhouse Ditch above Siphon[3]	*	*	*	May 1964	September 1964
NA	S. Cow Creek Powerhouse Ditch[3]	*	*	*	May 1964	September 1964
NA	Bassett Ditch above all laterals[3]	*	*	*	May 1964	October 1964
NA	German Ditch above all laterals[3]	*	*	*	May 1964	October 1964

1 – Incomplete data with missing years
2 – Data collected by PG&E but not verified or published by USGS
3 - Data collected in 1964 as part of the Cow creek adjudication
4 - Data collected as a single peak flow
* - Data are not known.Note: Station number in parentheses for non-USGS-reported stations is the Licensee station number.

Table 5-3. Miscellaneous Flow Data Collected in 1964

Station	Number of Days Sampled	Average Flow (cfs)
Old Cow Creek at Ponderosa Way	9	2.0
Old Cow Creek below Kilarc Powerhouse	9	32
S. Cow Creek at Ponderosa Way	2	41
S. Cow Creek above Wagoner Ditch	4	5.1
Cow Creek below confluence with Clover Creek	2	23
Cow Creek below Silverbridge Rd	2	15
Clover Creek at old Hwy 44	9	5.1
Oak Run Creek at old Hwy 44	9	2.8
N. Cow Creek at old Hwy 44 (Little Cow Creek)	8	5.0

Source: State Water Rights Board 1965

Table 5-4. Average Monthly Cow Creek Flow (cfs) at Millville (1950-2000)

Month	Minimum Flow	Average Flow	Maximum Flow
Oct	19	126	1,057
Nov	58	486	2,539
Dec	76	1,121	3,929
Jan	81	1,759	5,593
Feb	103	1,707	5,636
Mar	118	1,392	5,275
Apr	63	861	3,012
May	54	555	2,375
Jun	13	236	1,386
Jul	1	65	324
Aug	1	39	148
Sep	3	49	130

Table 5-5. Total Annual Flow at Millville (thousands of acre-feet)

Water Year	Exceedance (%)	Volume of Runoff	Water Year	Exceedance (%)	Volume of Runoff
1998	2%	1183	1975	52%	473
1983	4%	1090	1989	54%	440
1974	6%	1003	1954	56%	425
1982	8%	918	1961	58%	402
1995	10%	916	1968	60%	382
1958	12%	831	1962	62%	369
1969	13%	816	1966	63%	357
1956	15%	749	1950	65%	347
1952	17%	748	1979	67%	340
1993	19%	742	1981	69%	312
1978	21%	730	1972	71%	291
1970	23%	708	1957	73%	290
1967	25%	674	1987	75%	279
1986	27%	649	1959	77%	271
1971	29%	633	1955	79%	262
1973	31%	627	1960	81%	257
1980	33%	621	1988	83%	255
1963	35%	587	1985	85%	246
1965	37%	585	1990	87%	244
1999	38%	561	1994	88%	212
1953	40%	545	1976	90%	197
1996	42%	541	1992	92%	181
1984	44%	537	1964	94%	174
1951	46%	515	1991	96%	128
1997	48%	498	1977	98%	48
2000	50%	497			

Note: Data are from Cow Creek at Millville Gage (USGS Station No. 11374000) for water years 1950-2000

Table 5-6. Peak Flow Measurements in the Cow Creek Watershed

USGS Station Number	Station Name	Period of Record (Water Year)	Peak Flow (cfs)	Year of Peak 5.5.4.1.1.1 Flow[3]
11372200	South Cow Creek Near Millville	1957-1972	6,970	1970
1372350	Old Cow Creek Below Div To Olsen Power Plant Near Whitmore	1997	2,280	1997
11372700	Clover Creek Near Oak Run	1958-1959	868	1958
11373000	Clover Creek A Millville	1912-1914	6,300	1914
11373200	Oak Run Creek Near Oak Run	1958-1976	3,860	1974
11373300	Little Cow Creek Near Ingot	1958-1965	9,270[1]	1965
11373500	Little Cow Creek at Palo Cedro	1912-1914	20,000[2]	1914
11374000	Cow Creek Near Millville	1950-2001	48,700	1981
11372500	Cow Creek at Millville	1912-1914	10,500	1914

1 – Data missing for 1964
2 Estimated Flow
3 – Water Year

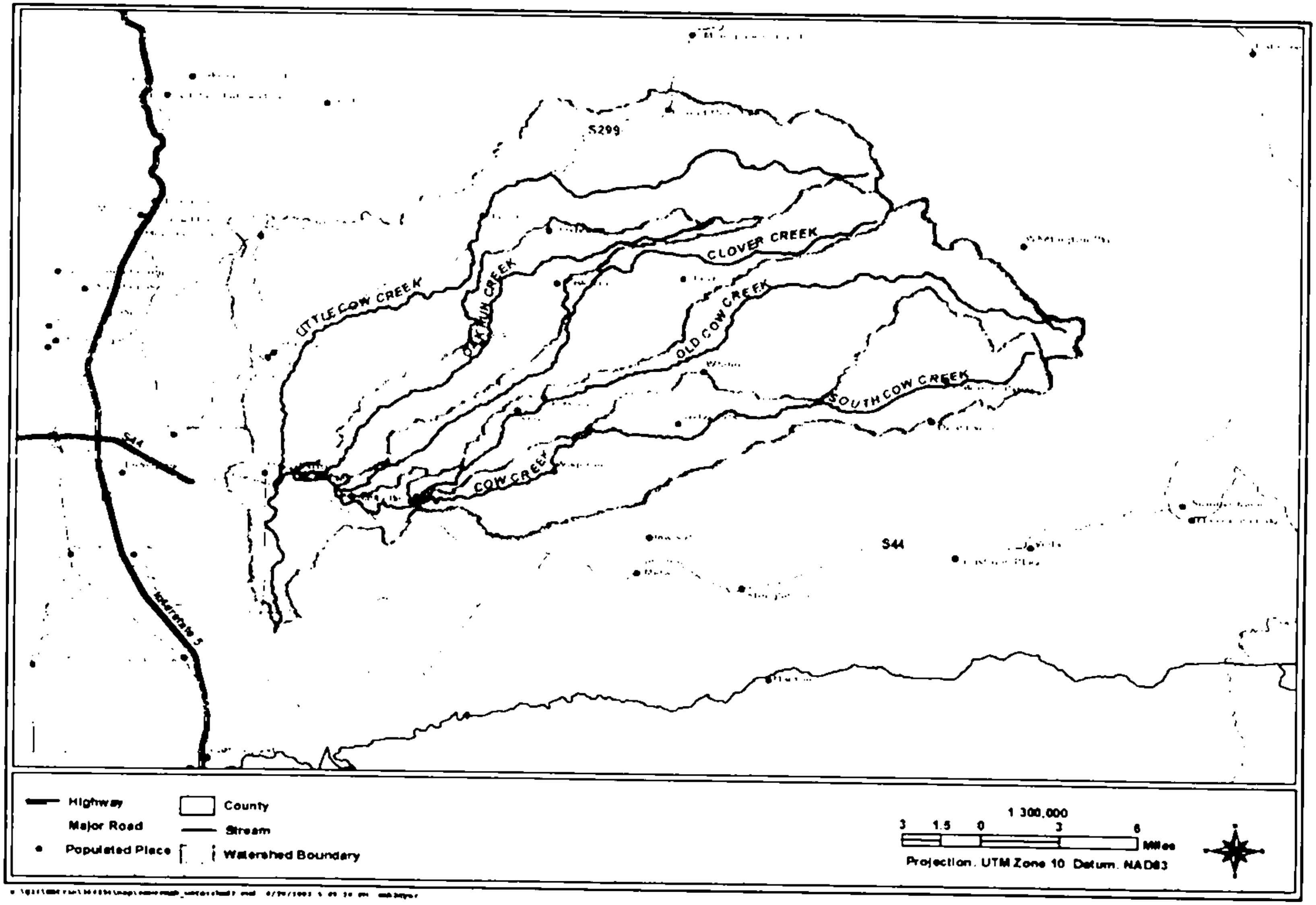

Figure 5-1. Cow Creek Watershed.

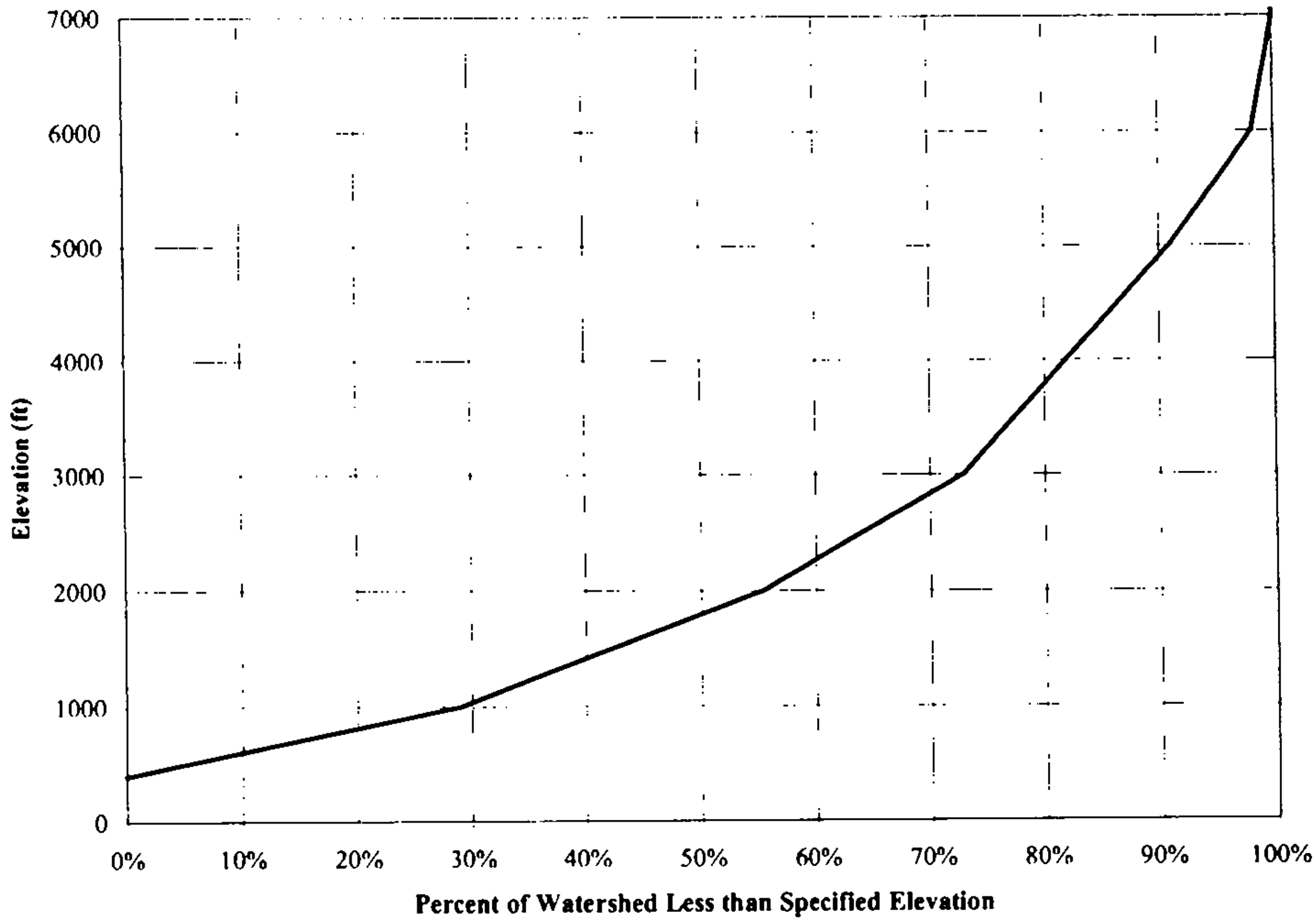

Figure 5-2. Area/Elevation Curve for the Cow Creek Watershed.

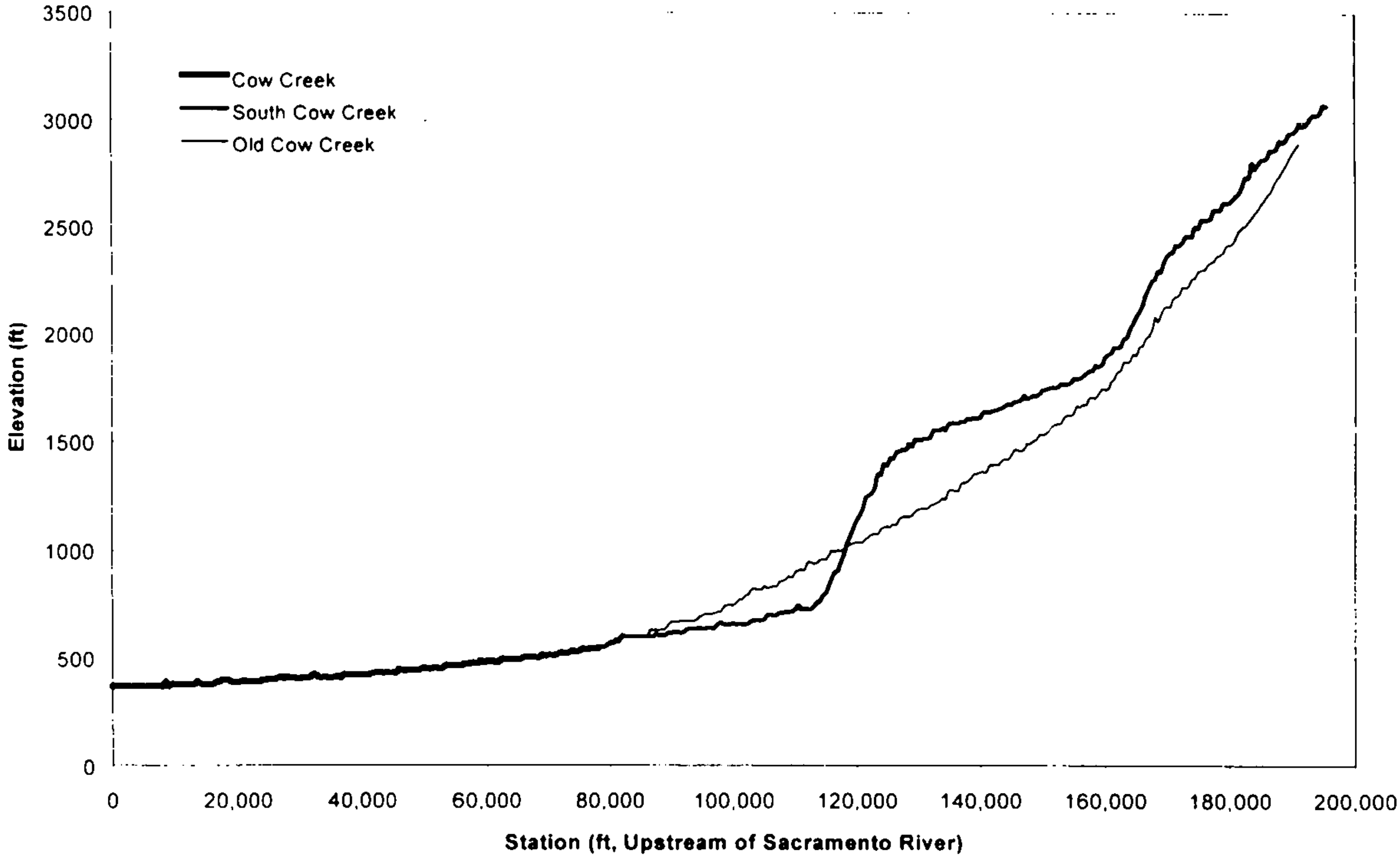

Figure 5-3. Stream Channel Slope in the Cow Creek Watershed.

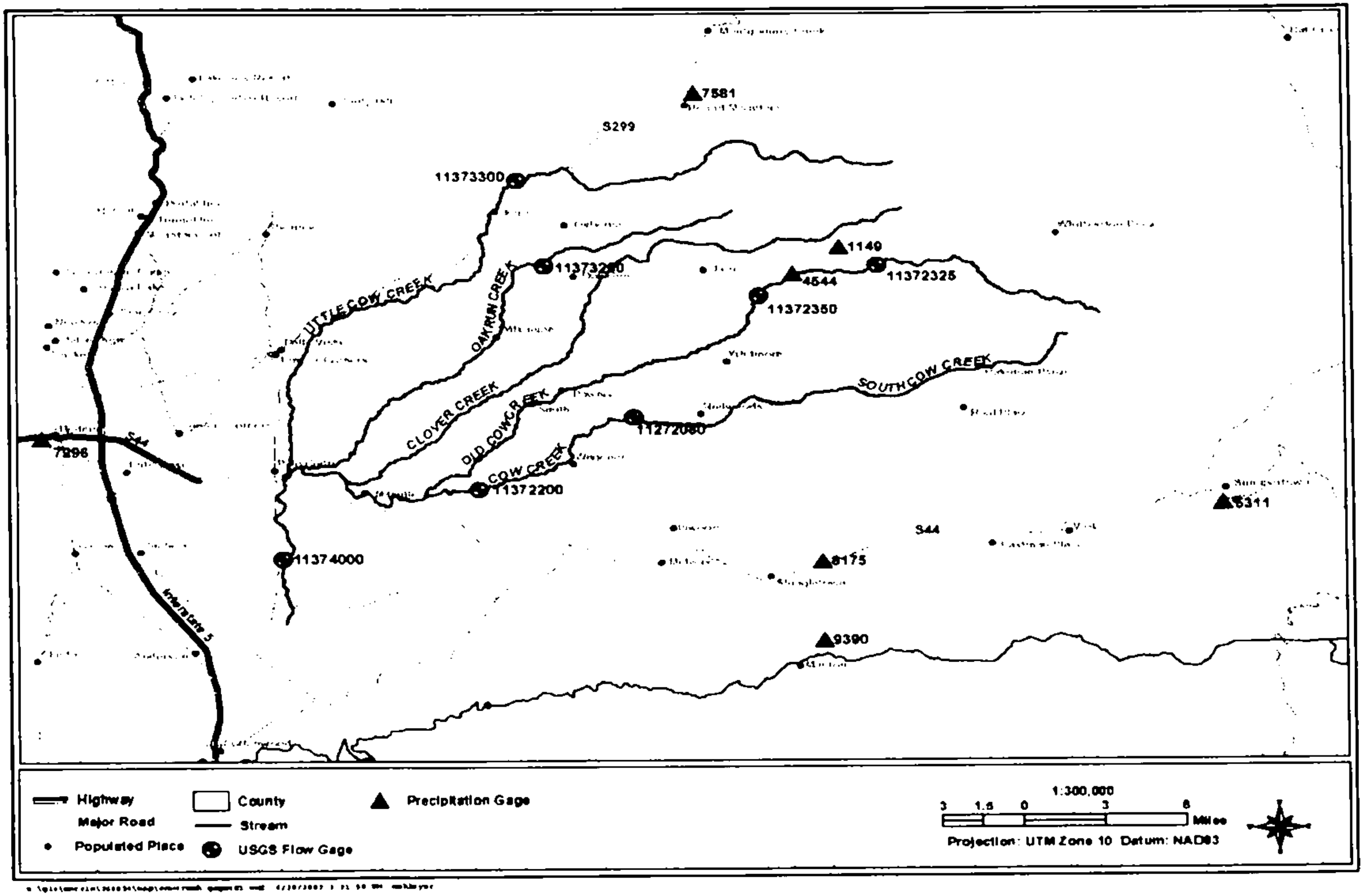

Figure 5-4. Streamflow and Precipitation Gages in the Cow Creek Watershed Area.

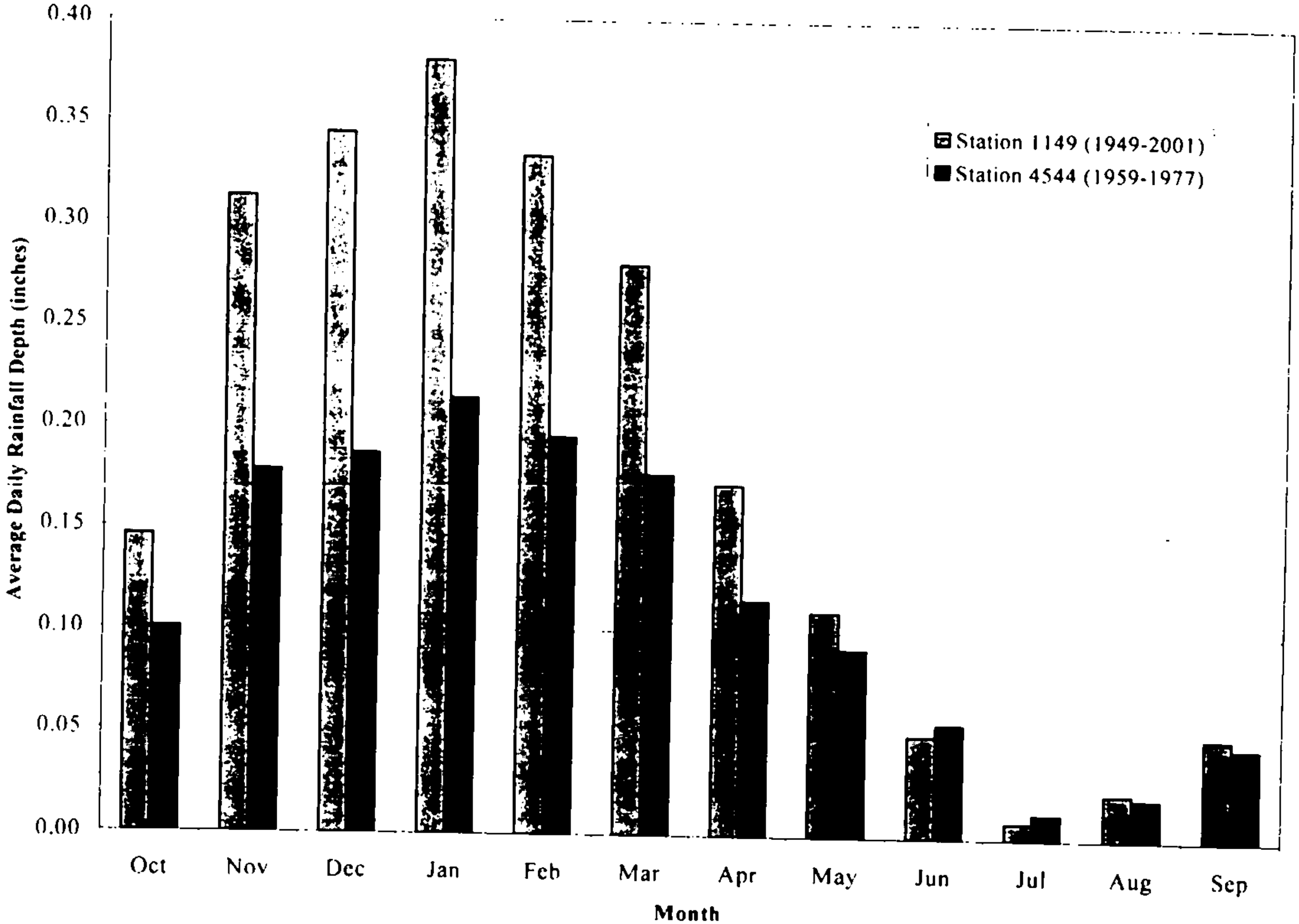

Figure 5-5a. Average Daily Rainfall for the Cow Creek Watershed Area.

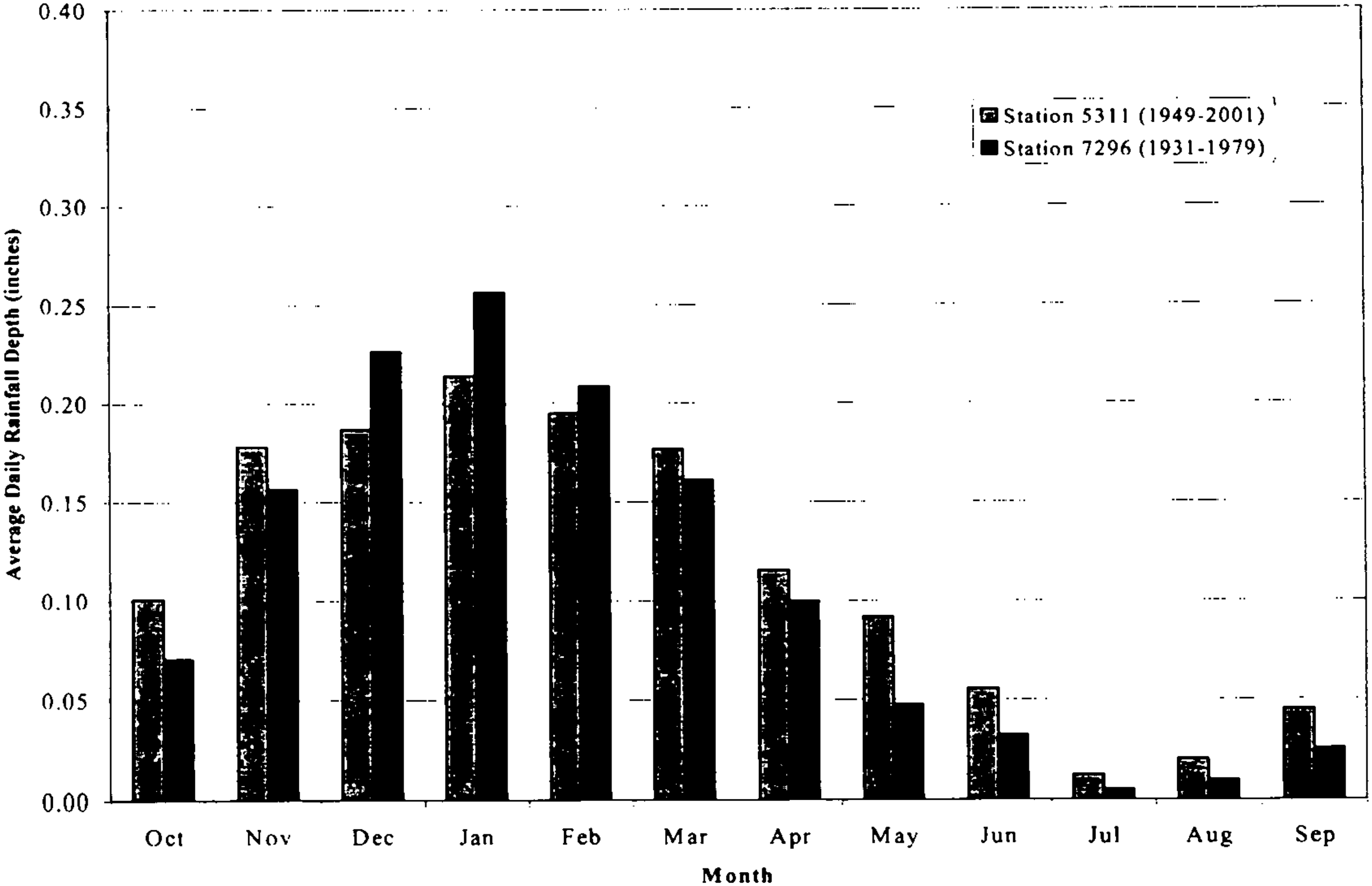

Figure 5-5b. Average Daily Rainfall for the Cow Creek Watershed Area.

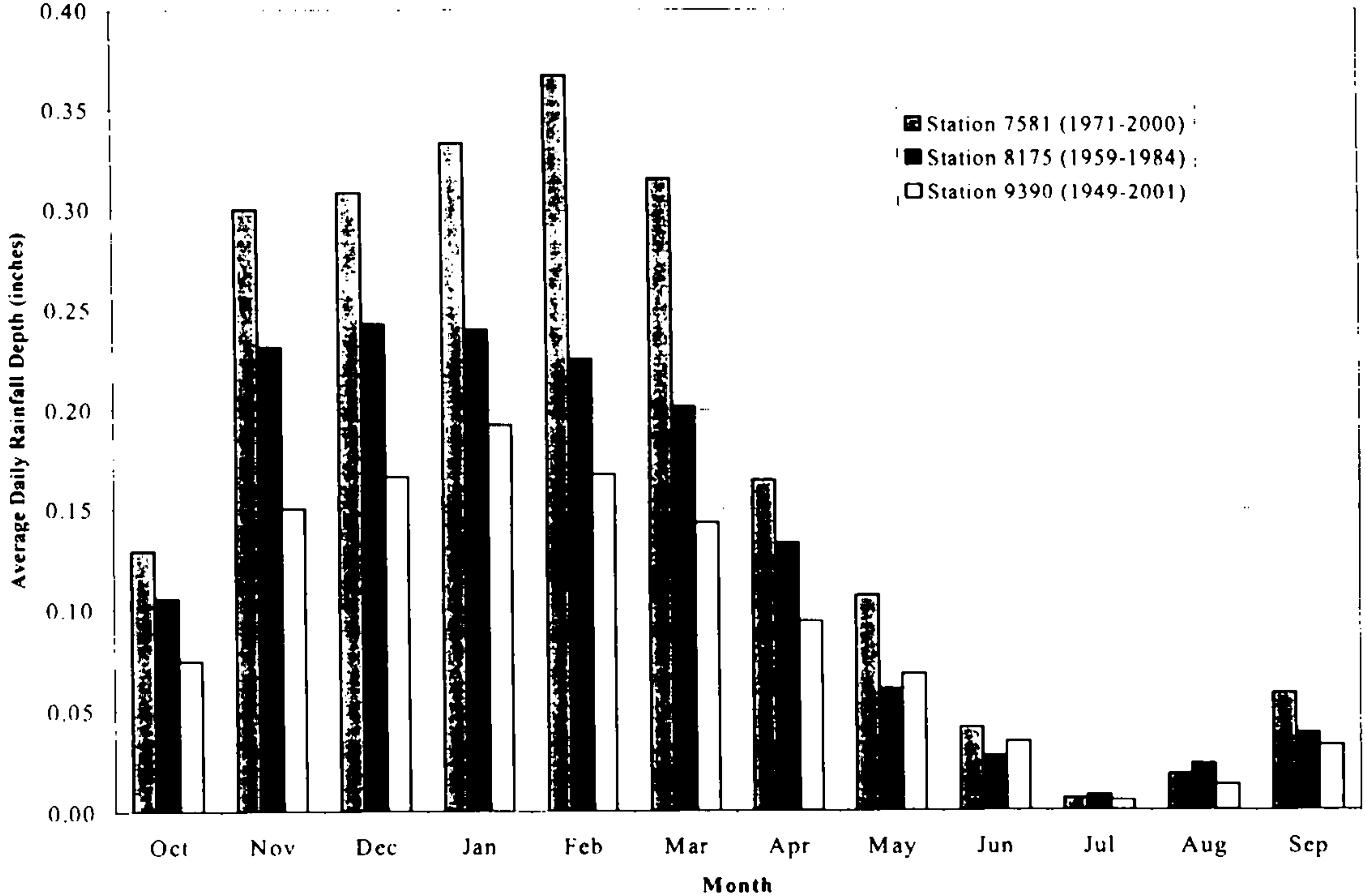

Figure 5-5c. Average Daily Rainfall for the Cow Creek Watershed Area.

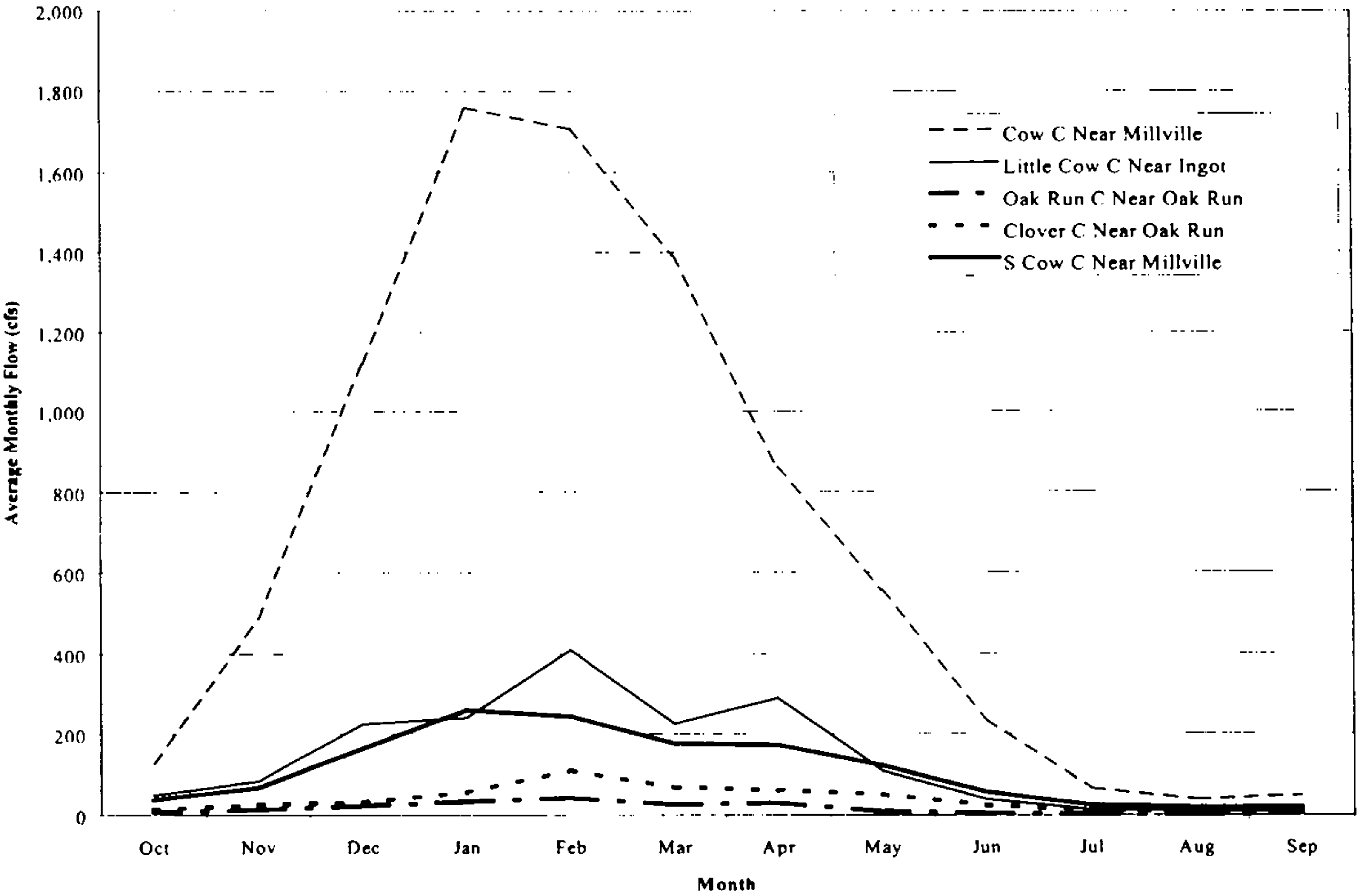

Figure 5-6. Average Monthly Flow for Cow Creek and Tributaries (1950-2000).

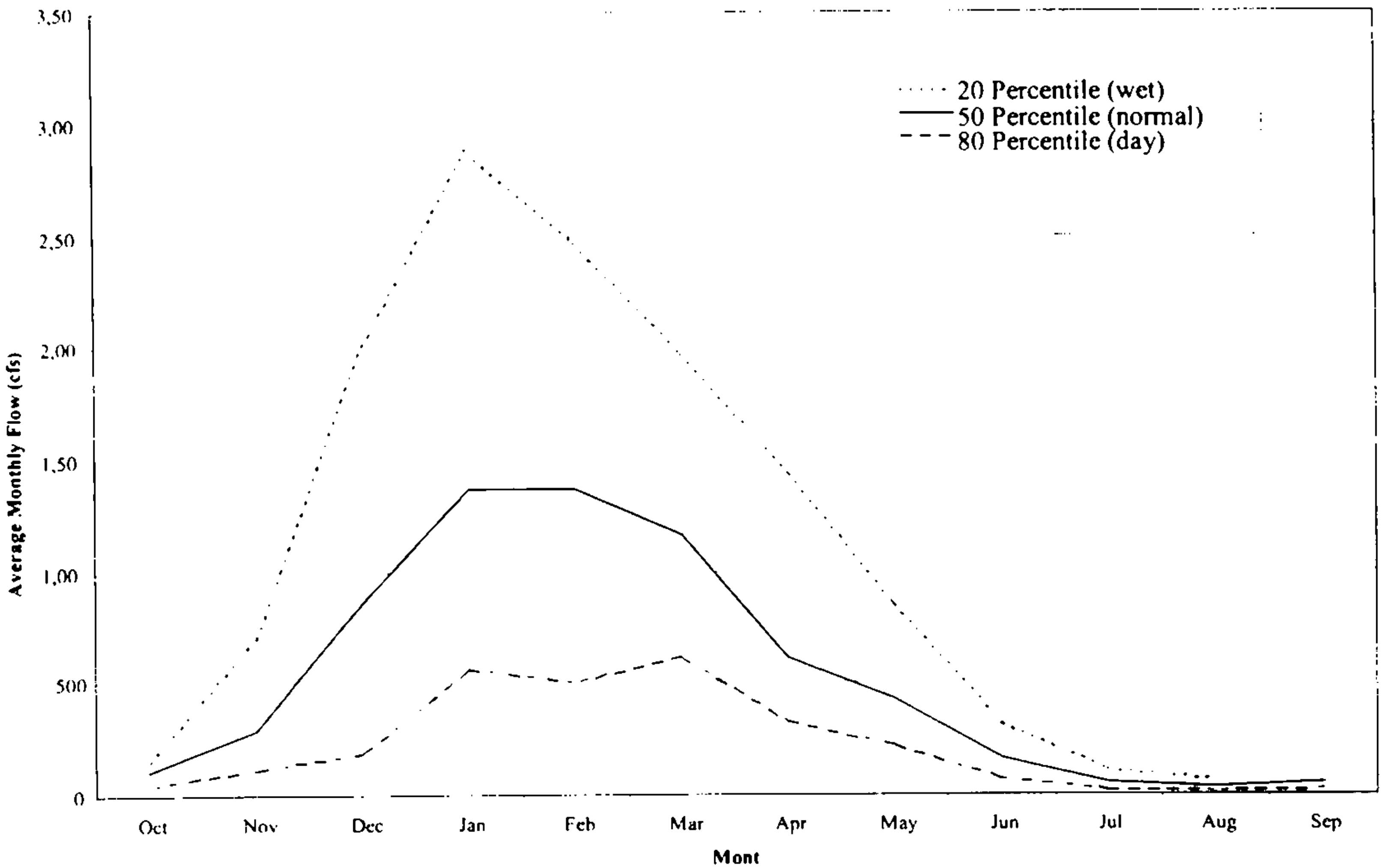

Figure 5-7. Cow Creek Flow at Millville Under Wet, Normal, and Dry Conditions (1950-2000).

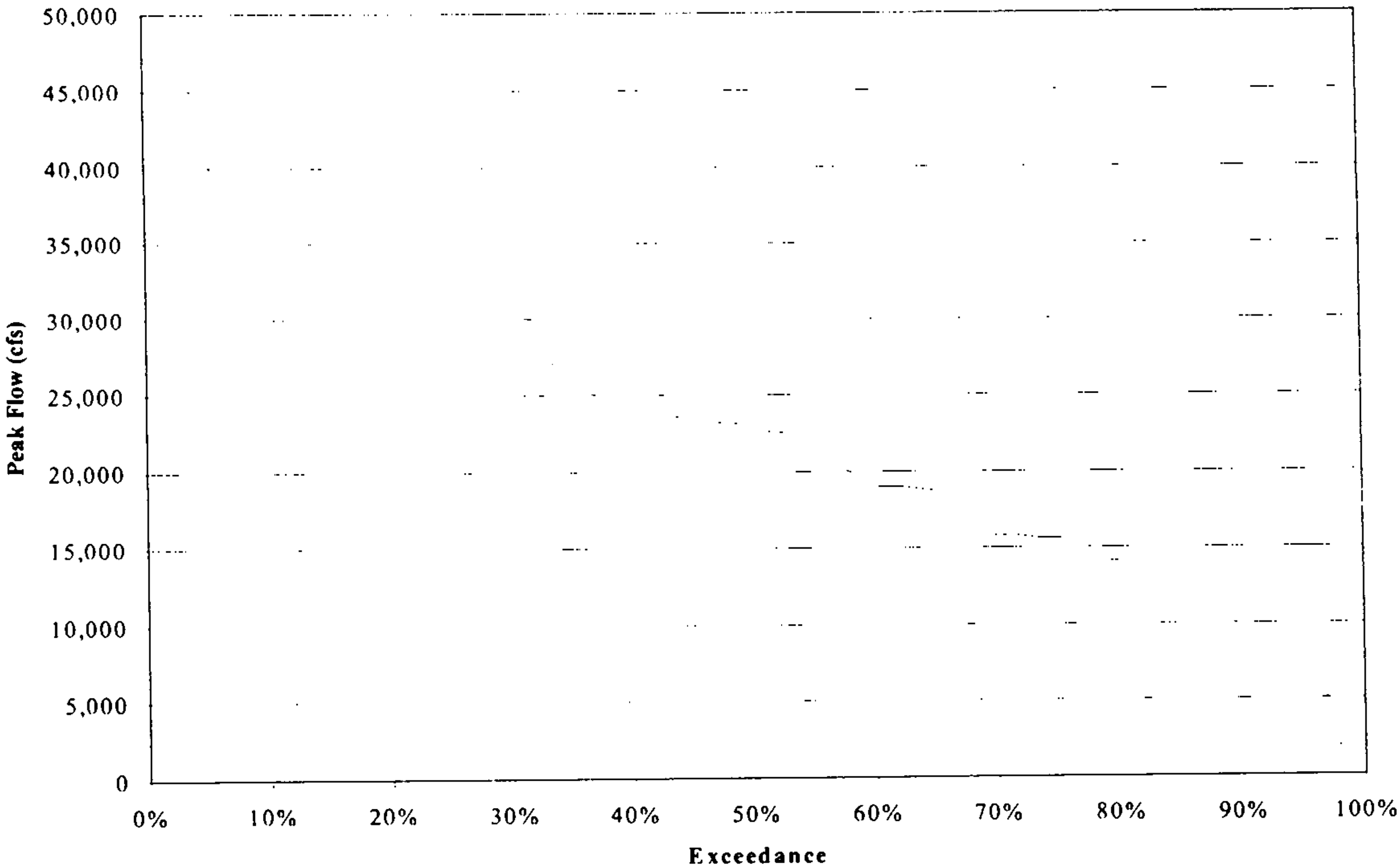

Figure 5-8. Exceedance Plot of Total Annual Flow of Cow Creek at Millville (1950-2000).

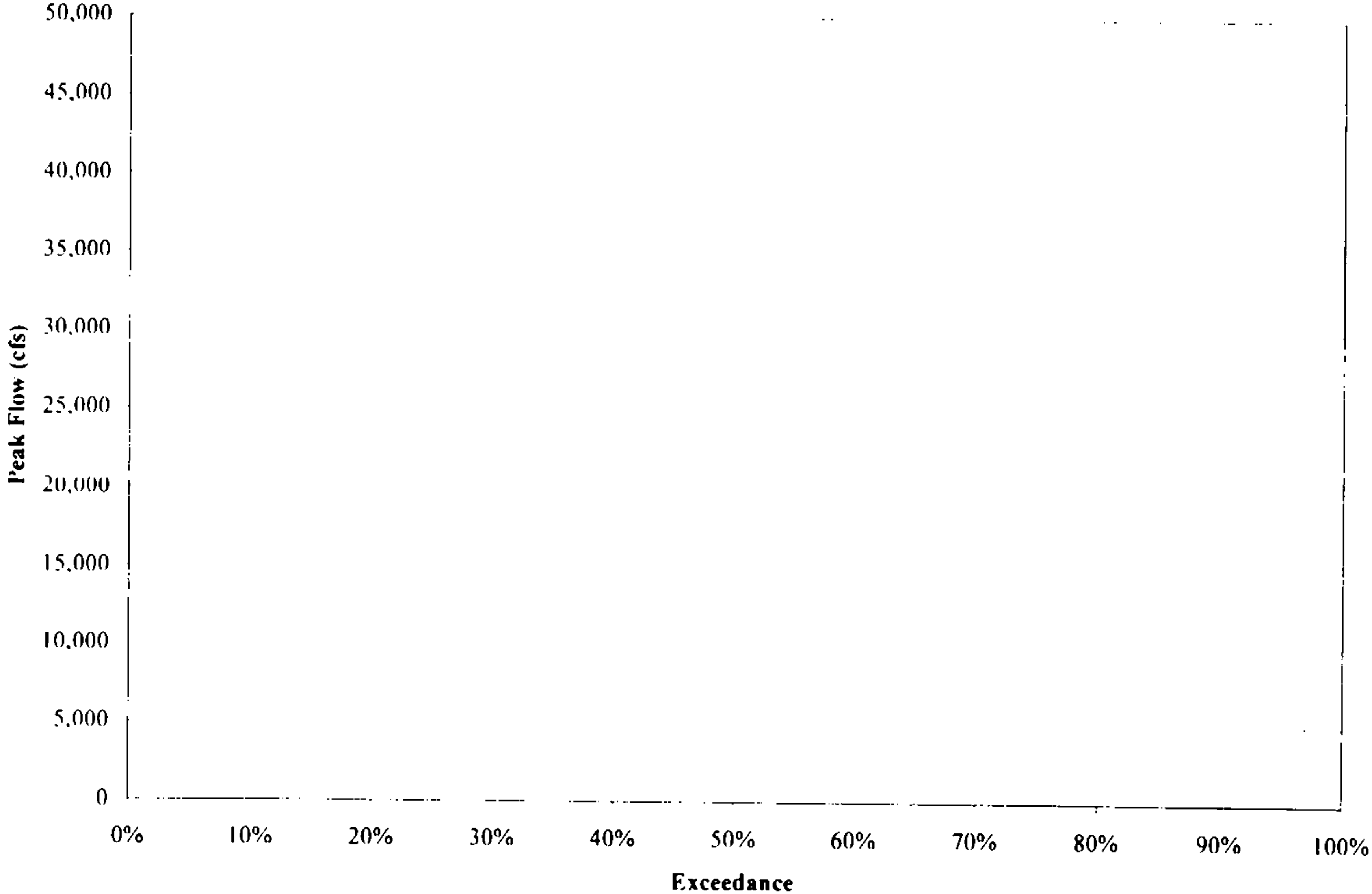

Figure 5-9. Peak Flow Versus Exceedance for the Cow Creek Watershed.

KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR
FIRST STAGE OF CONSULTATION

6.0 PROPOSED STUDIES AND METHODOLOGIES

18 CFR § 16.8 (b) First stage consultation.
(1) A potential applicant must provide each of the appropriate resource agencies and Indian tribes, listed in paragraph (a)(1) of this section, and the Commission with the following information:

(vi) Detailed descriptions of any proposed studies and the proposed methodologies to be employed;

KILARC-COW CREEK PROJECT
FERC NO. 606

REQUIREMENTS FOR
FIRST STAGE OF CONSULTATION

6.0 PROPOSED STUDIES AND METHOLOGIES

6.1 WATER USE AND QUALITY STUDIES

6.1.1 Hydrology

An element of assessing the Project's influence on stream flow is to describe the available flow at the Cow Creek and Kilarc Diversion Dams. "Available flow" is an estimate of the flow that is present at the Project diversions. Once available flow has been determined, the influence of the Project diversions on the flow regime can be assessed. Available flow estimates will rely on streamflow monitoring in the Project Area (described below), existing data from monitoring Project facilities (Section 5.0) and estimates of basin hydrologic characteristics (described in Section 6.1.1.2).

6.1.1.1 Stream Flow Monitoring

Streamflow measurements are currently taken at several locations in the Cow Creek Watershed and historic records are available for stations that are now discontinued. The records reflect measured streamflow as influenced by the diversions and natural accretions or depletions. While the influence of diversions for power production on stream flow is expected to be minor in winter (a high-flow period), the importance of these diversions increases in the summer when the available flow declines.

The oldest continuous record is the Old Cow Creek at Millville station that began operation in water year 1950. This station measures the total watershed runoff for the Cow Creek Watershed. The remaining historic data describe flows that have occurred in the sub-watersheds and are shorter in duration, may contain partial flow records, and reflect different time periods.

The streamflow records will be summarized based on a common time scale and missing records or changes in the gages will be noted as a first step to assess the flow at the Cow Creek and

Kilarc Diversion Dams (Study 1 in Appendix C). Much of the streamflow data have been collected and summarized for this First Stage Consultation Package (Section 5.0 and Appendix A). As part of the Exhibit E, all relevant data sources will be evaluated to complete the flow record for this watershed. Data from adjoining watersheds will be used to lengthen or complete the available Cow Creek Watershed record.

The Licensee measures flow once a day at the head and end of the Kilarc and South Cow Creek Canals. These data will be evaluated for adequacy and used to assess the historic diversions.

The 1965 adjudication study included spot flow measurements taken in different locations of the watershed. These data provided a greater spatial coverage of flow measurements than currently exists with the long-term flow recording stations. Because of this coverage, these data are important in describing the flow available at the Kilarc and South Cow Creek Diversion Dams.

These flow records will be supplemented with new flow records collected bimonthly in 2002 and 2003 at similar locations. The purpose of these flow records is to assess the change in streamflow within the watershed and the influence of accretions and depletions. The streamflow measurements will be collected with a Price Current Meter or similar flow measurement device at selected locations. The location will be chosen to characterize the flow levels upstream of the diversion, in the bypass reach, and downstream of the tailrace.

6.1.1.2 Estimate Available Flow

Using the historic long-term flow records from the USGS and the spot measurements collected for the adjudication and supplemented in 2002-2003, the long-term available flow at Cow Creek and Kilarc Diversion Dams will be assessed (Study 2, Appendix C). The estimated available flow will be used to evaluate the effects of Project diversions on Cow Creek.

The assessment process is outlined below:

1. Selected points along the watercourses will be used to develop available flow estimates. Based on the need to directly assess the effects of Project diversions, these points will include

Old Cow Creek at Kilarc Diversion, South Cow Creek at South Cow Creek Diversion, and Cow Creek at Millville. The measured flow records at these points include the partial records at Old Cow Creek at Kilarc Diversion and South Cow Creek at South Cow Creek Diversion, plus the full flow records at Cow Creek at Millville.

2. The major diversions in the watershed will be identified and aggregated to represent the total diversion (both Project and non-Project) for a reach of river. The reaches will be structured to accommodate the estimate of available flow and identify Project and non-Project influences on flow.

3. The magnitude and season of non-Project diversions will be evaluated from data collected for the adjudication, during 2002-2003 surveys, and discussions with local landowners. Using this information a long-term diversion record will be estimated based on these data and professional judgement.

4. The estimated diversion record and the measured flow will be used to estimate the available flow for the watershed and sub-watersheds where historic data exist.

5. The flow estimated for the reach will be divided by the area of the contributing watershed to estimate a flow per unit area. These data will be evaluated relative to precipitation data to assess if there are changes in the unit runoff because of season. Seasonal flow-per-unit area estimates will be developed if appropriate.

6. These sub-watershed estimates will be compared with the estimate developed for Cow Creek at Millville. Relationships between the Millville gage and the sub-watersheds will be developed. Using the relationships, the flow record for the selected points of interest (described in No. 1 above) will be extended to match the Millville period of record. Because these records are incomplete and may not match the period of record of other stations, the records will be lengthened and placed on a similar time scale.

7. The synthesized records for available flow will be compared with the actual measured flow. The Licensee will assess the appropriateness of the estimated flows with a mass balance using the assumed diversions.

6.1.2 Water Quality

6.1.2.1 Water Quality Monitoring

A water quality monitoring study will be performed to determine water quality conditions in the Project Area under existing operational and hydrological conditions (Study 3, Appendix C). These water quality conditions will then be compared to Basin Plan standards to verify that the Project is in conformance with the beneficial uses identified by the CRWQCB-CVR in the Basin Plan.

For the Old Cow Creek portion of the Project, water samples will be collected from six locations. Sample location OCC-1 will be located at the North Canyon Diversion. Sample location OCC-2 will be located upstream of North Canyon Canal on South Canyon Creek. Sample location OCC-3 will be immediately upstream of the diversion dam of Old Cow Creek to determine the water quality conditions entering the Project Area. Sample location OCC-4 will be in the Kilarc Forebay to assess water quality conditions that may have resulted due to the conveyance or retention. To assess the water quality conditions along the bypass reach, sample location OCC-5 will be located immediately upstream of the Kilarc Powerhouse on Old Cow Creek. Sample location OCC-6 will be downstream of the Kilarc Powerhouse tailrace after its confluence with Old Cow Creek to assess the quality of water below the Project Area.

For the South Cow Creek portion of the Project, water samples will be collected from six locations. Sample locations SCC-1 and SCC-2 will be immediately upstream of the diversion dams of the Mill Creek and South Cow Creek to determine the water quality conditions entering the Project Area. Sample location SCC-3 will be in the Cow Creek Forebay to assess any change in water quality conditions that may have resulted due to the conveyance system. To assess the water quality conditions along the bypass reach, sample location SCC-4 will be on South Cow Creek immediately upstream of its confluence with Hooten Gulch. Sample location SCC-5 will be immediately downstream of the Cow Creek Powerhouse tailrace in Hooten Gulch to assess the quality of water below Cow Creek Powerhouse. Sample location SCC-6 will be located immediately downstream of the South Cow Creek and Hooten Gulch confluence to assess the quality of water below the Project Area.

The water quality field sampling investigation will include two sampling events, one during the high flow season and the other in the summer low flow months. These periods represent important seasonal conditions where water quality may vary.

Water samples will be collected for analyses of inorganic chemicals, nutrients, and dissolved metals (these analyses are summarized in Table 6.1-1) by a state-certified laboratory. In-situ water quality measurements will be collected at each sampling location at the time of sampling. The in-situ measurement will include pH, air and water temperature, specific conductance, dissolved oxygen, and turbidity.

6.1.3 Water Temperature Monitoring

Water diversions can reduce the volume of water flowing in the downstream bypassed reach. Lower water levels can result in more rapid change in temperature downstream. Changes in water temperature in bypass reaches affect habitat suitability for biota. Water temperature monitoring will be conducted to assess Project-related sources and magnitudes of impacts to water temperature (Study 4 in Appendix C). The monitoring will provide information to be used to: (1) evaluate water temperature during the warmer months, (2) characterize water temperatures along bypass reaches for aquatic organisms, and (3) identify the ability of the Project to affect water temperatures in bypass reaches and reaches downstream of Project tailraces.

The objective of the water temperature monitoring program is to collect sufficient data to evaluate Project effects. This will involve collecting sufficient data to characterize water temperatures in Project bypass reaches and tailraces. Information about stream structure, which influences stream temperatures, will be collected during the aquatic habitat surveys discussed in Section 6.3.1 field effort. Variables such as stream slope, stream bearing, topographic, and vegetative shading have a significant influence on stream temperatures. These variables will be evaluated in the riparian habitat survey described in Section 6.2.4.

To determine whether water temperatures meet RWQCB Water Quality Objectives, the Licensee proposes to evaluate stream temperatures in the Project bypass reaches. In general, the sampling approach to meet this objective will involve operating a water temperature recorder in the upstream and downstream end of each Project bypass reach. The bypass reach on Old Cow Creek has a tributary entering about midway through the reach, Glendenning Creek. An additional temperature recorder will be located just downstream of the tributary's confluence. In order to understand the influence of meteorology and flow (including Project operations) on water temperatures, meteorology and hydrology data will also be needed. Meteorological data will be collected at one location in each of the two drainages.

6.1.4 Sediment

6.1.4.1 Potential Sources of Sediment

A qualitative evaluation of the sediment transport characteristics and stream stability of the bypass reaches of the Old Cow and South Cow Creeks will be conducted (Study 5, Appendix C). The purpose will be to determine whether Project operations adversely affect these conditions. Geologic controls, sediment sources and characteristics, sediment transport characteristics, sediment deposits, and channel stability will be evaluated.

The study methods will consist of the following tasks: review of existing information pertaining to geology and soils, hydrology, Project operations, and review of aerial photographs. Information collected during the aquatic habitat surveys on geomorphology, bank characteristics, and substrate conditions will be used in this evaluation. As part of the study, we will identify the channel maintenance flows, and evaluate the Project's influence on the timing and duration of these flows.

Hydrologic information developed as part of the evaluation of available flow will provide important information for this evaluation.

6.1.5 Project Impact Analysis

The Exhibit E will include an impact analysis of on-going Project operations and maintenance activities on water quantity, water quality, and beneficial uses within the Project Area. The analysis will include a discussion on anticipated impacts associated with the continued operation of the Project, including sediment transport, siltation levels, turbidity, dissolved and suspended solids, total settable solids, nutrients, and temperature.

The focus of the impact analysis will be on comparing existing instream conditions to objective standards such as those presented in the Basin Plan. The results of the water quality investigation will be interpreted and compared to historical data and to regulatory objectives. The analysis will identify on-going impacts to water quality that may be directly or indirectly related to the Project.

The impact evaluation will consider whether Project operations might contribute to any inconsistencies with agency plans or standards. Should inconsistencies be identified, mitigation recommendations will be developed, including applicable best management practices (BMPs).

The information will be included in the application. It will: (1) summarize agency consultation including comments or recommendation; (2) specific descriptions of how agency comments or recommendations have been accommodated; and (3) a discussion of differences between the applicant's proposals and agency recommendations.

Table 6.1-1. **Proposed Laboratory Water Quality Analyses**

Parameter	EPA Method	Technique	Purpose
Alkalinity			Buffering capacity (acid-neutralizing)
Chloride	300.0	Colorimetric	Typically analyzed – naturally occurring
Fluoride	300.0	Colorimetric	Typically analyzed – naturally occurring
Ortho-phosphate	300.0	Colorimetric	Can indicate nutrient enrichment
Carbonate*	SM 2320 B	Colorimetric	Component of alkalinity
Bicarbonate*	SM 2320 B	Colorimetric	Component of alkalinity
Hydroxide*	SM 2320 B	Colorimetric	Component of alkalinity
Nitrate	300.0	Colorimetric	Can indicate nutrient enrichment
Ammonia*	SM 4500	Colorimetric	Can indicate nutrient enrichment
Sodium	200.7	Flame Atomic Absorption (AA)	Can be increased through the reuse of irrigation water
Magnesium	200.7	ICP	Common, naturally occurring - contributes to hardness
Calcium	200.7	ICP	Common, naturally occurring – contributes to hardness
Copper	200.7	ICP	Potentially associated with acid drainage from metal mines
Lead	200.8	Graphite Furnace AA	Potentially associated with mining activity
Iron	200.7	ICP	Typically analyzed
Manganese	200.7	ICP	Potentially associated with acid mine drainage

Table 6.1-1. Proposed Laboratory Water Quality Analyses (continued).

Parameter	EPA Method	Technique	Purpose
Zinc	200.7	ICP	Potentially associated with mining discharges
Mercury	200.8	Cold Vapor AA	Potentially associated with mining activity
Molybdenum	200.8	ICP	Rare element – associated with metal ores
Hardness	130.2	Titrimetric	Typically analyzed – important in solubility of metals
Arsenic	200.8	Gaseous Hydride AA	Potentially associated with mining activity
Fecal Coliform	SM 9221-B/E	3x5 Multiple Tube Fermentation	Provides an indicator of harmful pathogens associated with mammal wastes
Total Dissolved Solids*	SM 2540 C	Gravimetric	Typically analyzed
Total Suspended Solids*	SM 2540 D	Gravimetric	Indication of sediment transport

* "Standard Methods for the Examination of Water and Wastewater", 20th Ed., 1998

6.2 BOTANICAL RESOURCE STUDIES

6.2.1 Vegetation Mapping

Six major plant communities were identified in the Project Area, based on the Cow Creek Watershed Assessment prepared by SHN Consulting Engineers & Geologists, Inc. and Vestra Resources, Inc. (SHN 2001).

- Non-native grassland
- Agricultural lands
- Riparian forest (white alder and mixed)
- Blue oak-foothill pine woodland
- Sierran mixed coniferous forest
- Wetlands (freshwater marsh and seeps)

The Licensee will map all major plant communities within the immediate Project vicinity by using available aerial photographs (Study 6 in Appendix C). Visual coverage by foot and vehicle will be used to ground-truth the vegetation/cover-type map. A description of each cover type will be provided. Any unique habitats or features, such as springs, cliffs, and rock outcrops not previously identified during the aerial photographic interpretation will be noted. The area of coverage will include: (1) the intake areas at the North Canyon Creek, South Canyon Creek, Kilarc, Mill Creek, and South Cow Creek Diversion Dams, (2) the Kilarc Forebay and spillways, Kilarc Penstock, Kilarc Powerhouse, Cow Creek Forebay and spillways, Cow Creek Penstock, and Cow Creek Powerhouse, (3) the North Canyon Creek Canal, South Canyon Creek Canal, Kilarc Main Canal, Mill Creek, and the South Cow Creek Main Canal, and (4) the diverted reaches of Old Cow Creek and South Cow Creek.

6.2.2 Special-Status Plant Surveys

The Licensee will conduct special-status plant surveys within the entire FERC Project boundary to identify the locations of special-status species (described in Study 7, Appendix C). Before field surveys are undertaken, herbarium investigations will be conducted to gather information on each special-status species. A description of each species, including current status, phenology, habitat requirements, and distributional range will be prepared. For some species field visits will be made to known locations of special-status plant populations in the Project vicinity to obtain additional morphological and ecological information if necessary.

All field surveys will be floristic and follow Nelson (1994) and plant taxonomy will be based on the Jepson Manual (Hickman 1993). Multiple surveys will be required to cover appropriate phenological periods for all special-status species identified as potentially present. During these surveys, a list of plant species observed within the Project Area will be compiled, and map locations of any special-status species will be noted.

6.2.3 Riparian Surveys

To identify the community types and condition of riparian vegetation potentially affected by the Project, the Licensee will conduct surveys of the riparian vegetation in the Project Area in conjunction with the vegetation community mapping and special-status plant survey. This study is described in Study 8 in Appendix C. The riparian vegetation will be described with descriptions of species composition, an estimate of the percent cover, the height of the vegetation, and mortality, if any. The precision of riparian vegetation mapping will depend on the scale, resolution, and quality of available aerial maps. Mapped polygons will be a minimum of 0.25 acre in size. Additionally, in polygons with tree species, the surveyors will record the presence or absence of seedlings and young saplings.

6.2.4 Project Impact Analysis

The Exhibit E will include a impact analysis of on-going Project operations and maintenance activities on botanical resources within the Project Area. The analysis will include a discussion of anticipated impacts associated with the routine maintenance activities, including regular clearing, trimming, and herbicide use for vegetation control at the Old Cow Creek and South Cow Creek Diversions. In addition, removal of vegetation from the Kilarc Main Canal and from the dredging of the Kilarc and Cow Creek Forebays could also result in impacts to special-status plant populations.

Routine maintenance activities that occur at the Old Cow Creek and South Cow Creek Diversion and vegetation removal that occurs adjacent to the access roads could result in removal of riparian vegetation. Potential emergent marsh vegetation that is present in the Kilarc and Cow Creek Forebays could be affected by dredging of the forebays.

The results of the vegetation mapping, special-status plant surveys and riparian surveys will be used to identify specific locations where on-going impacts are anticipated. The impact elevation will determine where impacts could occur and to what vegetation community or special-status species. If impacts are identified, mitigation measures will be developed.

6.2.5 References

Hickman, J.C., ed. 1993. The Jepson Manual. University of California Press, Berkeley, CA.

Nelson, J.R. 1994. Guidelines for assessing effects of proposed developments on rare plants and plant communities. *In:* Skinner, M.W. and B.M Pavlik, eds. Inventory of rare and endangered vascular plants of California. Sacramento, CA: California Native Plant Society Special Publication No. 1 (Fifth Edition).

SHN 2001. SHN Consulting Engineers & Geologists, Inc. and Vestra Resources, Inc. 2001. Cow Creek Watershed Assessment. Prepared for Western Shasta Resources Conservation District and Cow Creek Watershed Management Group.

6.3 AQUATIC RESOURCE STUDIES

The studies outlined below will provide additional data to assist in the analysis of potential Project impacts and to develop measures for protecting aquatic resources in the Project Area.

6.3.1 Aquatic Habitat Mapping

The Licensee will map habitat in the Project bypass reaches to describe the existing physical habitat conditions and to provide information for assessing the habitat types present and for selecting sampling locations for fish distribution and abundance studies (Study 9, Appendix C). The objective of this study component is to characterize geomorphological meso habitat characteristics of stream channels. The geomorphologic characteristics of stream channels and their sediments will be described using existing aerial photography and existing geology information. Stream surveys will evaluate aquatic mesohabitats in the stream reach of the study area. Habitats will be identified using methods described by Hawkins et al. (1993) and USFS R-5's Fish Habitat Relationships Technical Bulletin.

The geomorphic setting is important to aquatic habitat assessments. Rosgen channel typing-Level 1 will be applied to the bypass reach to characterize the geomorphic setting. Channel types will be evaluated using criteria developed by Rosgen (1996). Channel types are identified by slope, shape and pattern. The shape, slope and pattern of streams can be obtained by using existing aerial photography and existing inventories of geology, landform evolution, valley morphology, depositional history, and associated river slopes. Integration of available habitat data within a study site is dependent on its relationship to the stream channel of the area.

Aquatic mesohabitat typing will be performed using Hawkins et al. (1993) and USFS R-5's Fish Habitat Relationships Technical Bulletin (McCain et al. 1990). In general, mesohabitat is the stream channel structure aquatic organisms might use for shelter, feeding, spawning, rearing, or other activity. The relative abundance and distribution of the types of structures can be linked to the particular geomorphology of the stream channel.

Several habitat quality parameters will also be recorded including dominant and subdominate substrate type, percent of canopy cover for each habitat unit, and percent of habitat cover and cover type for fish. Substrate data will be visually classified. Stream bank vegetation will be measured as the percentage of stream bank covered by vegetation. Riparian corridors will be characterized by the dominant plant community at the sample sites.

Access to Project streams is subject to obtaining permission of the landowner since most the bypass reaches are privately owned. All survey efforts will be conducted only if access is granted by the property owner.

6.3.2 Passage Barrier Identification

During the course of conducting the aquatic habitat surveys, a passage barrier assessment will be conducted in the bypass reaches of the Project streams (Study 10 in Appendix C). The barrier survey will collect information on potential barriers for fish in the bypass reaches. All potential barriers will be photographed and described. The location of the barrier will be noted on a 1:24,000 scale map. The type of barrier will be noted such as falls, weir, debris jam, cascade, riffle, etc. The flow level when the barrier would functionally impede fish passage will be estimated as low, medium, or high. In addition, the severity of the barrier will be estimated as either partial or complete, relative to the flow level. The size of the pool downstream of the barrier, if any, will be evaluated to determine if it would serve as a jump pool providing fish an opportunity to leap the barrier. In passage evaluations, the size of the fish being considered is important. For example, steelhead are able to clear higher barriers than resident trout. The size of the fish that would be impeded will also be evaluated.

6.3.3 Instream Flow Study

The Licensee proposes to conduct an instream flow study using the IFIM in the bypass sections of South Cow Creek and Old Cow Creek (described in Study 11, Appendix C). The instream flow study results will be used to evaluate the impacts of the Project diversions on the aquatic habitat in the bypass reaches. The results will assist in the identification of factors potentially limiting fish populations in the Project reach and in the determination of appropriate minimum instream flows. The instream flow studies will also assist in determination of appropriate mitigation recommendations for the Project bypass reaches. The bypass reaches to be modeled include: (1) Old Creek downstream of the Kilarc Diversion to Kilarc tailrace, a reach length of 3.8 miles for rainbow and brown trout, and (2) South Cow Creek downstream of the South Cow Creek diversion to the confluence with Hooten Gulch, a reach length of 3.9 miles for steelhead and fall-run chinook salmon. These bypass reaches may be divided into one or more geomorphic reaches depending on the results of the habitat inventory.

The Licensee proposes to assess habitat versus flow relationships for several lifestages of each target species using the Physical HABitat SIMulation (PHABSIM) programs of the IFIM. This approach entails developing hydraulic models that predict velocity and depth across transects placed in the various habitats present in the river (Bovee 1982). The output of these hydrologic models are then interpreted based on a set of habitat suitability criteria which evaluate the suitability of the predicted values of depth, velocity and substrate for the target species and lifestages. The Licensee proposes to use available habitat suitability criteria for this study. The criteria will be selected in coordination with CDFG, NMFS, USFWS, and SWRCB.

Field data collection and data reduction techniques that will be used in this study will follow those procedures described by Trihey and Wegner (1981) and Trihey (1980). Calibration flows will be selected to allow the models to reliably simulate flows ranging from minimum bypass flow levels to approximately 100 to 150 cfs. One set of velocity data will be collected. The Licensee proposes to collect this velocity set at the middle calibration flow and to collect additional velocity measurements in those cells that are out of water during the middle calibration flow at the high calibration flow.

The Licensee proposed to use the IFG-4A model to simulate velocities across each transect. This model was introduced in 1984 by the USFWS Instream Flow and Aquatic Systems Group as a means of simulating hydraulic conditions in streams with complex channel structure (Milhous, et al. 1989). Habitat modeling will be conducted using the HABTAE model of the PHABSIM programs. This model uses the velocities and depths simulated at the location of the measured verticals, rather than averaging between these verticals, as does the HABTAT model. As the hydraulic simulations are calibrated for the actual vertical locations, it is more appropriate than the averaging approach used in HABTAT.

The application of this model will result in habitat versus flow relationships for the target species for each habitat type. These results will be weighted according to the proportion of each habitat type present in each reach as determined from the habitat mapping. The weighted habitat versus flow function for each reach will be used to evaluate the amount of flow needed in each reach to protect fish and other aquatic resources.

6.3.4 Fish Population Studies

The primary objective of this study component is to characterize the distribution and abundance of fish species within the Project Area with emphasis on anadromous and resident salmonids, the target species. The proposed sampling strategy is to sample representative units of major habitat types in selected locations in the bypass reaches (described in Study 12 in Appendix C). Major habitat types in the Project reach include deep and shallow pools, riffles and runs.

6.3.4.1 Project Streams

The proposed sampling strategy will vary depending on the potential presence of listed species. For fish population studies where anadromous salmonids may be present, snorkel surveys will be used to assess abundance and species compositions. These would include South Cow Creek, Hooten Gulch, and Mill Creek. For streams where resident fish are present, the Licensee proposes to use an approach of electrofishing in shallow habitats (less than 3 ft deep) and snorkeling in deeper habitats. Old Cow, North Canyon and South Canyon creeks will be sampled in this manner.

The sampling stations will be selected on the basis of providing an adequate sample of major habitats in each general area and accessibility for the types of equipment to be used in sampling. Since much of the land surrounding the Project is on private property, permission from the landowner needs to be obtained for the sampling activities. Stations may need to be adjusted to accommodate the access granted by the landowner. Each station will total about 100 m in length including representative habitat types.

For the resident fish studies (Old Cow Creek and North and South Canyon Creek stations), sampling will occur in the fall to assess populations after the summer low flow period. For stations with anadromous fish (South Cow and Mill Creeks), sampling will occur during June to evaluate the abundance and distribution of fish when water temperatures are likely suitable. Additional surveys will occur in selected areas in September after the summer period to assess summer use of the bypass reaches.

6.3.4.2 Snorkeling Surveys

The Licensee will conduct snorkeling surveys at selected stations in the South Cow and Mill creeks to document fish species distribution and relative abundance. Habitats will be sampled through direct observation and visual counts. Snorkel surveys will be conducted to sample contiguous habitat units at each sampling site.

Direct underwater observation methods will be used to identify and count fish. Methods will generally be similar to those presented in Griffith (1972), Platts et al. (1983), Hicks and Watson

(1985), Hankin and Reeves (1988), and Hillman et al. (1992). Estimates of fish species abundance will be calculated using equations presented in Hankin and Reeves (1988). Fish species abundance will be estimated and displayed by size class and habitat type.

6.3.4.3 Electrofishing Surveys

Electrofishing will be used in habitats sufficiently shallow to allow adequate sampling. Sampling will be conducted using three-pass depletion, in which fish are stunned and removed from the site, in three sequential passes. Block nets will be used to isolate the sampling station from the stream. Electrofishing will generally be conducted as described by Reynolds (1996) and will use one or more backpack electrofishing units (depending on the width of the stream sampled). Sampling will be performed in an upstream direction beginning at the downstream block net and finishing at the upstream block net.

When a multiple-pass-depletion method is used to determine the population estimate, fish captured from each pass will be transferred to separate holding pens outside of the sample site. All fish captured through electrofishing, or any other sampling technique, will be identified to species, measured for length to the nearest millimeter total length or fork length depending on the configuration of the caudal fin, and weighed to the nearest 0.1 g for fish up to 2 kg or to the nearest 1 g for fish over 2 kg. If very large numbers (>100) of a species are captured, these measurements will be collected from a sub-sample of fish. These sub-samples will be stratified by size class and 10 fish will be measured for each 25-mm size class. Age structure of the sampled fish will be determined through length frequency distribution to generally characterize population structure.

Population estimates will be based on the maximum likelihood technique of Zippin (1958). Population estimates will be prepared for all species. Salmonids will be divided into two or more size classes and estimates prepared by size class.

6.3.4.4 Physical Habitat Measurements

General observations will be made of habitat and physical conditions in the sampling stations. These observations will include physical measurements of water temperature, specific conductance, and dissolved oxygen. The sampling station will be measured for length and width, and photographs of the station will be taken. In addition, observations will be made to include characterization of mesohabitats sampled. These observations will include characterization of substrate, water transparency, depth, riparian conditions, and the presence of woody debris or other cover objects.

6.3.4.5 Kilarc Forebay Sampling

Since no anadromous fish are expected to be present in the forebay, the Licensee will sample fish abundance with a combination of electrofishing and netting. Sampling will be conducted with a boat shocker and a variety of passive net gear to characterize the species composition and fish abundance in the Kilarc Forebay. Sampling will be conducted at selected stations within the forebay and at various depths. The netting and night-time electrofishing sampling data will be used to generate a species breakdown for the forebay population. Kilarc Forebay is stocked with hatchery trout to support a "put and take" fishery. Fish collected during the abundance surveys sampling will be evaluated to determine if they were of hatchery origin or if they were naturally spawned fish.

All fish captured in the forebay through electrofishing, or netting will be identified to species, measured for length to the nearest millimeter total length or fork length depending on the configuration of the caudal fin, and weighed to the nearest 0.1 g for fish up to 2 kg or to the nearest 1 g for fish over 2 kg. If very large numbers (>100) of a species are captured, these measurements will be collected from a sub-sample of fish. These sub-samples will be stratified by size class and 10 fish will be measured for each 25-mm size class. Age structure of the sampled fish will be determined through length frequency distribution to generally characterize population structure.

6.3.5 Potential Effects of Entrainment

The Licensee will evaluate conditions that may affect potential entrainment at the Project diversions (Study 13, Appendix C). The assessment will consider potential effects at the population level by evaluating the opportunity for entrainment and the fate of entrained individuals.

Potential entrainment at the Old Cow Creek Diversion will be evaluated by sampling fish transported by the Kilarc Canal. The Licensee proposes to assess the number of fish entering the forebay from the canal by sampling the canal exit with fyke nets. Nets would be fished for three days and nights in June and in October to estimate the number of fish entering the Forebay from Old Cow Creek. June was selected based on the expected timing of dispersal of young fish and when the Project begins to divert 50 percent of the available flow. The October sampling period evaluates entrainment effects under low flow conditions.

6.3.6 Project Effect on Macroinvertebrates

Effects on macroinvertebrate populations will be evaluated in the bypass reaches on Old Cow and South Cow Creeks (Study 14, Appendix C). Macroinvertebrate habitat will be evaluated using the Instream Flow Incremental Method, as described by Gore et al. (in press) and Gore and Judy (1981). Gore et al. (in press) have developed habitat suitability criteria for "EPT" fauna (Ephemeraptera, Plecoteria, and Tricheptera) for use in high gradient or low gradient within 0.005 as the breakpoint between the two. The Instream flow studies described in Study 11 will be used to evaluate macroinvertebrae habitat as a function of flow. Macroinvertebrate habitat will be evaluated using Gore et al. (in press) EPT criteria. Habitat suitability criteria developed by will be used to estimate the relationship between macroinvertebrae habitat and flow in the by pass reaches.

6.3.7 Sensitive Aquatic Species

Sensitive species include fall-run Chinook salmon and steelhead. Only one specific study related to anadromous fish is proposed. However, anadromous fish will be addressed in many of the other studies. The habitat mapping and instream flow study will assess habitat for anadromous species. Abundance and distribution of these species will be documented as part of the various fish sampling efforts described above. The screens were built to prevent entrainment into Project canals and to promote safe passage for young salmonids and adult steelhead for their downstream migration after spawning.

6.3.7.1 Fish Protection Facilities Studies

For South Cow and Mill creeks, the effect of entrainment will focus on an evaluation of the performance of the fish screens vacated at South Cow Creek Diversion (Study 15, Appendix C). To evaluate screen effectiveness, velocity distribution across the face of the screens will be evaluated using an acoustic Doppler meter to measure three-dimensional velocities. The acoustic Doppler meter will be positioned along the screen at points spaced at 2 ft by 2 ft vertical and horizontal intervals. For each measurement node, the average and peak velocities in the normal and transverse (sweeping) directions will be assessed. The measured velocities will be evaluated against CDFG and NMFS screening criteria for salmonid fry and juveniles. The screening design including screen opening, cleaning method, and sweeping velocities will be compared to the relevant screen criteria. The efficacy of the current screen design will be described. The results of this evaluation will be presented in the Exhibit E of the FERC application.

6.3.8 Project Impact Analysis

The results of these aquatic studies will be used in conjunction with the results of the water use and water quality studies, as well as other available information, to evaluate the potential impacts of the Project and non-Project related activities on target species and their habitat. The results of all of these analyses, as well as a discussion of their implications, will be presented in the Exhibit E of the FERC application.

One of the primary objectives of this evaluation will be to identify the potential limiting factors that affect the population levels of the evaluation species and to assess the Projects impacts on these, if any. The Licensee's approach to mitigation planning emphasizes the identification of factors that control or limit fish populations in the Project Area. Focusing mitigation measures on limiting factors allows for the design of cost-effective measures that will directly benefit the targeted resource. Agency interaction is a critical element to the mitigation planning efforts. Where the potential limiting factors are related to Project operations or facilities, a second objective will be to identify the potential mitigation opportunities to reduce Project effects.

6.3.9 References

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Reynolds, J.B., Chapter 8, Electrofishing. B.R. Murphy and D.W. Willis (editors). 1996. Fishery Techniques, 2nd edition. American Fisheries Society. Bethesda, MD.

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6.4 WILDLIFE STUDIES

6.4.1 Common Wildlife Species Surveys

A reconnaissance-level study will be conducted to characterize wildlife use within the immediate Project vicinity (Study 16, Appendix C). The reconnaissance study will consist of a literature review, identification of habitat for common and special-status wildlife species, and a reconnaissance-level field survey. Each of these tasks is described below.

Existing information pertinent to the wildlife resources (i.e., amphibians, reptiles, birds, mammals, and big game) within the Project vicinity will be compiled, reviewed, and analyzed. A literature review will be conducted and will include a review of (1) CDFG's California Wildlife Natural Diversity Database (CNDDB; CDFG 2000a); (2) CDFG's Wildlife Habitat Relationship System (CDFG 2000b); and (3) other relevant documents relating to the Project Area (e.g., timber harvest plans and environmental documents). Consultation with appropriate agency representatives and resource specialists will be consulted. Known special-status species occurrences will be mapped on a 7.5-minute USGS quadrangle map and incorporated into a GIS database. Information obtained during this literature review will be used to focus field surveys.

Wildlife habitat will be mapped in conjunction with vegetation community mapping and ground-truthing (see Section 6.3). Habitat for common and special-status species within these vegetation communities will be determined based on a review of *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer 1988) and CDFG's *Wildlife Habitat Relationship System* (CDFG 2000b).

Reconnaissance-level wildlife surveys will be conducted during the spring and summer of 2003. Species will be recorded as present if they are observed, if species-specific vocalizations are heard, or if diagnostic field signs are found (e.g., scat, tracks, and pellets). Raptor nests (including bald eagles) located near Project facilities will be identified and recorded. Some species that are known to occur in the Project vicinity, and for which appropriate habitat is present within the Project Area, will be recorded as "expected but not observed." Wildlife taxonomy will be based on *California's Wildlife, Volumes I, II, and III* (Zeiner et al. 1988-1990).

These surveys will involve traversing habitats by walking and driving on roads in representative portions of the habitat types (vegetation communities). Visual surveys will be conducted to document the occurrence of wildlife species, including birds, mammals, reptiles, amphibians, and invertebrates. Additionally, loose boards, rocks, logs, and leaf litter will be checked for amphibians and reptiles.

6.4.2 Special-Status Wildlife Surveys

Vegetation communities information prepared for general wildlife surveys will be used to identify potential Special-Status Wildlife Habitat (Vegetation mapping is Study 6 and Common Wildlife Species Surveys is Study 16 in Appendix C). Habitat for special-status wildlife species within these vegetation communities will be determined based on a review of *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer 1988).

Surveys will be conducted in representative habitat for special-status wildlife species (Study 17 in Appendix C) and will be timed during the raptor nesting season, in order to detect active raptor nests, especially those of bald eagle and American peregrine falcon. Special-status species with a high probability of occurrence will be specifically targeted. These species include valley elderberry longhorn beetle, California red-legged frog, foothill yellow-legged frog, northwestern pond turtle, bald eagle, California spotted owl, American peregrine falcon, willow flycatcher, California thrasher, ring-tailed cat, and several species of bats.

Surveys will be conducted on foot or by vehicle, as appropriate. Wildlife observed or detected through sign (i.e., pellet, scat, track, feather, etc.) will be identified to species and recorded.

Special attention will be given to potential bald eagle and other raptor habitat by viewing snags, cliffs, and other habitats with binoculars and looking for evidence of roost or nest sites (e.g., whitewash). Each habitat in the immediate Project vicinity will be visited a minimum of two times during the 2003 raptor breeding season (generally March through August). Any nests or den sites observed during field studies will be reported to resource agencies, and plans to ensure their protection will be developed on a site-specific basis.

6.4.3 California Red-legged Frog Site Assessment

A site assessment and focused surveys for California red-legged frog (CRLF) will be conducted in accordance with USFWS approved protocol/guidelines (Study 18, Appendix C). Under the current guidelines (i.e., USFWS Guidance on Site Assessment and Field Surveys for California Red-legged Frogs, February 1997), this would include the following: (1) determine the location of CRLF within 5 miles of the Project site, (2) describe habitats on the Project site and within 1 mile of the site, (3) prepare a site assessment report, and (4) complete focused surveys if determined necessary by USFWS. Each of these components is described below. During CRLF field surveys, all special-status amphibians and reptiles observed (including foothill yellow-legged frog and northwestern pond turtle) will be identified and mapped.

The locations of California red-legged frogs within the Project Area and within 8 km (5 mi) of Project boundaries would be determined through consulting the CNDDB, biological consultants, local residents, species experts, herpetologists, resource managers, and agency biologists. In addition, all habitats present within 1 mile of the Project site would be identified. This would include review of recent aerial photographs and of National Wetlands Inventory (NWI) maps, followed by ground-truthing.

Following completion of the above tasks, a report would be prepared in accordance with the USFWS guidelines that include the following: photographs of the Project site, survey dates and times, names of surveyors, a description of methods, a map of the Project site and vicinity indicating habitats present (e.g., aquatic and upland habitat). USFWS will determine, following receipt of this report, if focused protocol-level CRLF surveys would be necessary. If it is determined that focussed surveys are required, the Licensee will complete these surveys in accordance with the USFWS protocol/guidelines.

6.4.4 Foothill Yellow-legged Frog Survey

Surveys for foothill yellow-legged frog (FYLF) will be conducted according to methods presented by the Licensee in their May 2002 document titled *A Standardized Approach for Habitat Assessments and Visual Encounter Surveys for the Foothill Yellow-Legged Frog (Rana boylii)*. The approach consists of preliminary field planning, visual encounter surveys (VES) and site habitat assessments (Study 19, Appendix C).

During the preliminary field planning phase, survey sites with potentially suitable FYLF habitat would be identified and the timing of surveys would be selected. The selection of survey sites will depend on identification of potentially suitable habitat in the study area, the results of preliminary habitat assessments, and existing data on FYLF in the study area. Survey site selection would be based on information obtained from all available resources including, but not limited to: literature on habitat requirements and life history of FYLFs, historical records, knowledgeable biologists, topographic maps, aerial photographs, and habitat information obtained during preliminary ground surveys. Sites identified for surveys during the initial site selection process will be in representative sections of the study area that contain moderate- to high- value habitats for FYLFs, based on species-specific criteria.

Since the study's objective is to determine presence of FYLF, two surveys would be conducted. These two surveys would include a tadpole survey in the late spring/early summer followed by a second survey for juveniles/subadults and adults in the late summer.

During the VES phase, the presence or absence of FYLF would be determined. This would include an overall site evaluation to determine habitats to be included in the VES, the selection of the appropriate survey method, and selection of preliminary site boundaries for the VES. At the beginning of the initial site visit, an overall site evaluation would be conducted from a distance so as not to disturb amphibians. Specific habitat data such as habitat type, distribution and extent would be recorded. The appropriate survey method is expected to consist of basic creek surveys conducted by a two-person team in tandem. Basic creek surveys are designed to evaluate selected reaches of a creek. Final survey boundaries would be established at the conclusion of the initial VES and would be used in the site habitat assessment and subsequent VES's.

During the site habitat assessment phase, which is conducted immediately following the initial VES, information collected would include riparian vegetation, aquatic and terrestrial cover, substrate, water quality, aquatic habitat and upland habitat.

VES's would be conducted according to the approach provided in Licensee's above-referenced document. The VES would include aquatic habitats that can be adequately surveyed within approximately 2 hours. The VES would be conducted in tandem by a two-person team. Surveys would begin along the bank. Adjacent aquatic habitat would then be searched and finally suitable aquatic habitat would be searched. All observations would be recorded on VES data sheets.

6.4.5 Valley Elderberry Longhorn Beetles

To determine the presence of potential habitat for the Valley Elderberry Longhorn Beetle (VELB), the Licensee will conduct surveys for its habitat, elderberry shrubs, in the Project Area (Study 20, Appendix C). These surveys will be conducted in conjunction with the special-status plant species surveys. The locations of any elderberry shrubs identified will be mapped. The number of stems greater than 1-in in diameter will be recorded. Any evidence of VELB use of elderberry stems in the Project Area will be noted.

6.4.6 Project Impact Analysis

The information gathered during proposed studies will be used to identify potential on-going Project impacts to wildlife resources within the Project Area. The operation of the Project facilities will be assessed to determine if they are significantly impacting wildlife resources, especially special-status species, game species, and raptors protected under Section 3503.5 of the Fish and Game Code. Impacts to wildlife resources will be assessed in accordance with Section

4.51(f)(3) of the Commissions regulations. Because the Project does not include construction of new facilities or the implementation of new operations and maintenance practices, this impact analysis will be based on an analysis of current Project operations and maintenance practices.

6.4.7 References

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6.5 PREHISTORIC AND ARCHAEOLOGICAL STUDIES

The Licensee will summarize the cultural resources within the Project Area, as well as the cultural resources adjacent to the FERC license boundary, that may be adversely effected by the ongoing operation and maintenance. The Licensee will describe adverse effects to cultural resources from on-going operation and maintenance, and will develop methods for mitigating those effects to a less than significant level.

Cultural resources within the Project Area are likely to include historic hydroelectric structures and related features, historic non-hydroelectric structures, Traditional Cultural Properties (TCPs), and prehistoric and historic archaeological sites. FERC regulations at 18 CFR 4.51 (c)(4) specify consideration of cultural resources in the Project Area and the impact of the Project on those resources. Procedures for the identification, evaluation, and treatment of impacts to cultural resources are discussed in the regulations contained in Section 106 of the National Historic Preservation Act (e.g., 36 CFR 60.4 and 36 CFR 800).

In Section 4.6 it was noted that less than 3 percent of the APE has been surveyed for the presence of cultural resources. The Licensee will begin the cultural resource studies by identifying the APE within the Project's Study Area; this is the area in which the Project could effect historic standing structures, archaeological sites, TCP, and other cultural resources. Following FERC regulations, and the newly revised 36 CFR Part 800, the Licensee will initiate early consultation with the State Historic Preservation Office (SHPO) and the effected Native American tribes by providing copies of the Study Plan for cultural resources. SHPO and tribal consultation will continue, as deemed necessary, throughout the process.

The APE will be inventoried for the presence of prehistoric, historic, architectural and ethnographic resources. As the record search was conducted on May 20, 2002 the inventory will include consultation with Native American tribes, private organizations, and other parties likely to have knowledge or concerns regarding cultural resources within the APE. The Native American Heritage Commission in Sacramento was contacted on May 17, 2002 and responded on May 22, 2002 that a search of the Sacred Lands Inventory failed to indicated the presence of Native American cultural resources within the immediate Project APE.

Work tasks described below will inventory historic structures, archaeological sites, and Traditional Cultural Properties; determine their eligibility for listing in the NRHP; evaluate Project effects on these properties; and develop mitigation and management measures.

6.5.1 Historic Buildings and Structures

The Licensee will conduct background research at the Northeast Information Center, Chico, the Chico County Historical Society, and the Licensee Archival Record Center for previous studies on recorded historic buildings and structures within the APE (Study 21, Appendix C). Field surveys will evaluate and record, as necessary on Department of Parks and Recreation (DPR) inventory forms, the two powerhouses, the two penstocks, and all related structures and historic water conveyance systems currently known to exist in the Project Area. The Licensee will prepare a brief historic context for the study area and compare the characteristics of the buildings and structures with the criteria of the NRHP to evaluate which structures may be eligible for listing on the NRHP. Appropriate DPR forms will be submitted to SHPO for review.

6.5.2 Archaeological Sites

The information received from the Northeast Information Center in Chico will be utilized to develop a study plan for field surveys of the APE (Study 22, Appendix C). The total acreage to be surveyed has not yet been determined. Following a detailed review of the results of the literature search, a field assessment will be conducted to identify cultural resources within the APE. Resources identified as adjacent to the APE will be field checked to verify size and distance from the APE. Survey methodology will follow standard methods in accordance with the Secretary of Interior's Standards for Identification [48 Fr44720-44721] and the Federal regulations found at 36 CFR 800.4(b)1. Field surveys will be dependent on accessibility and terrain. When cultural resources are discovered within the APE, further investigation will be conducted to determine if the resource is eligible for listing on the NRHP. As indicated in Section 4.6, evaluations are needed because NRHP eligibility assessments have not been completed for the nine unrecorded sites nor for sites that may be discovered during the field survey. Assessment is required to document site(s) integrity and significance with regard to the criteria set forth at 36 CFR 60.4. Project archaeologists will prepare a brief prehistoric context for the study area and then use available information to determine which sites are eligible for listing on the NRHP. Appropriate DPR forms will be submitted to SHPO for review.

6.5.3 Traditional Cultural Properties

The Licensee will identify Native American tribes with concerns about the Project, which are expected to include the Pit River Tribe of California and the Redding Rancheria. The Licensee will research ethnographic and ethnohistoric literature to prepare a context for the study area of traditional Native American land and resource use (Study 23, Appendix C). One meeting between the Licensee and the members of each individual tribe will be arranged to discuss their concerns about Project effects on Traditional Cultural Properties and resources (such as fish, plants, and wildlife), and their recommendations for mitigation measures. Tribal concerns about confidentiality could preclude a site specific inventory of Traditional Cultural Properties.

6.5.4 Project Impact Analysis

The Exhibit E of the FERC license application will summarize information from the cultural resource studies and the recorded resources, including their eligibility for listing in the NRHP.

The Licensee will set out the character-defining features of each type of eligible resource: historic, archaeological, and traditional cultural. Flow charts will outline decision-making processes and show the points where consultation or coordination with other agencies or groups is needed. If needed, the Exhibit E will describe management measures for cultural resources during the new FERC license.

6.5.5 Cultural Resource Management

The Licensee will evaluate the need for the development of a Cultural Resource Management Plan. If eligible sites are found, the Licensee will prepare a Cultural Resource Management Plan for the Project.

6.6 RECREATION STUDIES

To document existing recreation use in the immediate Project Area and assess potential impacts to recreation use resulting from the continued operation of the Project, the current recreational facilities and opportunities in the Project Area will be described. In addition, future recreation goals and objectives for the Project Area and Project region as outlined in local, state, and federal plans will be addressed.

Based on existing information, Project-related impacts will be identified, conflicts will be identified between Project operation and maintenance activities and established recreation goals and objectives. If needed, mitigation measures will be developed and proposed.

The objectives for the proposed studies are set forth below:

- Develop description of existing recreation facilities.
- Estimate existing and potential recreational uses of the Project Area.
- Identify existing and future recreational demand for the Project Area.
- Describe existing recreational opportunities within the Project region, and identify existing and future recreational demand for the Project region.
- Identify measures or facilities recommended by agencies for creating, preserving or enhancing recreational opportunities, and of the purpose of ensuring the safety of the public in its use of Project lands and waters.

- Identify existing measures or facilities to be continued, maintained, or discontinued, and new measures or facilities proposed by applicant.
- Identify which entity(s) will be responsible for implementing construction, operation or maintenance of existing or proposed mitigation measures, including schedule, costs and maps or drawings.

6.6.1 Regional Recreation Assessment

The recreation resources and uses associated with the Project region will be described (Study 24, Appendix C). This description will include: (1) the study area boundaries, (2) an estimate of the current level of use of recreational resources and Projection future levels, and (3) any additional facilities that are currently being planned for the area. Current recreation goals and objectives for the Project Area as outlined by local, state and federal agencies will be summarized. Agencies will be consulted to ascertain their current management objectives and to identify areas of mutual compatibility and potential areas of conflict.

To the extent possible, the origin and destination of users in the Project Area will be documented. Projection of future demand for recreation resources in the Project Area will be based on a review of Shasta County General Plan. Recreation specialists will conduct site visits to the Project Area to verify and supplement the recreation information and ground-truth the study map.

To develop a recreation profile, agencies will be consulted to ascertain their current management objectives and recreation goals and objectives for the Project Area. Areas of mutual compatibility and potential areas of conflict will be identified.

The existing recreational facilities and opportunities within the regional vicinity of the Project Area will be identified using the methodology described above. A map will be developed showing the regional recreational resources in the study area. A reconnaissance level assessment of the future demand for recreation resources in the study area will be made using existing information, such as the California Department of Recreation's State Comprehensive Outdoor Recreation Plan, planning documents developed by the Latour State Forest, and Lassen National

Forest, and consultation with agency representatives. Agencies will also be consulted to identify future recreation goals for the Project Area and region that will then be presented in the Application. The regional resources identified as part of this task will be used to provide a context for the recreational resources within the Project Area.

6.6.2 Project Area Recreation

To develop a more specific picture of recreation use on the Project's resources and facilities, a reconnaissance-level recreation survey will be conducted (Study 25, Appendix C). The purpose of the recreation survey will be to identify number of visitors, trip origin, and the relative frequency to which the Project's resources and facilities are utilized. During the summer of 2003, a study team will conduct the surveys. Because access to the majority of the Project's facilities is restricted, the survey will be limited to the only recreation area accessible to the public, Kilarc Forebay where picnicking and fishing takes place.

The team will be provided with a Recreation Survey Form based on similar forms used by the USFS. The form records the number of people observed at the forebay, the time of day, date, number of future recreation days expected in the Project Area, number of vehicles, types of recreational activities observed, and weather and general water levels. Where possible, the surveyor will contact observed subjects to determine the trip origin. Specific data will be collected to determine angler success. The approach to be used focuses on collecting information on numbers of anglers, fishing effort, catch, and size. The proposed schedule for the recreation use survey is:

- Twice weekly during weekdays once per month
- One weekend per month
- All holiday weekends between Memorial Day and Labor Day

In addition, similar Recreation Survey Forms will be left in visible locations, such as a kiosk, requesting that recreationalists fill them out and mail them to ENTRIX (address and postage will be part of the Recreation Survey Form).

6.6.3 Project Impact Analysis

Potential impacts resulting from the ongoing operation and maintenance of the Project on recreation resources and opportunities will be identified. The impact analysis will focus on:

1) Project-related restrictions to access that might limit recreation opportunities or degrade the experience;
2) Recreation related conflicts between the Project and the goals and objectives of applicable federal, state and local agency comprehensive plans;
3) Project-related safety concerns relative to recreation use in and around Project facilities and areas.

Based on the identification of conflicts between Project operation and maintenance activities and established recreation goals and objectives, Project-related impacts will be identified. Where needed, mitigation measures will be developed in consultation with appropriate resource agencies.

A description will be provided of any facilities or improvements requested by the resource agencies as a part of the relicensing, and any new facilities or improvements proposed by the Licensee. In conjunction with the Land Management Review, accessible areas within the Project Area that could provide recreational opportunities will be identified and evaluated, such as fishing opportunities at the Kilarc Powerhouse. In addition to enhancement measures, entities responsible for development, operation, and maintenance of the facilities; the schedule for development; and estimated costs will be identified.

Data gathered through the proposed studies will be used to develop a Recreation Resources Management Plan. The Recreation Resources Management Plan will incorporate the assessment of Project impacts to recreation, the adequacy of existing recreational facilities, and the identification of future recreation needs. Appropriate mitigation measures will also be incorporated into the Recreation Resource Management Plan. The Recreation Resource Management Plan will guide the Licensee in the maintenance and development of the Project's recreation resources through the next licensing period.

6.7 LAND USE STUDIES

Land uses within the lower South Cow Creek watershed consist primarily of grazing and rural residential uses, with some timber harvesting. Land use in the immediate vicinity of the Cow Creek Powerhouse and associated facilities is primarily used for cattle grazing, with smaller portions in private timber, and rural residential use.

The Old Cow Creek watershed consists of lands utilized for cattle grazing (private). Lands in the immediate vicinity of the Kilarc Powerhouse and associated facilities are primarily managed for timber harvest, with some smaller portions used for cattle grazing.

6.7.1 Existing Land Uses, Regulations, and Comprehensive Plans

Land Management review will describe relevant Federal, State and local comprehensive plans, policies and regulations; the Licensee's easements; and public and private land and water uses and facilities within the Project Area (Study Plan 26, Appendix C). The geographic extent of these items will be mapped, and the acres will be summarized in tabular form.

Information and documents on federal, state and local management plans, policies and regulations will be obtained from consultation with appropriate agencies, including but not limited to the USFS (Lassen National Forest), the CDFG (Latour State Forest), the County of Shasta, and local Timber Plans. Information on the Licensee's easements will be obtained from the Licensee's records. Land uses will be mapped based on site visits, consultation with resource users and county planners, and a review of aerial photographs.

The 100-year floodplain within the Project Area will be mapped. Information on the 100-year floodplain will be obtained from the Federal Emergency Management Agency (FEMA), and if needed, a qualified geologist will map the floodplain.

6.7.2 Land Management Inventory

The land management inventory will be presented in a map or set of maps for use in the Exhibit E Report (Study 27, Appendix C). Table 6.7-1 presents a list of the probable land management maps and attributes that will be included. Resource information on the Project Area will be input into a GIS and will be mapped, in general, at a scale of 1:24,000. The specific scale and geographic extent presented for each resource, however, will ultimately depend on the distribution of each resource and the requirements of the resource information.

6.7.3 Consistency with Government Regulations and Comprehensive Plans

The Licensee's land and water uses and land management practices will be assessed for consistency with federal, state and local regulations and comprehensive plans governing the Project region's lands and waters. For each inconsistency, the assessment will include either proposals to bring the Project into compliance with government regulations and comprehensive plans or justification for an inconsistent use or management practice.

Table 6.7-1. Land Management Inventory Maps

Resource Maps	Resource Attributes
Base	Hydrology, roads, contours, public land survey, recreation facilities, hydroelectric facilities, cities, and Project boundary
Ownership	PG&E, State, Federal and private
Local Zoning	Shasta County Land Use, Metropolitan Bakersfield Land Use Designations, Kern River Plan Element Designations
Slope	0-5%, 5-10%, 10-20%, 30-60%, and >60%
Hazards	Flood, hydro operations, slope stability and geologic hazards
Land Use	Residential, timberlands, grazing, recreation, wildlife habitat resources, public land, commercial
Easements	PG&E's easements

6.7.4 Project Access Studies

In order to protect recreational and visual resources and maintain public access within the Project Area, the Licensee will assess and map land ownership, roads and trails, recreational facilities, recreational and aesthetic resources, and access and use limitations of Project lands and waters.

The Recreation Exhibit Report and the resource inventory will be the major source for this information. If additional access is needed to enhance public access to Project lands and waters, the Licensee will evaluate the costs of providing additional access. In addition, recreation and other land and water uses will be assessed to evaluate how management of these activities can be best implemented to maintain or enhance the Project Area's recreational and aesthetic values.

6.7.5 Project Impact Analysis

An assessment will be made to identify the consistency between comprehensive plans for the Project region and proposed Project management plans and land and water uses. Studies will also evaluate additional needs for enhancing public access to Project lands and water. In addition, management of the region's recreation and other land and water uses will be evaluated for best implementation to maintain or enhance the Projects Area's recreational and aesthetic values.

6.8 AESTHETIC RESOURCES STUDIES

The Project is located in the foothills at the southern end of the Cascade Mountain Range. The elevation within the Project Area ranges from about 820 ft above MSL at the Cow Creek Powerhouse to 3,940 ft above MSL at the North Canyon Creek Diversion Dam. The topography varies from gently rolling low hills near the Cow Creek Powerhouse to steep, narrow canyons in the upper Old Cow and Canyon Creeks Watershed. The Project Area encompasses a range of scenery, varying from the narrow and steep river canyons and densely vegetated riverbank with conifer forest in the upper watershed to open rolling foothills with grasses and oak and pine trees with a sparse and scattered overstory in the lower watershed.

6.8.1 Visual Resources of the Project Area and Vicinity

In order to assess the visual resources of the Project Area and vicinity, the extent and pattern of the landscape and vegetation will be defined. Land forms and habitats will be studied through a field assessment from primary travel routes in the area, regional visual resource reports, and an examination of topographic maps and aerial photographs of the region. This review will then be used to assess the relative uniqueness of aesthetic resources within the Project Area.

6.8.2 Project Features Visual Contrast with the Project Area's Visual Resources

The visual contrast of Project features with the Project Area's visual resources will also be assessed. For this assessment, Key Observation Points (KOPs) representing where the public can see Project facilities will first be identified and mapped. KOPs will most likely be located on local roads, such as Fern Road, Whitmore Road, and South Cow Creek Road, private logging roads, and at recreation use areas.

Views of Project facilities from mapped KOPs will be photographed and assessed based on scenic character and quality. This assessment will study vegetation, land form, water, and man-made features (including Project and non-Project features). The assessment will also take into account viewing conditions, including viewing distance, standard duration and orientation of view, number of viewers, and an observer's activity while viewing (such as driving or recreating).

Views of Project facilities will be analyzed for contrast with the local landscape and vegetation. Project facilities will be characterized by their color, size, contrast and proximity to other man-made features. These elements, in turn, will be compared to the local land form's color, slope, uniqueness and complexity and the local vegetation's color, density, barren spaces, uniqueness, and complexity.

The visibility of Project facilities from KOPs will also be assessed. This assessment will consider observed distance, orientation, cover, background and likely duration of view. The overall visual contrast of Project features to the local scenery will be assessed from each KOP. This assessment will consider the physical contrast of Project features to the area's landscape and vegetation, as well as the visibility of Project features and the number of viewers. A Project feature will have a high visual contrast if it's physical contrast is moderate to high and its visibility is high to a large number of viewers. A Project feature will have a low visual contrast if its physical contrast and visibility are low.

6.8.3 Project Impact Analysis

Aesthetic studies will assess the visual resources of the Project Area and vicinity, as well as the visibility of Project facilities from the Area's public travel routes. The visual contrast between Project facilities and the scenic resources of the area will be evaluated, and the effects of Project operations on the visual quality of the Project Area and adjacent lands will be examined (Study 28, Appendix C).

APPENDICES

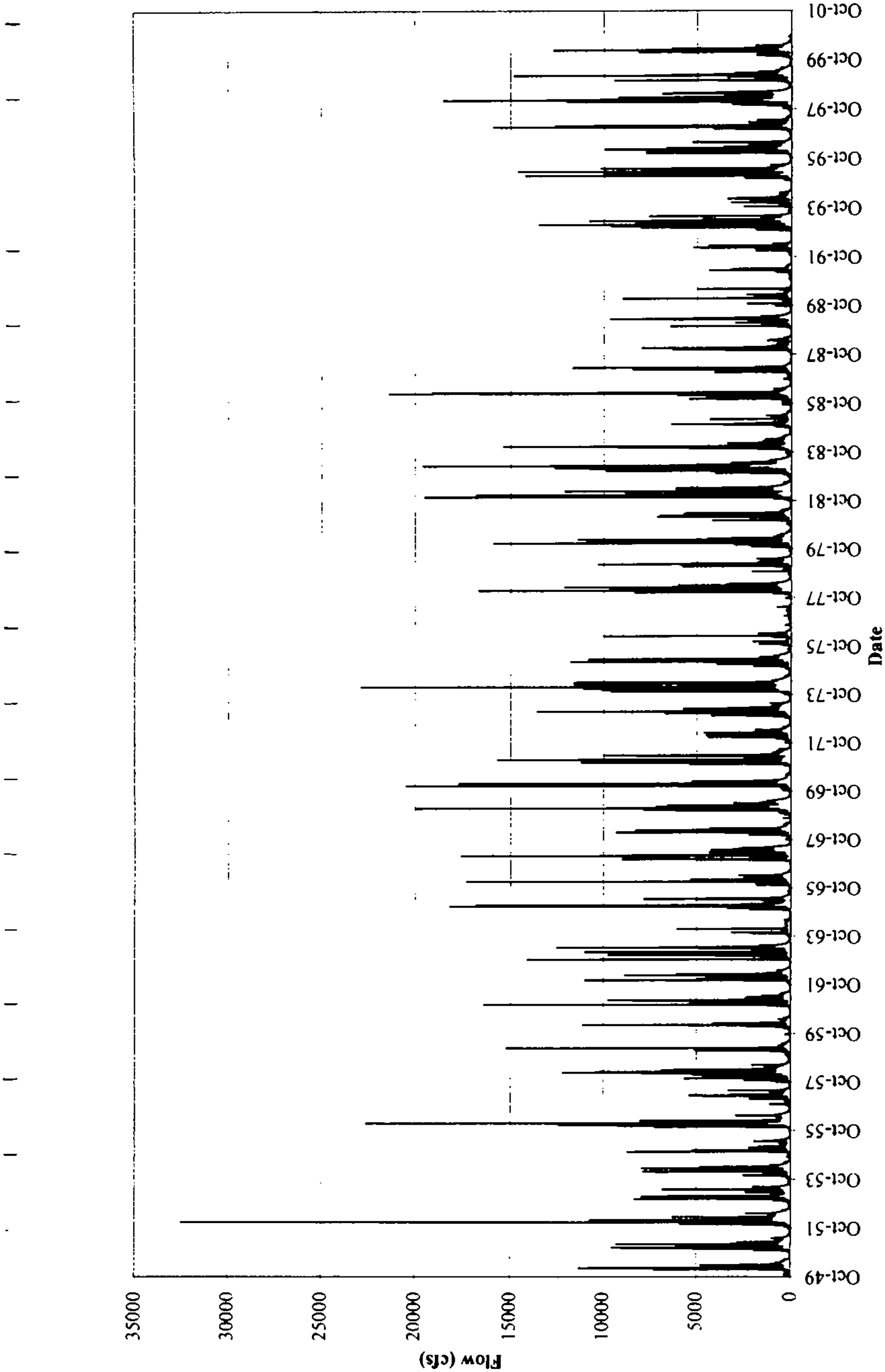
KILARC-COW CREEK PROJECT

FERC NO. 606

APPENDIX A

HYDROLOGIC DATA

Cow Creek at Millville



Average Daily Flow for Cow Creek at Millville.

Kilarc-Cow Creek Project, FERC No. 606

Average Monthly Flow. Cow Creek Near Millville, Water Years 1950-2000

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1950	37	98	111	1,248	1,860	1,115	682	448	170	37	20	27
1951	199	704	2,008	1,812	1,827	950	463	437	101	39	24	30
1952	102	610	2,716	2,694	2,431	1,466	883	897	353	117	56	64
1953	84	156	2,029	2,941	505	649	846	892	627	121	65	56
1954	91	362	341	1,528	1,311	1,527	1,259	357	163	45	47	61
1955	83	659	1,076	691	387	259	612	435	90	23	10	22
1956	45	589	3,227	4,367	1,268	658	532	1,121	310	91	50	56
1957	162	147	138	325	898	1,579	544	682	183	52	33	91
1958	365	620	1,064	2,111	4,570	2,114	1,762	695	459	148	77	73
1959	94	143	183	1,207	1,736	487	381	227	64	12	10	49
1960	41	60	104	565	1,830	1,005	320	304	66	8.9	2.3	10
1961	36	446	1,312	601	2,045	1,109	589	388	183	28	16	26
1962	57	294	1,237	480	2,045	1,193	497	284	97	18	14	17
1963	1,057	292	1,339	727	1,356	779	3,012	855	208	80	42	44
1964	103	746	191	825	252	201	221	192	110	18	7.0	18
1965	34	639	2,486	2,490	598	382	2,336	424	147	48	54	40
1966	53	509	449	1,778	1,150	843	805	265	72	16	5.0	14
1967	29	762	1,134	2,658	774	1,206	1,914	1,795	676	108	45	43
1968	94	124	421	1,363	2,511	1,055	394	235	92	17	64	31
1969	108	298	1,965	4,183	3,366	1,139	1,193	886	320	99	52	51
1970	127	174	2,729	5,593	1,185	1,118	314	196	118	43	27	35
1971	101	1,463	2,403	1,961	501	1,892	834	659	371	119	57	64
1972	107	201	554	710	959	1,167	653	276	113	33	23	35
1973	147	782	1,400	2,887	2,263	1,558	634	481	157	54	33	65
1974	154	2,441	2,604	4,289	1,370	2,998	1,544	604	288	146	82	64
1975	103	172	375	448	2,328	2,319	1,001	698	308	96	69	58
1976	229	238	329	153	893	617	498	178	52	14	52	38
1977	46	78	83	113	103	118	63	136	18	0.63	0.74	44

Average Monthly Flow Exceedance. Cow Creek Near Millville, Water Years 1950-2000

Exceedance	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
5%	320	1,952	3,248	4,546	4,602	3,892	2,194	1,621	814	185	101	109
10%	223	1,191	2,716	4,289	3,366	2,741	1,914	1,121	617	146	77	91
25%	148	659	1,814	2,694	2,328	1,863	1,193	695	308	96	56	64
50%	101	294	875	1,363	1,370	1,167	612	432	157	48	33	49
75%	46	140	329	710	774	658	423	265	92	21	15	26
90%	30	98	111	256	387	382	277	176	52	12	5	14
95%	28	69	94	133	205	226	219	131	29	9	2	7

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1949 to Sept 1950

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	36	42	92	93	357	455	740	600	297	65	22	12
2	36	46	92	96	329	442	725	655	272	56	26	12
3	36	45	92	87	365	428	695	730	263	59	18	14
4	36	48	92	87	9,250	424	650	580	248	59	18	12
5	36	47	102	81	10,900	500	630	505	227	59	24	11
6	36	46	109	84	11,300	545	1,060	460	216	50	30	14
7	36	50	106	100	2,920	450	915	428	219	50	30	14
8	36	59	109	94	1,600	414	888	406	197	45	22	24
9	36	163	100	115	1,170	473	876	378	187	45	19	28
10	36	334	96	715	1,550	635	700	365	182	38	21	26
11	36	215	94	517	1,280	482	650	365	200	36	24	29
12	36	140	90	254	904	396	615	378	230	41	22	27
13	36	120	90	223	810	361	852	396	197	41	22	25
14	36	116	94	689	740	345	725	437	182	35	18	21
15	36	100	98	286	766	318	645	468	175	33	15	15
16	36	99	104	219	882	308	615	478	318	34	18	27
17	36	94	181	7,260	844	814	600	491	168	26	18	32
18	36	94	258	5,500	725	709	600	482	150	25	18	48
19	36	88	234	3,090	665	4,300	615	450	135	31	16	59
20	36	88	138	1,940	635	1,580	635	437	122	31	22	50
21	36	87	115	4,180	575	1,130	655	442	109	31	24	44
22	36	87	107	3,130	540	2,300	710	455	100	30	18	37
23	36	88	104	4,390	500	1,850	680	464	94	30	16	40
24	36	88	100	1,640	496	4,760	635	468	97	23	16	37
25	36	88	94	850	510	2,750	600	442	97	24	14	35
26	36	88	93	595	500	1,820	590	406	94	24	16	28
27	36	88	93	515	491	1,760	570	392	86	25	18	28
28	46	90	93	491	478	1,190	555	361	82	25	17	19
29	44	96	93	482		982	520	333	79	26	15	18
30	43	93	94	468		860	500	325	75	22	14	24
31	41		94	414		778		311		19	15	
Total	1,146	2,927	3,451	38,685	52,082	34,559	20,446	13,888	5,098	1,138	606	810
Mean	37	98	111	1,248	1,860	1,115	682	448	170	37	20	27
Max	46	334	258	7,260	11,300	4,760	1,060	730	318	65	30	59
Min	36	42	90	81	329	308	500	311	75	19	14	11
AC-FT	2,273	5,806	6,845	76,731	103,303	68,547	40,554	27,546	10,112	2,257	1,202	1,607

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1950 to Sept 1951

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	27	294	703	385	660	690	433	425	166	55	19	33
2	27	239	643	373	645	630	433	405	157	52	19	33
3	28	190	9,030	437	1,610	585	417	646	147	52	17	25
4	44	166	3,700	1,390	9,290	2,430	417	1,000	137	51	20	28
5	52	154	1,620	920	7,510	2,250	421	842	137	51	28	25
6	112	144	2,180	650	2,720	1,950	425	966	135	42	30	23
7	86	137	4,400	555	2,040	1,720	433	762	141	51	28	25
8	68	125	4,180	535	1,710	1,510	441	625	132	56	24	31
9	62	116	3,680	675	1,450	2,760	445	540	125	56	21	29
10	59	116	1,830	3,980	1,520	1,850	476	522	119	50	18	30
11	53	114	2,720	4,630	3,180	1,030	504	595	119	47	21	30
12	55	116	1,950	1,920	2,560	900	494	517	114	50	26	26
13	52	125	1,380	1,140	1,690	823	494	481	101	45	22	31
14	48	180	9,540	900	1,380	796	512	441	95	40	16	28
15	48	182	2,920	1,590	1,200	757	508	401	95	38	18	29
16	56	1,980	1,800	1,740	1,060	730	504	385	95	36	17	27
17	84	2,350	1,330	5,480	1,070	670	508	369	92	36	20	35
18	91	5,140	1,090	3,630	1,040	625	499	354	90	34	26	29
19	78	1,250	944	2,100	872	605	472	340	81	31	31	26
20	72	1,260	834	1,380	960	585	441	323	74	33	24	27
21	72	1,860	735	2,420	1,340	580	417	302	77	35	22	33
22	72	994	665	6,060	994	570	397	285	79	33	24	34
23	72	715	610	3,400	884	530	381	278	76	28	30	35
24	75	560	565	2,250	768	512	377	265	74	29	33	35
25	106	472	526	1,690	725	512	369	244	74	27	32	32
26	455	413	494	1,370	768	504	358	232	73	21	30	31
27	539	413	463	1,170	746	481	362	221	63	28	27	27
28	646	421	437	1,030	762	476	834	205	60	27	21	23
29	640	373	417	906		472	635	200	55	32	25	34
30	1,880	506	425	757		463	481	188	57	28	33	43
31	414		437	710		441		177		26	32	
Total	6,173	21,105	62,248	56,173	51,154	29,437	13,888	13,536	3,040	1,220	754	897
Mean	199	704	2,008	1,812	1,827	950	463	437	101	39	24	30
Max	1,880	5,140	9,540	6,060	9,290	2,760	834	1,000	166	56	33	43
Min	27	114	417	373	645	441	358	177	55	21	16	23
AC-FT	12,244	41,861	123,467	111,417	101,462	58,387	27,546	26,848	6,030	2,420	1,496	1,779

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1951 to Sept 1952

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	58	105	5,860	1,680	10,700	1,120	846	1,180	526	251	74	55
2	90	101	2,410	1,330	6,830	936	834	1,010	498	225	74	55
3	135	100	3,990	1,130	3,890	1,070	804	930	474	211	75	60
4	92	101	3,330	1,000	2,590	1,390	816	858	446	193	67	60
5	79	97	1,830	924	2,020	1,010	864	798	438	183	60	60
6	74	100	950	1,150	1,660	1,810	918	775	454	169	52	60
7	73	100	650	1,350	1,440	2,240	990	1,300	482	147	60	65
8	68	100	512	1,500	1,280	1,420	966	2,340	442	134	61	70
9	64	100	421	1,340	1,160	1,140	906	1,280	438	119	62	80
10	65	126	365	1,900	1,070	1,160	870	1,090	462	121	64	87
11	84	302	337	6,660	1,820	966	852	1,030	458	117	57	87
12	93	818	320	7,250	1,480	1,170	852	990	410	121	56	79
13	85	320	302	4,100	1,160	990	882	942	362	124	54	78
14	79	203	278	8,030	1,020	2,340	924	912	326	121	53	71
15	79	181	256	3,700	958	6,260	810	858	316	106	53	69
16	81	155	244	2,310	4,130	2,510	780	822	287	103	54	63
17	81	139	238	1,540	2,080	1,700	786	828	257	101	58	60
18	81	134	318	1,230	1,610	2,690	834	822	248	100	62	62
19	79	183	787	1,090	2,300	1,880	888	828	233	96	55	62
20	79	1,420	405	2,430	3,570	1,360	846	816	222	88	50	62
21	76	3,930	330	1,530	2,030	1,100	810	770	230	90	48	62
22	68	740	298	1,320	2,200	960	804	720	225	82	48	58
23	77	369	295	1,130	4,360	870	834	715	251	75	49	58
24	285	265	381	7,130	2,280	840	876	720	350	82	48	58
25	340	227	334	4,660	1,760	900	900	715	277	79	50	53
26	155	1,510	3,590	4,590	1,500	960	900	680	242	71	50	55
27	119	1,170	32,500	2,590	1,300	942	990	660	236	75	45	55
28	105	2,460	9,400	1,830	1,210	924	1,040	655	319	71	50	57
29	105	1,220	6,370	1,520	1,090	948	1,020	625	382	57	50	52
30	108	1,510	4,580	1,890		948	1,050	575	308	58	55	56
31	107		2,330	3,690		906		560		66	55	
Total	3,164	18,286	84,211	83,524	70,498	45,460	26,492	27,804	10,599	3,636	1,749	1,909
Mean	102	610	2,716	2,694	2,431	1,466	883	897	353	117	56	64
Max	340	3,930	32,500	8,030	10,700	6,260	1,050	2,340	526	251	75	87
Min	58	97	238	924	958	840	780	560	222	57	45	52
AC-FT	6,276	36,270	167,030	165,667	139,831	90,169	52,546	55,148	21,023	7,212	3,469	3,786

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1952 to Sept 1953

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	54	101	846	3,020	670	374	471	1,220	680	218	71	84
2	53	98	1,090	2,040	635	331	458	1,010	655	207	71	71
3	55	96	482	1,180	610	312	444	896	625	204	76	64
4	57	95	260	882	595	298	435	824	585	194	77	58
5	60	96	1,340	720	650	292	440	782	565	186	72	59
6	60	100	2,150	1,520	710	285	448	776	868	174	67	64
7	58	100	4,690	5,410	675	281	430	1,310	1,970	161	67	62
8	67	95	1,230	3,300	914	288	426	1,020	1,360	154	67	52
9	68	98	2,490	7,460	665	295	490	854	1,120	150	72	48
10	67	100	8,310	3,630	605	506	585	728	944	139	66	48
11	69	105	3,940	2,220	570	787	505	655	842	137	57	50
12	67	117	1,200	4,960	530	963	435	605	776	137	54	54
13	66	258	715	4,410	505	868	408	580	722	128	56	56
14	69	882	522	3,120	490	515	386	605	650	118	61	51
15	67	280	430	2,090	471	430	362	630	620	114	54	46
16	67	188	366	1,580	453	417	366	650	610	109	59	51
17	74	157	319	5,980	435	495	471	605	560	96	62	46
18	127	147	294	7,930	422	404	448	585	540	94	57	46
19	160	140	2,500	7,920	399	2,360	404	1,600	515	101	53	47
20	112	136	2,790	5,910	386	1,700	412	1,280	476	94	56	50
21	105	130	960	3,470	374	1,520	430	1,170	426	89	55	54
22	105	128	635	2,360	362	1,030	480	908	390	76	55	55
23	103	126	494	1,820	350	818	540	980	362	78	58	55
24	103	126	418	1,510	342	704	535	1,010	320	78	55	58
25	103	128	1,030	1,310	335	640	545	1,330	302	78	54	58
26	103	128	5,550	1,170	327	595	631	1,100	288	83	54	57
27	103	130	4,870	1,000	327	570	6,810	932	278	82	61	61
28	101	128	1,440	908	335	550	3,060	806	272	76	58	61
29	103	126	2,360	848		525	1,980	752	256	66	78	63
30	105	128	6,560	770		495	1,540	734	241	66	109	62
31	105		2,630	710		480		716		71	96	
Total	2,616	4,667	62,911	91,158	14,142	20,128	25,375	27,653	18,818	3,758	2,008	1,691
Mean	84	156	2,029	2,941	505	649	846	892	627	121	65	56
Max	160	882	8,310	7,930	914	2,360	6,810	1,600	1,970	218	109	84
Min	53	95	260	710	327	281	362	580	241	66	53	46
AC-FT	5,189	9,257	124,782	180,809	28,050	39,923	50,331	54,849	37,325	7,454	3,983	3,354

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1953 to Sept 1954

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	62	103	213	166	1,040	500	690	630	161	80	17	79
2	66	103	188	166	860	462	660	576	146	76	22	73
3	63	103	196	230	728	444	1,560	541	150	73	27	69
4	66	105	848	323	650	422	4,790	511	170	71	24	63
5	62	118	354	241	585	404	3,210	490	217	64	25	66
6	53	148	1,150	224	535	390	3,540	474	204	58	29	61
7	49	139	1,430	531	490	386	2,030	462	186	56	33	56
8	52	124	530	346	448	1,560	1,660	454	214	59	30	50
9	52	120	366	275	417	7,930	1,820	462	336	59	29	43
10	70	143	302	244	394	4,150	1,260	442	296	57	32	44
11	124	247	259	227	404	2,000	1,100	418	239	62	26	52
12	94	194	232	213	3,430	1,460	998	406	236	55	26	50
13	91	221	218	202	3,360	1,180	938	386	236	47	29	50
14	96	435	207	191	2,670	1,000	890	364	206	47	30	51
15	101	285	199	199	2,080	896	836	353	191	42	37	87
16	100	210	194	2,370	1,750	2,140	818	343	189	42	33	87
17	96	331	186	7,180	5,530	1,940	812	336	163	42	29	88
18	132	207	202	1,620	2,640	1,330	806	329	146	42	23	88
19	171	188	434	956	1,610	2,520	784	319	138	39	25	83
20	122	213	471	645	1,250	2,700	745	312	140	35	34	71
21	109	188	339	510	1,030	3,280	718	299	120	30	42	69
22	101	689	275	4,040	896	1,920	712	268	107	24	40	61
23	101	2,480	241	7,850	788	1,360	690	256	97	31	35	57
24	105	1,820	224	2,090	722	1,120	685	242	91	33	31	53
25	103	615	213	1,190	665	998	712	228	87	29	34	52
26	93	378	202	1,060	630	842	660	217	85	29	85	53
27	96	288	191	2,020	570	767	1,000	204	87	31	102	49
28	98	238	184	5,160	530	740	1,060	186	93	29	194	39
29	103	213	178	3,360		878	872	184	82	20	146	34
30	100	207	174	2,160		860	712	186	80	19	102	42
31	98		168	1,370		756		179		17	87	
Total	2,829	10,853	10,568	47,359	36,702	47,335	37,768	11,057	4,893	1,398	1,458	1,820
Mean	91	362	341	1,528	1,311	1,527	1,259	357	163	45	47	61
Max	171	2,480	1,430	7,850	5,530	7,930	4,790	630	336	80	194	88
Min	49	103	168	166	394	386	660	179	80	17	17	34
AC-FT	5,611	21,527	20,961	93,935	72,797	93,888	74,912	21,931	9,705	2,773	2,892	3,610

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1954 to Sept 1955

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	52	80	316	1,330	1,650	268	330	690	170	37	14	7.8
2	55	83	2,850	768	746	271	323	948	161	37	15	11
3	57	91	1,620	536	576	271	287	700	154	46	10	11
4	55	90	2,180	446	495	249	268	630	143	42	9.2	10
5	58	93	1,900	414	459	228	252	576	129	42	11	11
6	62	93	4,900	362	418	215	234	576	116	35	10	8.20
7	87	98	2,200	319	382	212	226	620	111	37	11	10
8	113	121	1,040	298	358	212	220	625	106	30	10	10
9	102	1,020	5,180	450	338	234	223	585	102	32	10	6.7
10	91	388	1,910	674	312	301	237	544	99	35	9.2	6.7
11	91	273	990	442	298	291	220	531	108	29	6.7	8.2
12	85	1,200	710	362	291	287	207	513	102	24	6.3	13
13	87	339	757	338	284	278	209	486	102	21	8.2	13
14	87	798	595	319	271	258	226	442	93	23	9.2	17
15	79	8,680	490	362	261	237	218	394	102	20	10	49
16	80	2,360	418	1,020	287	228	212	366	102	16	10	46
17	85	774	366	740	406	223	1,470	342	91	21	6.9	46
18	80	486	334	2,170	338	218	845	319	86	20	6.1	47
19	91	370	308	1,830	287	209	640	334	76	14	8.9	32
20	120	305	287	1,260	271	204	790	346	61	10	8.2	28
21	106	268	274	872	261	196	1,900	354	49	13	10	26
22	98	243	268	730	252	194	1,720	350	46	14	10	25
23	88	226	261	752	240	192	984	319	53	16	13	24
24	87	209	255	650	231	189	768	298	52	20	11	29
25	87	202	246	590	228	184	960	278	50	12	10	30
26	85	192	231	549	234	186	1,030	255	52	10	10	28
27	79	182	215	486	350	196	695	231	48	13	12	25
28	85	174	212	438	312	337	610	220	43	10	14	23
29	88	170	223	406		605	1,130	209	40	13	7.3	23
30	80	168	237	508		495	918	204	44	14	6.5	23
31	77		1,570	1,010		362		186		15	7.3	
Total	2,577	19,776	33,343	21,431	10,836	8,030	18,352	13,471	2,691	721	300	647
Mean	83	659	1,076	691	387	259	612	435	90	23	10	22
Max	120	8,680	5,180	2,170	1,650	605	1,900	948	170	46	15	49
Min	52	80	212	298	228	184	207	186	40	10	6.1	6.7
AC-FT	5,111	39,225	66,135	42,508	21,493	15,927	36,401	26,719	5,338	1,430	595	1,284

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1955 to Sept 1956

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	28	54	364	2,470	1,190	956	514	550	532	143	48	46
2	30	54	398	1,960	1,080	872	482	540	500	137	51	44
3	26	58	305	1,440	1,000	836	464	586	482	130	58	49
4	28	65	291	2,000	938	1,430	447	1,530	478	128	60	48
5	32	72	2,580	2,810	884	1,260	447	2,390	442	128	60	39
6	24	77	9,210	2,040	818	878	451	2,820	421	120	58	43
7	26	71	1,420	6,320	767	784	455	2,600	401	114	58	45
8	33	67	1,160	3,910	718	745	464	1,640	384	114	51	46
9	36	64	3,370	2,340	680	706	451	1,310	376	112	53	41
10	44	61	1,060	3,370	655	660	486	1,840	364	99	48	46
11	55	65	701	2,320	635	625	532	2,880	349	88	48	39
12	50	71	568	1,510	620	586	554	1,500	326	88	48	48
13	43	93	468	4,150	600	576	581	1,190	307	94	52	52
14	41	124	401	15,000	576	558	563	1,020	318	108	46	56
15	40	126	345	22,600	550	536	518	908	329	108	45	56
16	40	152	800	5,980	509	522	491	848	296	95	46	52
17	38	168	4,000	3,500	522	518	491	818	269	84	44	59
18	37	264	6,000	2,770	514	518	478	794	253	71	51	62
19	43	629	9,000	2,740	550	518	504	842	272	71	51	85
20	53	7,230	5,400	6,060	758	518	532	812	293	79	52	94
21	49	3,350	3,500	4,270	2,500	518	568	800	262	76	55	85
22	49	635	8,880	7,400	8,000	518	568	772	237	77	55	74
23	52	1,030	12,400	5,300	3,230	518	605	767	222	68	52	68
24	49	1,120	4,330	3,360	1,920	532	645	723	205	62	45	65
25	48	567	2,790	4,430	1,640	554	635	675	194	53	49	56
26	67	378	8,000	4,890	1,430	563	650	660	180	55	45	56
27	68	312	5,000	3,180	1,220	536	625	625	170	60	46	58
28	67	268	2,570	2,410	1,100	514	605	581	146	62	49	60
29	64	234	1,840	1,890	1,160	504	581	563	143	62	46	64
30	62	212	1,520	1,600		514	558	600	135	64	44	56
31	61		1,360	1,360		536		572		56	48	
Total	1,383	17,671	100,031	135,380	36,764	20,409	15,945	34,756	9,286	2,806	1,562	1,692
Mean	4.6	589	3,227	4,367	1,268	658	532	1,121	310	91	50	56
Max	68	7,230	12,400	22,600	8,000	1,430	650	2,880	532	143	60	94
Min	24	54	291	1,360	509	504	447	540	135	53	44	39
AC-FT	2,743	35,050	198,408	268,522	72,920	40,481	31,626	68,937	18,419	5,566	3,098	3,356

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1956 to Sept 1957

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	60	285	121	116	162	1,240	722	376	380	85	30	39
2	56	271	118	116	183	1,060	550	546	348	82	30	39
3	53	205	118	113	171	1,750	518	514	317	75	37	30
4	58	183	276	113	165	5,360	478	416	286	64	41	27
5	64	174	264	111	162	5,090	456	380	269	60	44	22
6	64	165	177	113	159	4,850	444	362	246	60	42	31
7	65	156	148	113	165	2,590	420	356	240	65	33	33
8	71	154	129	118	244	1,780	400	373	226	66	30	33
9	76	151	129	118	274	1,530	392	392	246	59	34	29
10	84	148	129	113	231	1,170	376	388	265	60	32	23
11	225	145	137	126	214	1,120	362	384	223	53	36	30
12	160	145	142	1,090	218	2,200	362	352	200	56	40	32
13	122	137	148	2,140	214	1,300	400	345	190	55	36	36
14	114	131	156	526	278	1,030	1,060	356	184	57	33	39
15	110	134	145	422	240	1,920	610	345	180	50	27	35
16	104	131	137	338	224	3,220	492	306	167	44	30	33
17	103	129	134	247	211	1,810	523	292	157	39	27	40
18	106	129	129	211	198	1,270	710	2,110	141	43	27	41
19	120	118	129	198	198	1,030	926	3,290	131	49	27	38
20	116	118	124	602	195	854	1,060	1,590	124	47	28	39
21	108	121	124	564	701	764	764	1,360	124	48	30	41
22	103	124	121	398	1,380	656	640	1,030	120	50	32	39
23	108	124	118	338	1,300	590	580	866	114	45	34	40
24	132	124	116	319	4,120	550	541	764	108	37	33	33
25	122	121	116	300	4,660	532	492	674	94	35	32	31
26	139	118	116	247	3,150	500	460	610	83	37	30	46
27	364	118	116	174	3,970	469	428	550	85	39	34	761
28	197	118	116	198	1,760	469	404	500	80	40	29	591
29	162	121	116	168		722	384	474	80	43	33	289
30	1,080	121	113	165		854	380	444	89	42	32	184
31	566		116	165		674		408		33	33	
Total	5,012	4,419	4,278	10,080	25,147	48,954	16,334	21,153	5,497	1,618	1,016	2,724
Mean	162	147	138	325	898	1,579	544	682	183	52	33	91
Max	1,080	285	276	2,140	4,660	5,360	1,060	3,290	380	85	44	761
Min	53	118	113	111	159	469	362	292	80	33	27	22
AC-FT	9,941	8,765	8,485	19,993	49,878	97,099	32,398	41,956	10,903	3,209	2,015	5,403

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1957 to Sept 1958

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	226	164	189	635	1,980	1,740	6,180	700	449	221	98	66
2	177	155	186	1,450	3,770	1,500	5,520	710	416	249	103	54
3	172	153	181	870	5,540	1,340	4,140	730	509	226	101	54
4	157	148	181	674	5,790	1,200	2,860	730	441	205	91	59
5	367	146	184	575	3,860	1,100	3,790	730	392	187	82	61
6	366	148	178	516	2,450	1,030	4,830	725	371	180	80	61
7	370	148	175	476	3,300	946	2,380	710	367	167	80	67
8	243	148	173	454	3,100	946	1,710	710	432	153	86	71
9	240	148	170	432	3,500	862	1,400	705	2,040	144	86	78
10	519	155	165	3,540	3,080	817	1,240	725	670	146	83	77
11	303	206	162	2,630	2,510	778	1,170	1,050	545	137	74	71
12	223	177	162	5,210	12,200	756	1,120	1,310	915	137	71	78
13	2,420	5,620	160	2,930	3,860	1,050	1,040	898	650	131	67	83
14	1,360	5,260	162	1,480	6,570	1,440	1,040	784	522	122	71	77
15	482	1,140	239	1,290	7,500	1,740	1,020	740	461	131	68	70
16	334	674	2,940	1,040	6,270	1,130	1,000	720	416	120	72	67
17	265	498	4,010	822	3,690	1,200	1,070	710	389	135	86	70
18	231	424	2,720	690	4,550	958	1,130	700	360	153	88	66
19	206	392	1,350	613	8,870	839	1,050	680	367	135	76	64
20	187	349	2,220	565	3,760	3,450	1,020	665	403	124	74	66
21	180	309	4,640	516	2,540	5,630	1,010	630	335	116	72	64
22	172	278	2,250	467	2,040	6,850	1,010	620	311	120	72	68
23	192	258	1,210	662	2,340	3,990	916	690	302	170	71	112
24	420	246	940	5,100	10,400	3,740	839	670	298	153	74	101
25	289	237	738	3,000	6,370	4,260	790	590	282	146	71	89
26	253	225	912	6,040	3,500	2,150	751	558	238	140	66	83
27	217	211	702	2,240	2,550	1,660	725	527	224	124	63	77
28	200	205	2,570	4,950	2,060	1,430	705	483	221	114	64	80
29	187	200	1,420	7,910		3,650	700	466	221	114	67	74
30	174	192	947	4,590		4,770	690	445	224	107	68	70
31	172		744	3,060		2,590		436		96	67	
Total	11,304	18,614	32,980	65,427	127,950	65,542	52,846	21,547	13,771	4,603	2,392	2,178
Mean	365	620	1,064	2,111	4,570	2,114	1,762	695	459	148	77	73
Max	2,420	5,620	4,640	7,910	12,200	6,850	6,180	1,310	2,040	249	103	112
Min	157	146	160	432	1,980	756	690	436	221	96	63	54
AC-FT	22,421	36,920	65,415	129,772	253,785	130,001	104,818	42,738	27,314	9,130	4,744	4,320

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1958 to Sept 1959

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	65	107	124	170	480	650	526	364	114	17	5.0	19
2	65	116	126	163	411	632	506	356	110	15	6.0	13
3	66	116	124	156	582	610	510	321	107	8.8	5.0	9.2
4	65	121	126	149	341	601	506	297	101	18	4.0	6.5
5	72	118	126	1,400	325	560	506	280	99	28	3.0	12
6	69	112	126	2,450	302	547	486	271	114	25	4.0	17
7	76	112	128	1,540	292	526	458	256	114	16	3.0	17
8	74	112	128	1,710	275	510	438	240	103	15	2.5	16
9	67	116	135	4,520	272	494	418	228	95	15	2.7	14
10	65	288	133	1,390	382	478	406	231	93	14	2.5	14
11	72	179	128	1,120	992	458	398	217	82	22	2.3	9.2
12	77	149	124	5,060	611	450	379	203	73	17	2.7	10
13	81	145	124	2,190	458	454	375	203	71	18	3.5	10
14	81	222	126	928	501	438	353	228	71	12	5.6	14
15	81	179	124	635	1,540	426	342	268	62	4.7	6.2	22
16	81	156	124	501	15,200	422	328	237	59	6.5	7.4	29
17	83	145	124	411	3,770	418	317	237	58	12	7.4	18
18	138	147	124	360	2,490	414	297	234	54	14	5.9	136
19	156	154	124	315	3,130	410	283	217	51	9.2	8.3	290
20	149	156	126	288	3,520	398	271	192	28	10	10	146
21	118	149	156	267	4,180	398	259	179	31	9.0	36	109
22	118	145	168	253	2,480	422	259	187	31	8.0	26	85
23	114	142	140	244	1,680	458	259	217	27	7.0	31	73
24	112	138	147	374	1,160	478	265	211	22	6.0	23	71
25	116	135	230	2,500	965	418	287	195	16	6.0	14	65
26	114	133	256	1,210	827	502	458	187	23	7.0	10	62
27	114	131	1,050	1,880	751	458	458	184	33	6.0	5.6	55
28	107	126	370	2,820	690	422	394	171	35	5.0	6.5	51
29	107	126	250	1,070		422	356	157	27	4.0	14	41
30	105	126	199	762		623	342	141	22	3.0	17	41
31	109		179	577		614		126		4.0	20	
Total	2,917	4,301	5,669	37,413	48,607	15,111	11,440	7,035	1,926	362	300	1,475
Mean	94	143	183	1,207	1,736	487	381	227	64	12	10	49
Max	156	288	1,050	5,060	15,200	650	526	364	114	28	36	290
Min	65	107	124	149	272	398	259	126	16	3.0	2.3	6.5
AC-FT	5,786	8,531	11,244	74,208	96,411	29,972	22,691	13,954	3,820	718	595	2,925

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1959 to Sept 1960

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	40	46	74	92	5,440	232	393	325	165	17	5.6	1.8
2	42	46	78	87	2,260	224	367	645	151	12	3.8	1.8
3	40	49	75	87	2,260	278	360	500	135	12	2.8	1.9
4	40	51	68	87	2,180	2,200	356	550	111	20	3.4	10
5	38	51	67	87	2,230	3,800	342	432	96	18	2.2	14
6	35	50	68	94	1,400	2,440	339	378	93	15	1.6	12
7	36	49	72	97	9,910	4,080	332	397	88	12	1.6	11
8	40	51	74	317	11,100	2,500	328	382	122	11	1.6	8.4
9	58	58	81	298	3,440	1,450	308	346	109	13	2.1	7.8
10	59	54	80	246	3,010	1,040	311	318	86	11	1.6	11
11	58	56	78	800	1,520	840	315	305	83	13	1.4	13
12	47	57	87	644	1,030	1,230	311	295	75	12	1.4	12
13	28	62	94	255	1,030	1,600	276	286	67	12	1.4	12
14	31	60	89	225	740	886	279	252	52	16	2.9	8.8
15	31	59	92	262	615	730	270	232	55	14	1.9	7.8
16	33	58	90	208	522	635	246	210	54	12	1.9	4.2
17	31	60	89	181	457	572	235	202	44	4.2	1.9	5.9
18	33	64	89	168	509	545	229	184	41	6.1	2.1	10
19	35	62	89	160	479	504	232	182	42	3.6	1.4	12
20	35	64	89	162	389	483	215	180	40	2.9	1.2	11
21	40	64	92	324	349	466	205	213	32	2.9	1.2	9.2
22	56	66	90	2,390	325	457	205	192	31	2.5	1.1	11
23	51	66	106	1,000	298	449	325	200	28	2.4	1.1	11
24	50	67	225	591	286	445	374	372	24	3.2	1.3	16
25	44	66	384	1,210	276	436	382	342	22	6.8	1.6	17
26	45	69	173	834	267	441	378	332	29	7.3	4.5	16
27	47	71	127	1,060	258	436	504	286	30	3.4	3.8	12
28	39	72	115	2,610	246	461	457	252	26	3.1	3.1	10
29	39	72	104	858	235	405	389	235	24	2.6	5.0	7.5
30	41	69	99	1,400		432	342	215	21	1.8	2.9	4.7
31	41		96	683		453		187		2.1	1.9	
Total	1,283	1,789	3,234	17,517	53,061	31,150	9,605	9,427	1,976	275	71	290
Mean	41	60	104	565	1,830	1,005	320	304	66	8.9	2.3	10
Max	59	72	384	2,610	11,100	4,080	504	645	165	20	5.6	17
Min	28	46	67	87	235	224	205	180	21	1.8	1.1	1.8
AC-FT	2,545	3,548	6,415	34,744	105,245	61,785	19,051	18,698	3,919	545	141	576

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1960 to Sept 1961

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	10	44	16,400	195	2,840	408	751	457	328	49	22	16
2	13	45	3,320	184	4,270	401	715	453	461	46	15	17
3	18	44	1,670	177	2,590	386	715	408	393	45	16	16
4	18	41	844	172	1,500	371	725	389	367	49	12	15
5	20	48	580	167	1,100	436	710	371	332	48	12	12
6	65	54	442	165	952	509	670	412	308	45	14	11
7	64	62	354	165	892	412	630	496	292	45	12	16
8	54	83	315	174	1,020	606	590	424	279	48	11	23
9	44	78	285	195	9,770	1,270	558	397	255	45	11	16
10	40	75	260	230	3,490	904	536	457	241	43	17	16
11	44	83	248	189	7,960	762	514	572	227	37	17	18
12	42	195	227	172	2,680	620	540	509	214	33	20	20
13	41	1,170	216	167	1,790	554	532	449	185	33	26	18
14	39	731	205	160	2,270	713	487	412	164	32	18	21
15	33	305	222	157	3,220	2,370	449	389	151	26	17	29
16	29	187	1,440	150	2,040	1,160	428	371	145	28	12	34
17	27	160	5,370	148	1,430	2,260	441	360	125	26	12	59
18	28	603	2,580	146	1,140	1,140	445	353	110	15	12	53
19	31	312	1,300	141	958	1,300	424	356	105	12	13	44
20	30	195	802	139	839	1,880	389	371	99	12	16	39
21	31	167	595	137	751	1,090	401	374	96	15	21	40
22	31	153	486	134	680	916	532	356	89	17	18	37
23	32	146	404	144	605	922	1,500	335	87	20	16	30
24	37	200	351	157	563	2,320	915	308	80	17	16	31
25	37	3,210	315	144	527	1,900	680	292	70	12	18	35
26	40	3,110	289	148	487	2,350	545	325	67	10	14	25
27	45	859	263	273	457	2,180	483	349	58	7.3	17	18
28	45	379	242	273	428	1,430	449	298	56	11	20	23
29	42	249	225	2,030		1,080	453	279	51	10	26	25
30	39	391	211	3,380		922	474	328	51	18	18	24
31	45		205	8,410		817		371		25	21	
Total	1,114	13,379	40,666	18,623	57,249	34,389	17,681	12,021	5,486	879	510	781
Mean	36	446	1,312	601	2,045	1,109	589	388	183	28	16	26
Max	65	3,210	16,400	8,410	9,770	2,370	1,500	572	461	49	26	59
Min	10	41	205	134	428	371	389	279	51	7.3	11	11
AC-FT	2,210	26,537	80,660	36,938	113,552	68,210	35,070	23,843	10,881	1,744	1,012	1,549

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1961 to Sept 1962

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	28	85	11,000	237	221	1,580	500	387	180	44	12	11
2	26	89	3,560	224	212	2,610	510	392	172	38	8.4	11
3	25	87	1,320	215	206	1,420	505	392	170	27	6.5	9.4
4	30	85	760	206	201	1,130	495	387	165	27	10	13
5	26	82	570	201	198	4,280	505	369	149	24	17	10
6	20	80	441	193	218	6,050	505	360	138	25	13	10
7	21	80	369	190	1,700	2,720	515	356	124	22	16	9.4
8	25	80	324	187	2,320	1,660	535	351	120	23	27	11
9	29	82	291	187	5,490	1,240	550	378	116	24	32	16
10	29	85	261	180	4,090	980	520	346	111	17	44	12
11	43	85	234	177	2,800	836	490	315	107	18	31	13
12	84	82	228	185	2,290	720	490	295	98	13	22	7.8
13	75	78	218	187	8,850	645	500	311	93	13	18	11
14	55	73	215	172	5,500	600	520	291	109	16	14	14
15	49	70	209	168	6,800	580	575	283	111	16	6.5	16
16	46	70	201	165	3,000	590	540	261	107	18	3.4	18
17	48	75	356	163	2,080	640	515	237	96	14	5.7	17
18	45	85	461	175	2,400	525	490	254	85	13	10	12
19	45	90	4,960	4,460	1,890	490	510	261	74	12	16	7.5
20	48	118	4,940	2,890	1,320	515	515	250	72	18	15	11
21	77	110	2,520	841	1,060	515	436	224	58	18	9.4	16
22	70	106	1,140	480	872	1,230	423	221	53	18	6.2	21
23	65	120	760	436	760	891	423	228	55	16	7.8	22
24	65	150	595	396	685	690	432	218	54	13	10	18
25	64	2,450	495	360	605	625	428	212	54	10	9.4	20
26	70	1,310	418	328	515	585	414	221	49	7.8	16	20
27	101	657	360	291	465	550	441	218	48	7.8	4.1	22
28	158	325	320	264	500	540	705	204	47	5.7	7.5	34
29	114	1,110	295	250		525	505	201	42	14	9.1	43
30	94	824	272	234		515	423	201	50	14	6.2	45
31	89		250	224		495		190		12	9.4	
Total	1,764	8,823	38,343	14,866	57,248	36,972	14,915	8,814	2,907	558	423	501
Mean	57	294	1,237	480	2,045	1,193	497	284	97	18	14	17
Max	158	2,450	11,000	4,460	8,850	6,050	705	392	180	44	44	45
Min	20	70	201	163	198	490	414	190	42	5.7	3.4	7.5
AC-FT	3,499	17,500	76,052	29,486	113,550	73,333	29,583	17,482	5,766	1,107	838	993

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1962 to Sept 1963

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	38	199	318	325	7,390	388	2,060	900	412	129	35	48
2	32	196	3,460	311	3,810	371	1,300	867	354	127	40	43
3	41	194	3,950	305	3,160	359	1,060	952	312	119	41	35
4	43	192	1,210	298	2,040	340	881	958	300	123	48	35
5	39	192	806	279	1,580	332	3,730	893	296	119	46	36
6	39	189	630	267	1,250	325	12,500	874	278	115	42	39
7	40	187	536	258	1,050	322	12,400	1,650	260	115	39	42
8	48	185	466	255	958	311	4,990	1,650	243	113	42	40
9	64	189	416	249	874	311	3,690	1,620	237	96	48	34
10	920	230	386	241	895	293	3,700	1,300	224	85	53	32
11	3,330	216	356	224	860	284	3,090	1,290	221	83	50	39
12	14,100	204	335	192	1,040	274	2,240	1,110	203	83	48	41
13	4,270	199	325	209	1,930	297	2,280	990	192	81	40	45
14	3,800	196	322	216	1,590	280	6,970	926	200	86	35	43
15	1,100	192	3,340	214	1,070	307	4,120	854	192	80	33	48
16	660	189	3,870	212	944	379	2,670	797	178	74	41	39
17	491	185	9,750	206	1,190	426	2,070	767	184	66	34	35
18	408	185	2,940	204	839	426	1,790	743	166	70	34	40
19	356	182	1,510	194	739	363	3,960	719	154	76	35	49
20	322	182	1,070	192	714	348	2,120	701	154	70	37	66
21	295	180	844	194	660	329	1,660	725	149	59	39	60
22	276	180	710	194	584	314	2,400	684	154	59	36	53
23	258	180	620	194	539	516	1,400	634	168	56	40	58
24	246	178	532	189	500	887	1,210	612	161	58	49	53
25	238	178	483	189	476	472	1,120	563	149	58	52	55
26	235	1,290	445	185	448	400	1,140	520	140	58	50	50
27	227	1,380	412	182	422	2,150	1,050	480	136	50	46	40
28	222	554	393	182	404	4,850	958	450	136	50	43	43
29	214	405	371	199		1,750	912	421	151	50	41	48
30	209	342	353	4,980		1,630	893	416	138	45	42	43
31	204		342	11,000		4,110		435		34	43	
Total	32,765	8,750	41,501	22,539	37,956	24,144	90,364	26,501	6,242	2,487	1,302	1,332
Mean	1,057	292	1,339	727	1,356	779	3,012	855	208	80	42	44
Max	14,100	1,380	9,750	11,000	7,390	4,850	12,500	1,650	412	129	53	66
Min	32	178	318	182	404	274	881	416	136	34	33	32
AC-FT	64,988	17,355	82,316	44,705	75,285	47,889	179,234	52,564	12,381	4,933	2,582	2,642

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1963 to Sept 1964

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	41	121	246	181	440	205	270	248	116	30	11	34
2	40	123	230	181	396	261	293	242	114	27	7.6	45
3	41	131	215	173	359	211	252	277	108	28	12	38
4	41	277	206	168	336	197	242	304	108	31	10	31
5	46	367	200	163	322	191	239	255	112	33	9.2	27
6	55	470	192	161	300	185	230	233	114	30	7.0	25
7	62	385	186	163	287	183	220	211	154	22	7.0	19
8	62	1,050	181	156	277	174	208	211	160	19	7.6	19
9	66	2,010	200	156	270	174	217	211	261	20	12	17
10	86	640	195	173	267	172	227	208	322	21	12	16
11	149	336	176	163	261	174	227	191	224	17	7.6	18
12	168	256	176	159	248	270	236	183	174	17	8.2	18
13	123	240	176	161	242	255	230	199	150	18	7.0	19
14	115	1,380	173	184	236	227	233	202	137	16	5.3	14
15	109	1,410	168	173	248	199	242	191	122	14	3.7	11
16	105	590	166	171	245	188	248	191	112	15	4.8	7.6
17	103	385	163	513	230	183	242	191	106	15	6.5	10
18	99	308	161	1,140	214	177	236	183	90	14	8.7	12
19	101	1,530	161	3,010	205	174	217	180	89	18	6.5	16
20	103	1,890	250	6,040	199	174	208	174	82	17	4.4	17
21	107	580	243	3,170	199	180	208	164	78	12	6.1	12
22	113	394	195	1,690	199	202	197	157	73	12	5.7	7.0
23	209	3,130	178	1,200	197	230	202	150	52	10	7.0	4.8
24	168	1,820	173	993	197	217	197	137	46	13	5.3	4.1
25	142	767	168	1,240	188	227	185	134	26	14	2.9	5.7
26	131	510	166	986	185	205	183	141	37	13	2.0	9.2
27	123	398	168	764	185	199	183	157	34	13	2.0	16
28	119	328	197	621	183	194	177	188	42	10	2.9	17
29	123	289	227	539	191	197	191	160	38	13	5.3	18
30	127	263	197	515		199	202	148	33	17	8.2	19
31	123		186	467		197		128		13	11	
Total	3,200	22,378	5,919	25,574	7,306	6,221	6,642	5,949	3,314	562	216	526
Mean	103	746	191	825	252	201	221	192	110	18	6.98	18
Max	209	3,130	250	6,040	440	270	293	304	322	33	12	45
Min	40	121	161	156	183	172	177	128	26	10	2.0	4.1
AC-FT	6,347	44,386	11,740	50,725	14,491	12,339	13,174	11,800	6,573	1,114	429	1,044

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1964 to Sept 1965

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	17	99	2,130	1,660	752	408	470	881	225	78	49	38
2	18	317	1,590	1,480	722	384	2,220	790	213	77	44	32
3	17	224	951	4,420	668	380	920	714	207	72	37	22
4	17	137	574	7,120	644	376	680	655	198	72	35	31
5	13	114	422	16,800	1,400	373	596	610	198	66	38	40
6	11	124	336	7,780	1,320	362	4,500	574	195	57	37	42
7	16	99	290	3,790	836	356	1,710	544	186	51	40	43
8	22	135	267	2,330	746	348	4,150	515	189	49	42	42
9	24	1,840	264	1,770	680	345	7,820	476	172	47	36	41
10	24	2,160	352	1,540	626	345	3,680	448	161	45	37	40
11	26	2,170	1,400	3,100	590	345	2,330	426	161	52	51	39
12	24	1,990	627	1,900	560	428	1,530	413	150	51	160	41
13	19	520	448	1,490	540	384	1,340	404	138	42	117	41
14	22	300	375	1,300	525	356	1,290	404	148	43	83	38
15	26	211	348	1,220	505	345	1,800	392	172	43	68	37
16	24	172	307	1,180	475	342	4,390	371	145	41	58	36
17	23	152	270	1,090	456	338	2,130	359	156	43	44	36
18	25	139	258	1,050	448	331	4,690	352	175	39	78	37
19	20	132	3,760	1,020	432	320	4,140	348	148	41	60	44
20	21	126	1,860	997	424	317	3,000	356	128	39	47	41
21	24	122	5,060	969	420	314	3,720	356	116	38	53	36
22	29	134	18,200	908	416	317	2,520	371	112	37	58	42
23	28	132	7,500	1,820	396	320	1,920	340	94	38	56	40
24	30	128	4,580	2,600	384	338	1,620	304	93	35	53	37
25	31	403	4,180	1,600	380	328	1,400	284	94	38	51	37
26	33	741	5,780	1,330	380	366	1,270	270	98	41	50	45
27	42	383	3,850	1,140	560	938	1,170	258	98	43	47	55
28	73	3,340	3,110	1,040	470	550	1,090	245	91	44	45	52
29	130	1,770	2,790	955		420	1,040	239	74	39	42	47
30	124	856	2,790	908		388	958	230	74	40	37	42
31	103		2,410	878		384		230		45	33	
Total	1,056	19,170	77,079	77,185	16,755	11,846	70,094	13,159	4,409	1,486	1,686	1,194
Mean	34	639	2,486	2,490	598	382	2,336	424	147	48	54	40
Max	130	3,340	18,200	16,800	1,400	938	7,820	881	225	78	160	55
Min	11	99	258	878	380	314	470	230	74	35	33	22
AC-FT	2,095	38,023	152,884	153,094	33,233	23,496	139,029	26,100	8,745	2,947	3,344	2,368

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1965 to Sept 1966

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	40	78	260	883	1,600	625	608	390	144	18	8.5	10
2	42	70	218	560	918	549	640	375	146	18	8.4	9.2
3	43	72	202	1,270	883	485	659	369	139	25	8.4	10
4	44	73	192	13,600	3,450	448	661	370	130	31	6.5	14
5	44	79	184	17,300	2,890	631	642	384	120	23	2.1	14
6	43	82	175	4,750	5,290	740	623	394	118	20	1.0	7.0
7	46	86	168	2,120	2,010	715	605	380	130	20	1.9	6.0
8	46	150	163	2,380	1,220	1,540	616	362	128	20	2.5	8.1
9	45	126	158	1,550	876	1,280	754	360	116	26	1.0	8.6
10	46	124	153	1,050	696	2,450	1,940	358	94	19	1.3	7.6
11	48	124	153	820	576	1,600	1,790	347	82	22	2.8	10
12	51	172	158	666	510	1,140	2,730	326	79	21	1.6	14
13	52	315	150	576	438	1,070	1,380	308	72	28	0.80	17
14	57	855	143	505	402	1,040	1,030	302	56	23	1.0	16
15	64	1,760	138	460	371	1,020	883	283	54	19	2.6	20
16	64	560	135	434	339	1,320	834	270	50	25	2.2	19
17	64	1,190	133	388	323	897	843	240	50	21	4.7	17
18	63	1,820	130	363	315	777	800	225	38	21	7.6	20
19	64	612	130	335	666	1,060	694	215	39	13	10	27
20	63	505	130	307	918	783	621	208	45	10	8.1	25
21	62	303	128	292	554	673	567	207	42	12	9.2	20
22	57	239	128	299	470	592	525	201	43	9.2	7.3	18
23	58	216	126	299	794	541	502	183	42	7.6	5.5	18
24	53	834	190	278	1,500	513	497	164	37	4.2	5.0	19
25	52	1,140	480	264	1,130	492	500	154	36	7.0	4.2	19
26	50	1,220	359	250	1,480	482	499	141	37	9.2	2.2	13
27	48	1,290	267	242	864	487	460	148	36	9.2	4.2	10
28	53	520	2,020	264	706	503	439	142	30	5.5	9.2	9.2
29	56	359	1,620	420		528	420	143	23	5.0	9.4	8.1
30	57	288	2,710	1,460		563	402	135	17	8.4	7.6	7.0
31	72		2,620	748		586		144		6.8	9.2	
Total	1,647	15,262	13,921	55,133	32,189	26,130	24,164	8,228	2,173	507	156	420
Mean	53	509	449	1,778	1,150	843	805	265	72	16	5.0	14
Max	72	1,820	2,710	17,300	5,290	2,450	2,730	394	146	31	10	27
Min	40	70	126	242	315	448	402	135	17	4.2	0.80	6.0
AC-FT	3,267	30,272	27,612	109,355	63,846	51,828	47,929	16,320	4,310	1,006	309	834

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1966 to Sept 1967

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	12	40	2,000	210	3,440	334	1,910	1,090	1,200	198	66	28
2	22	40	9,000	202	2,210	326	1,590	978	1,120	178	56	33
3	25	40	4,000	197	1,630	310	1,580	938	1,060	175	60	40
4	20	44	2,500	196	1,310	300	1,230	980	1,000	164	62	41
5	18	45	1,700	194	1,110	292	1,110	1,060	980	154	61	36
6	14	107	1,300	184	960	287	1,890	1,140	930	146	60	33
7	17	238	887	179	859	282	1,870	1,260	920	138	59	37
8	25	127	747	175	773	279	1,260	1,480	910	131	58	36
9	25	101	605	175	707	281	1,130	1,900	905	132	56	47
10	22	99	1,640	169	656	312	1,080	3,050	900	126	52	48
11	21	120	1,000	167	604	1,080	1,220	2,100	905	121	51	52
12	23	800	692	166	577	874	988	1,780	890	111	53	49
13	26	500	1,510	166	561	1,380	893	1,580	850	109	50	40
14	27	350	1,330	161	542	1,940	1,940	1,480	800	102	44	33
15	30	600	819	161	501	1,170	1,370	1,420	750	99	36	35
16	29	2,000	641	154	481	4,320	1,070	1,650	700	101	35	36
17	31	900	527	152	458	2,240	2,290	2,060	650	102	38	47
18	27	600	464	148	438	2,960	4,220	2,680	600	93	33	60
19	25	1,200	414	150	411	1,740	3,400	2,640	550	85	33	54
20	30	5,000	377	6,060	390	1,690	2,700	2,580	500	79	41	42
21	30	1,600	350	17,600	376	1,450	1,900	2,540	450	84	41	44
22	37	1,000	320	4,240	367	1,190	1,650	2,580	400	74	29	42
23	43	750	312	1,860	356	1,700	2,320	2,590	360	74	24	49
24	41	600	321	3,600	359	1,410	2,830	2,490	340	73	28	52
25	35	500	286	2,390	504	1,380	3,060	2,150	321	78	36	49
26	36	450	271	5,270	399	1,340	1,930	1,900	298	73	40	41
27	38	400	249	4,920	357	1,320	4,170	1,750	275	73	38	40
28	44	700	236	8,620	343	1,300	2,030	1,600	258	60	40	44
29	45	3,000	231	9,280		1,290	1,530	1,500	242	71	35	48
30	45	900	223	6,480		1,280	1,270	1,400	220	73	35	54
31	42		215	8,760		1,330		1,300		67	32	
Total	905	22,851	35,167	82,386	21,679	37,387	57,431	55,646	20,284	3,344	1,382	1,290
Mean	29	762	1,134	2,658	774	1,206.	1,914	1,795	676	108	45	43
Max	45	5,000	9,000	17,600	3,440	4,320	4,220	3,050	1,200	198	66	60
Min	12	40	215	148	343	279	893	938	220	60	24	28
AC-FT	1,795	45,324	69,753	163,410	43,000	74,156	113,913	110,372	40,233	6,633	2,741	2,559

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1967 to Sept 1968

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	108	76	224	157	1,170	1,150	669	245	123	29	16	33
2	256	74	164	150	3,980	1,020	675	249	116	21	18	31
3	129	73	1,450	146	2,580	933	590	244	118	17	17	26
4	123	80	1,720	140	1,510	863	551	254	120	21	16	19
5	121	88	2,200	136	1,110	858	545	249	183	27	16	21
6	110	88	479	133	969	819	522	237	265	23	13	26
7	104	88	1,670	131	891	763	488	222	234	20	11	29
8	97	95	629	134	752	727	467	218	155	17	14	33
9	92	109	349	161	734	661	456	214	137	17	11	27
10	93	110	282	3,510	718	606	445	204	125	17	11	28
11	88	108	245	1,120	640	571	465	197	114	16	14	29
12	81	106	215	604	572	934	456	214	109	15	17	29
13	73	107	183	915	513	1,720	430	324	101	20	17	29
14	72	190	144	6,550	519	1,680	413	384	97	19	27	38
15	78	189	156	9,320	508	1,760	402	277	88	23	26	39
16	75	139	163	3,600	645	4,300	378	236	81	19	27	32
17	64	126	156	1,800	7,000	2,410	349	215	65	17	32	25
18	60	121	164	1,050	2,800	1,460	333	208	63	16	31	28
19	66	206	189	766	4,040	1,090	317	214	55	13	58	31
20	73	162	174	620	7,290	909	310	325	47	15	346	31
21	90	134	162	547	6,150	802	296	283	46	13	411	38
22	92	121	156	530	5,480	740	278	279	48	17	194	40
23	85	117	157	460	8,260	707	270	280	44	10	110	35
24	89	116	176	409	4,550	666	262	253	38	10	92	31
25	95	117	203	379	2,820	735	254	233	39	9.2	75	34
26	90	120	214	353	2,150	736	251	227	34	10	77	31
27	90	117	253	332	1,740	652	248	197	29	10	74	29
28	82	126	237	321	1,450	614	238	169	26	12	69	30
29	83	142	201	1,990	1,270	603	237	157	21	13	51	29
30	78	260	182	3,900		603	233	138	24	14	42	34
31	74		166	1,880		606		133		13	39	
Total	2,911	3,705	13,063	42,244	72,811	32,698	11,828	7,279	2,745	513	1,972	915
Mean	94	124	421	1,363	2,511	1,055	394	235	92	17	64	31
Max	256	260	2,200	9,320	8,260	4,300	675	384	265	29	411	40
Min	60	73	144	131	508	571	233	133	21	9.2	11	19
AC-FT	5,774	7,349	25,910	83,790	144,418	64,856	23,460	14,438	5,445	1,017	3,911	1,815

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1968 to Sept 1969

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	36	136	341	1,070	1,600	4,390	1,180	1,000	514	151	63	43
2	39	234	370	1,160	1,400	3,060	1,090	974	491	142	64	35
3	37	533	253	1,280	1,300	2,590	1,100	949	463	138	68	37
4	31	349	215	1,330	1,200	1,840	950	875	458	133	63	39
5	33	237	198	1,230	3,900	1,550	2,590	866	442	129	54	45
6	37	184	190	1,070	4,100	1,380	3,000	937	423	121	58	44
7	39	158	179	945	2,430	1,190	1,630	1,050	406	122	60	46
8	33	141	248	821	1,900	1,080	1,310	1,110	392	98	57	47
9	32	135	322	700	5,110	980	1,160	1,150	427	100	58	44
10	36	131	6,110	632	4,880	910	1,060	1,210	433	104	58	39
11	43	131	2,230	6,830	6,990	834	1,000	1,240	448	111	58	39
12	112	524	980	18,900	7,170	789	1,020	1,230	411	107	45	45
13	349	268	672	20,000	3,190	736	1,030	1,210	373	111	51	46
14	328	207	5,240	5,700	4,710	696	976	1,120	342	106	53	47
15	237	511	4,820	2,680	6,930	684	898	998	320	92	47	46
16	152	646	2,120	2,000	4,630	680	861	927	283	90	50	49
17	126	450	1,040	1,770	2,700	804	871	888	266	91	52	49
18	111	634	711	1,940	2,480	952	1,130	894	264	90	48	54
19	103	592	557	8,320	1,920	847	1,030	848	276	81	54	64
20	102	345	446	9,880	1,740	792	1,020	789	261	75	59	67
21	101	259	365	9,790	1,600	754	1,060	744	234	84	45	71
22	97	231	329	5,860	1,380	722	1,130	724	216	84	43	64
23	88	222	420	3,240	2,180	713	1,460	712	208	79	39	57
24	86	248	5,100	2,450	3,520	690	1,420	714	197	89	46	55
25	87	359	7,840	3,300	3,560	700	1,110	692	189	85	52	62
26	86	265	4,400	4,900	2,780	709	972	690	182	85	36	58
27	87	218	2,340	3,380	2,410	735	915	666	179	81	36	55
28	86	196	6,030	2,800	6,550	776	904	610	175	78	41	56
29	130	184	3,550	2,050		826	952	562	169	73	45	65
30	318	222	1,960	1,990		887	975	546	158	68	48	62
31	176		1,350	1,670		1,010		526		66	46	
Total	3,358	8,950	60,926	129,688	94,260	35,306	35,804	27,451	9,600	3,064	1,597	1,530
Mean	108	298	1,965	4,183	3,366	1,139	1,193	886	320	99	52	51
Max	349	646	7,840	20,000	7,170	4,390	3,000	1,240	514	151	68	71
Min	31	131	179	632	1,200	680	861	526	158	66	36	35
AC-FT	6,660	17,752	120,845	257,232	186,962	70,028	71,016	54,448	19,041	6,077	3,168	3,035

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1969 to Sept 1970

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	60	87	134	475	1,570	5,240	451	224	136	73	33	35
2	58	90	135	406	1,360	2,000	431	219	130	73	28	35
3	56	98	134	365	1,240	1,000	420	209	125	68	33	38
4	61	130	131	329	1,130	1,350	403	205	124	69	30	31
5	72	460	132	288	1,010	1,250	384	198	120	71	27	37
6	71	500	132	264	940	980	377	210	108	59	25	39
7	76	330	133	252	900	1,480	364	222	96	54	23	33
8	73	240	157	329	870	2,000	348	224	103	50	29	34
9	93	200	184	8,850	860	1,550	339	274	140	50	30	35
10	86	180	177	6,350	829	1,800	337	261	262	51	28	32
11	79	165	363	3,160	789	1,500	306	243	191	51	26	34
12	79	170	6,000	3,910	932	1,200	302	255	147	44	28	31
13	81	160	4,480	4,510	2,190	1,100	300	246	134	45	32	28
14	93	155	1,510	9,100	1,580	1,000	314	219	154	37	28	29
15	169	150	921	5,130	1,090	950	307	194	155	35	25	30
16	398	150	570	16,100	2,210	926	311	195	131	36	22	32
17	358	145	525	7,240	2,850	864	310	195	119	34	22	29
18	209	145	750	5,180	1,600	794	298	189	108	27	16	36
19	178	145	20,500	5,730	1,260	754	301	195	99	30	16	50
20	152	140	13,600	6,390	1,100	722	285	188	92	35	19	43
21	142	140	10,700	14,500	992	688	261	187	89	30	25	41
22	137	140	3,630	10,800	908	662	254	171	79	32	33	37
23	137	142	6,220	17,700	836	636	249	162	70	32	35	25
24	136	139	4,140	15,900	802	604	240	163	67	32	28	33
25	135	138	3,060	6,060	744	571	249	153	73	32	25	37
26	135	136	1,900	5,270	714	553	261	146	74	25	24	36
27	135	138	1,330	8,190	690	532	276	147	78	35	27	39
28	130	135	992	3,630	1,170	518	261	146	88	36	28	40
29	130	134	782	2,820		495	246	148	132	28	30	39
30	117	135	642	2,260		483	234	141	101	30	25	32
31	98		546	1,880		467		142		32	29	
Total	3,934	5,217	84,610	173,368	33,166	34,669	9,419	6,071	3,525	1,336	829	1,050
Mean	127	174	2,729	5,593	1,185	1,118	314	196	118	43	27	35
Max	398	500	20,500	17,700	2,850	5,240	451	274	262	73	35	50
Min	56	87	131	252	690	467	234	141	67	25	16	25
AC-FT	7,803	10,348	167,821	343,870	65,784	68,765	18,682	12,042	6,992	2,650	1,644	2,083

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1970 to Sept 1971

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	31	124	2,400	1,040	652	366	1,210	619	633	233	70	68
2	36	121	3,550	924	639	356	1,100	612	594	216	70	66
3	40	121	3,030	717	609	356	1,020	756	516	207	69	57
4	45	142	11,200	633	585	356	966	937	519	195	69	55
5	46	1,100	3,410	585	567	343	932	828	480	186	64	52
6	44	1,580	2,360	549	549	334	929	750	457	174	63	52
7	49	1,130	4,810	525	520	330	1,020	715	443	163	57	50
8	55	712	5,560	503	503	325	966	815	429	147	67	44
9	53	5,350	3,590	498	492	316	895	825	420	136	66	59
10	53	1,550	1,950	1,710	476	321	1,590	751	446	131	59	62
11	53	1,080	1,360	3,090	476	356	1,030	728	413	129	57	59
12	51	1,170	1,070	2,250	498	8,240	901	794	389	126	52	57
13	50	617	932	1,350	508	2,750	864	797	377	120	53	55
14	50	436	828	1,210	514	1,850	828	765	350	111	52	44
15	54	342	932	2,860	525	1,800	818	707	313	104	49	39
16	58	288	2,180	15,700	525	1,280	808	660	289	99	61	41
17	54	252	3,340	7,080	508	1,240	837	603	278	96	53	42
18	65	227	2,030	3,890	492	932	740	549	277	95	52	42
19	88	208	1,270	2,840	597	828	688	533	276	97	50	42
20	132	196	1,580	2,180	492	766	726	516	264	93	49	38
21	191	190	3,710	1,670	455	717	759	492	239	83	49	41
22	238	211	1,590	1,370	445	690	674	466	221	79	52	44
23	241	282	1,120	1,190	430	2,620	630	457	213	77	47	42
24	367	1,620	916	1,070	420	3,540	600	460	204	75	49	52
25	186	3,360	773	940	405	6,390	574	478	200	74	47	62
26	150	1,290	710	852	385	10,000	569	699	294	76	41	70
27	135	1,320	788	788	385	3,860	564	602	631	74	53	88
28	130	10,400	1,220	745	385	2,450	571	767	419	74	55	86
29	126	5,510	3,380	704		1,930	588	617	297	73	58	112
30	128	2,960	1,670	678		1,640	615	580	254	72	61	301
31	125		1,230	664		1,370		557		70	70	
Total	3,124	43,889	74,489	60,805	14,037	58,652	25,012	20,435	11,135	3,685	1,764	1,922
Mean	101	1,463	2,403	1,961	501	1,892	834	659	371	119	57	64
Max	367	10,400	11,200	15,700	652	10,000	1,590	937	633	233	70	301
Min	31	121	710	498	385	316	564	457	200	70	41	38
AC-FT	6,196	87,053	147,747	120,605	27,842	116,334	49,611	40,532	22,086	7,309	3,499	3,812

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1971 to Sept 1972

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	163	124	221	277	473	2,180	536	336	170	59	18	21
2	131	129	238	265	399	2,430	543	323	168	48	19	20
3	120	125	531	249	363	3,800	533	312	162	42	20	20
4	110	125	418	227	397	2,530	506	309	150	44	19	20
5	103	124	324	218	495	1,830	664	309	145	48	19	23
6	94	123	399	208	693	1,460	986	316	145	44	25	27
7	88	124	296	204	720	1,210	739	333	147	42	27	24
8	80	119	224	198	499	1,060	641	395	147	45	16	22
9	80	126	202	188	422	977	592	331	165	35	14	22
10	75	128	202	183	368	1,120	554	301	210	34	18	25
11	74	159	204	179	329	1,050	758	279	155	40	17	30
12	70	244	429	175	305	984	1,870	259	135	36	19	28
13	70	311	484	174	285	953	1,430	257	123	29	18	23
14	77	260	308	171	273	925	921	256	112	28	20	22
15	82	170	254	171	260	830	783	256	107	29	20	23
16	98	153	216	169	247	794	713	255	104	26	27	24
17	103	146	200	167	237	777	655	264	100	25	40	25
18	105	141	197	167	230	750	603	246	89	25	41	27
19	105	139	193	189	226	706	568	245	90	24	38	29
20	124	141	185	264	239	639	539	326	73	29	30	31
21	125	142	187	3,300	283	604	510	427	69	29	23	35
22	118	140	4,380	4,470	322	799	475	308	67	30	19	30
23	127	138	1,350	3,020	1,810	1,200	433	271	66	28	16	37
24	142	138	1,210	1,220	3,990	842	601	248	84	26	30	37
25	128	141	1,120	1,300	1,540	1,410	500	234	78	23	25	37
26	123	161	997	1,120	3,390	969	433	213	71	22	22	65
27	127	320	677	1,000	1,820	815	406	202	62	28	21	46
28	122	672	463	777	2,600	721	389	199	63	27	21	99
29	116	764	392	664	4,610	648	368	191	60	24	20	103
30	118	309	364	559		595	350	178	58	32	22	88
31	123		309	522		558		168		29	21	
Total	3,321	6,036	17,174	21,995	27,825	36,166	19,599	8,547	3,375	1,030	705	1,063
Mean	107	201	554	710	959	1,167	653	276	113	33	23	35
Max	163	764	4,380	4,470	4,610	3,800	1,870	427	210	59	41	103
Min	70	119	185	167	226	558	350	168	58	22	14	20
AC-FT	6,587	11,972	34,064	43,626	55,190	71,734	38,874	16,953	6,694	2,043	1,398	2,108

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1972 to Sept 1973

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	81	117	908	520	1,510	2,940	778	580	381	75	26	40
2	75	119	522	466	1,180	2,040	670	550	306	75	30	42
3	69	203	357	423	1,040	2,830	618	536	275	74	35	39
4	61	1,930	399	381	2,960	2,400	590	536	257	72	31	36
5	64	668	390	350	3,400	1,700	585	518	235	70	28	33
6	62	325	435	330	2,310	3,200	590	500	206	59	29	35
7	62	511	455	310	4,310	2,100	585	492	185	62	27	36
8	66	637	389	320	2,270	1,500	574	487	177	56	28	42
9	111	324	316	6,800	2,940	1,120	568	475	168	64	33	41
10	166	810	312	3,700	4,250	1,600	580	455	153	58	36	38
11	194	2,460	250	9,800	2,530	2,190	590	450	153	54	37	35
12	278	665	258	5,800	3,260	1,300	612	444	154	56	33	31
13	192	927	252	3,600	1,950	1,120	640	448	153	52	30	36
14	187	4,210	250	2,550	4,000	922	634	472	148	55	24	36
15	318	1,600	250	4,400	2,560	830	618	468	146	51	28	38
16	339	2,090	255	13,600	1,760	766	612	469	144	53	22	37
17	347	783	6,700	6,020	1,410	877	949	464	147	54	25	40
18	227	584	5,200	7,430	1,160	717	758	449	143	55	32	44
19	174	1,200	4,700	3,330	989	690	676	443	124	52	36	47
20	155	726	2,590	2,180	869	3,040	618	421	113	49	34	113
21	141	475	2,050	1,980	776	3,320	580	389	107	49	32	110
22	135	350	3,930	1,500	707	2,190	568	360	101	46	33	90
23	129	284	2,520	1,230	656	1,480	580	335	100	49	32	149
24	121	251	2,590	1,090	1,170	1,170	582	512	115	55	35	167
25	115	237	1,720	1,630	1,430	1,020	591	1,090	106	47	40	143
26	115	218	1,160	1,360	2,800	921	622	604	93	48	44	110
27	116	202	1,130	1,040	5,690	830	659	488	87	42	48	95
28	115	194	1,070	911	3,470	765	690	424	77	39	45	89
29	115	188	785	1,400		700	679	375	74	34	38	84
30	114	184	672	2,630		907	623	341	77	40	37	85
31	116		596	2,410		1,120		339		34	40	
Total	4,560	23,472	43,411	89,491	63,357	48,305	19,019	14,914	4,705	1,679	1,028	1,961
Mean	147	782	1,400	2,887	2,263	1,558	634	481	157	54	33	65
Max	347	4,210	6,700	13,600	5,690	3,320	949	1,090	381	75	48	167
Min	61	117	250	310	656	690	568	335	74	34	22	31
AC-FT	9,045	46,556	86,104	177,503	125,667	95,812	37,724	29,581	9,332	3,330	2,039	3,890

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1973 to Sept 1974

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	83	123	10,100	1,880	3,200	5,150	10,100	750	443	136	86	78
2	84	122	2,950	1,520	1,800	3,970	4,820	774	427	137	90	77
3	73	121	1,820	1,360	1,440	3,370	3,160	768	429	137	86	66
4	69	124	1,410	1,200	1,280	1,890	2,300	744	420	128	85	63
5	68	160	1,170	1,150	1,150	1,560	1,910	747	408	129	95	61
6	73	878	1,000	1,130	1,050	2,170	1,780	754	389	126	115	63
7	309	3,220	917	1,050	999	11,600	1,440	763	367	126	98	63
8	344	1,720	854	1,000	941	3,630	1,240	786	343	272	91	64
9	226	2,300	740	938	899	2,430	1,530	804	320	311	84	63
10	172	3,250	680	887	859	1,970	1,240	758	313	310	81	65
11	141	9,590	1,970	853	821	3,240	1,080	723	300	250	86	63
12	130	8,770	1,370	2,350	864	2,570	988	708	301	214	82	61
13	127	3,810	2,480	5,020	970	2,070	917	668	297	185	86	58
14	127	2,430	2,360	8,530	830	1,680	868	624	296	173	86	57
15	122	1,640	1,440	22,900	777	1,480	847	597	279	156	84	51
16	118	4,350	1,160	22,300	875	1,330	828	572	280	143	81	59
17	114	4,380	1,810	9,400	800	1,390	828	558	295	131	85	56
18	112	5,170	1,400	11,800	1,050	1,300	847	552	269	130	81	63
19	115	2,100	1,130	11,700	5,400	1,180	810	513	267	121	82	63
20	123	1,510	1,060	4,970	1,750	1,100	768	478	286	117	78	59
21	134	1,430	4,570	3,350	1,410	1,030	756	454	246	107	82	55
22	188	1,710	3,160	2,610	1,390	992	762	438	219	111	71	58
23	421	1,370	1,960	2,180	1,110	954	804	430	204	109	75	63
24	270	1,440	1,570	1,890	995	923	980	433	204	99	73	68
25	196	1,080	1,300	1,690	920	1,140	1,010	437	192	97	71	63
26	162	935	1,420	1,540	904	1,540	828	447	185	96	68	65
27	148	774	4,490	1,410	920	1,800	756	482	172	94	65	68
28	140	713	7,160	1,320	2,960	2,450	714	510	173	95	71	71
29	130	698	11,100	1,240		11,600	702	508	167	97	75	67
30	125	7,310	3,700	1,160		10,700	714	484	155	89	77	77
31	125		2,460	2,620		4,730		462		86	75	
Total	4,769	73,228	80,711	132,948	38,364	92,939	46,327	18,726	8,646	4,512	2,545	1,908
Mean	154	2,441	2,604	4,289	1,370	2,998	1,544	604	288	146	82	64
Max	421	9,590	11,100	22,900	5,400	11,600	10,100	804	443	311	115	78
Min	68	121	680	853	777	923	702	430	155	86	65	51
AC-FT	9,459	145,246	160,088	263,698	76,094	184,342	91,888	37,142	17,149	8,949	5,048	3,784

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1974 to Sept 1975

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	77	234	155	213	1,360	481	820	727	558	153	62	72
2	77	171	169	200	2,540	529	741	714	535	137	68	70
3	83	157	1,310	190	1,180	490	834	884	523	128	64	68
4	76	154	1,960	189	1,350	461	1,060	893	492	126	53	64
5	69	151	444	195	986	444	1,700	744	478	132	55	55
6	74	151	289	1,220	1,450	549	1,470	668	469	125	52	53
7	74	174	238	2,070	4,330	1,250	1,240	648	461	118	54	49
8	71	283	214	3,910	4,200	1,500	1,390	666	410	113	56	51
9	83	191	196	863	4,650	1,380	1,150	695	370	100	59	53
10	87	170	186	509	2,300	1,210	998	716	350	87	58	56
11	84	164	179	381	1,710	949	894	745	338	80	50	61
12	77	160	188	311	8,490	754	809	765	313	78	47	60
13	73	157	241	273	11,800	955	757	810	298	74	46	60
14	78	154	201	250	3,180	924	1,010	851	287	74	45	58
15	78	154	199	233	1,790	729	1,210	886	266	96	50	62
16	79	151	189	220	1,260	1,100	867	841	253	156	52	59
17	77	151	182	209	956	2,100	741	827	233	127	55	54
18	76	171	177	202	792	8,860	667	827	226	108	129	55
19	84	172	171	197	2,920	10,800	1,100	826	222	102	165	58
20	86	161	168	192	2,330	3,130	848	752	217	96	120	62
21	85	167	168	184	1,230	3,800	739	643	210	84	96	57
22	87	209	172	178	902	3,980	705	592	198	83	81	58
23	85	176	161	175	747	2,250	819	568	191	75	76	59
24	93	163	156	172	652	4,740	1,220	570	195	74	64	57
25	96	180	156	171	584	8,920	1,640	553	226	67	55	54
26	98	191	154	173	528	2,950	1,190	531	208	65	50	54
27	113	171	1,480	174	497	1,980	989	521	194	56	55	56
28	270	163	1,200	163	479	1,480	870	527	183	60	89	51
29	253	160	399	158		1,200	800	539	173	59	96	53
30	180	157	287	153		1,050	759	546	163	63	80	50
31	273		239	172		937		549		67	72	
Total	3,196	5,168	11,628	13,900	65,193	71,882	30,037	21,624	9,240	2,963	2,154	1,729
Mean	103	172	375	448	2,328	2,319	1,001	698	308	96	69	58
Max	273	283	1,960	3,910	11,800	10,800	1,700	893	558	156	165	72
Min	69	151	154	153	479	444	667	521	163	56	45	49
AC-FT	6,339	10,251	23,064	27,570	129,308	142,576	59,577	42,891	18,327	5,877	4,272	3,429

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1975 to Sept 1976

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	46	289	151	156	127	3,310	295	280	91	22	8.7	20
2	53	221	152	153	128	2,240	244	275	91	22	13	24
3	53	191	148	153	129	2,240	224	273	83	21	15	25
4	57	175	158	154	123	1,430	220	262	79	21	21	27
5	57	168	2,010	156	118	978	216	258	77	21	19	27
6	57	165	1,600	157	116	754	231	237	62	20	15	27
7	111	181	556	152	125	629	284	235	60	18	20	22
8	112	216	391	153	125	561	1,720	242	54	17	20	20
9	103	178	314	220	125	494	1,080	246	55	17	20	18
10	270	174	275	207	125	444	662	242	65	16	13	22
11	412	182	248	176	120	406	636	238	70	15	13	26
12	231	165	353	168	121	369	1,420	221	81	16	13	37
13	162	160	306	164	125	345	1,030	209	84	15	12	37
14	138	157	246	155	154	333	688	205	77	15	50	34
15	134	291	221	157	218	318	574	193	62	15	330	48
16	127	1,210	213	154	846	305	497	181	47	14	170	63
17	120	464	208	153	1,040	302	448	172	37	13	72	65
18	122	311	197	149	503	314	424	168	36	13	80	62
19	118	248	190	145	418	336	394	154	34	12	122	51
20	112	235	184	144	327	287	383	142	32	12	88	48
21	116	226	181	142	259	273	371	135	32	11	71	46
22	125	203	231	141	227	263	365	115	34	10	66	43
23	122	188	234	141	208	260	360	115	32	10	71	41
24	116	176	203	141	195	260	348	114	30	10	65	42
25	136	167	192	138	359	293	342	107	29	10	56	39
26	898	164	184	136	1,390	252	323	98	27	10	42	37
27	358	164	180	135	1,900	242	303	88	26	8.6	35	39
28	218	160	175	134	6,250	233	298	76	26	7.8	34	48
29	183	154	172	136	10,000	224	285	73	25	7.4	31	54
30	1,680	151	169	133		216	279	79	23	6.4	20	52
31	554		163	130		227		88		6.6	21	
Total	7,101	7,134	10,205	4,733	25,901	19,138	14,944	5,521	1,561	432	1,627	1,144
Mean	229	238	329	153	893	617	498	178	52	14	52	38
Max	1,680	1,210	2,010	220	10,000	3,310	1,720	280	91	22	330	65
Min	46	151	148	130	116	216	216	73	23	6.4	8.7	18
AC-FT	14,085	14,150	20,241	9,388	51,374	37,960	29,641	10,951	3,096	857	3,227	2,269

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1976 to Sept 1977

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	52	57	84	108	87	116	94	59	55	1.0	0.40	0.60
2	56	57	84	284	87	104	86	61	46	3.5	0.45	0.41
3	65	53	83	376	86	97	83	62	39	2.3	0.30	0.40
4	68	49	83	156	86	91	83	64	30	1.2	0.30	0.45
5	55	47	79	122	86	86	68	64	24	1.3	0.45	0.50
6	44	53	78	113	86	85	64	62	21	1.2	0.45	1.5
7	40	54	78	101	83	88	66	68	19	0.67	0.45	1.0
8	43	56	81	98	98	88	72	64	19	1.0	0.40	0.80
9	42	55	87	93	149	112	145	73	21	1.8	0.14	0.90
10	42	60	81	94	114	136	139	119	20	0.65	0.86	1.1
11	37	65	81	94	100	103	105	740	31	0.49	0.70	1.0
12	36	69	81	105	96	98	91	563	34	0.46	0.60	1.0
13	39	71	79	103	92	100	79	261	26	0.42	0.50	1.0
14	37	109	82	98	89	102	66	187	17	0.31	0.19	1.0
15	36	163	81	97	88	115	66	151	14	0.30	0.48	1.4
16	38	113	78	96	88	144	58	128	8.2	0.29	0.35	0.80
17	36	98	79	95	84	140	54	112	7.3	0.28	0.60	88
18	36	91	77	96	74	137	52	103	11	0.27	0.86	74
19	36	95	77	97	70	116	48	104	23	0.26	0.77	72
20	41	92	81	98	71	106	42	95	23	0.26	1.7	278
21	45	88	82	100	101	101	38	75	14	0.25	1.7	135
22	46	90	82	97	169	98	34	67	12	0.25	1.6	78
23	45	90	83	94	152	108	33	98	8.6	0.20	1.4	60
24	49	89	83	91	197	208	29	120	8.1	0.15	0.70	59
25	48	86	82	89	132	258	31	100	4.7	0.08	0.70	55
26	46	81	81	88	115	163	38	99	2.1	0.08	0.70	52
27	48	78	81	88	107	134	29	130	1.0	0.06	1.2	48
28	47	79	80	88	102	117	27	127	0.80	0.04	1.6	63
29	52	81	81	85		108	31	101	2.8	0.02	1.0	116
30	56	84	100	84		102	38	86	1.8	0.20	0.85	127
31	56		112	86		95		70		0.30	0.70	
Total	1,417	2,353	2,561	3,514	2,889	3,656	1,889	4,213	544	20	23	1,319
Mean	46	78	83	113	103	118	63	136	18	0.63	0.74	44
Max	68	163	112	376	197	258	145	740	55	3.5	1.7	278
Min	36	47	77	84	70	85	27	59	0.8	0.02	0.14	0.40
AC-FT	2,811	4,667	5,080	6,970	5,730	7,252	3,747	8,356	1,080	39	46	2,616

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1977 to Sept 1978

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	97	70	128	650	519	823	3,230	1,090	279	102	32	39
2	77	61	119	744	1,800	2,070	2,150	949	274	92	29	41
3	67	59	110	1,200	1,280	4,640	1,460	876	257	92	27	37
4	57	59	108	1,190	865	12,100	3,350	814	256	90	27	39
5	52	86	106	3,390	3,000	7,040	1,810	760	246	84	26	40
6	53	104	106	2,100	9,640	3,910	5,980	711	234	81	26	69
7	52	83	106	1,210	9,050	2,420	3,170	677	226	76	24	75
8	51	75	104	2,140	4,180	8,550	1,930	636	221	84	25	62
9	48	68	100	16,700	4,140	5,580	1,480	620	217	84	20	73
10	40	68	94	6,790	2,220	3,100	1,280	621	209	75	20	128
11	31	68	114	2,840	1,620	4,320	1,170	608	204	64	20	140
12	29	67	325	2,250	2,210	2,470	1,060	582	190	57	22	94
13	28	65	360	3,980	3,180	1,850	1,240	572	182	59	25	73
14	23	70	8,340	9,760	2,030	1,540	1,800	581	176	57	27	71
15	26	74	4,910	6,690	2,030	1,330	2,510	776	169	53	24	68
16	26	73	1,690	6,130	1,410	1,160	2,120	689	177	47	25	63
17	23	71	5,570	4,000	1,160	1,050	1,640	580	165	48	23	53
18	24	70	1,430	3,220	992	965	1,210	532	147	49	20	56
19	23	67	715	5,770	874	892	1,910	498	138	44	21	57
20	21	69	502	2,870	801	840	3,400	471	133	41	22	54
21	24	110	408	1,930	739	854	1,790	446	128	35	25	56
22	23	379	1,730	1,550	691	1,210	1,330	433	123	39	53	56
23	22	944	4,880	1,200	655	1,710	1,150	419	122	37	48	54
24	30	623	1,190	973	629	1,420	1,060	404	119	39	40	52
25	33	462	739	843	612	1,060	3,270	386	112	32	42	53
26	36	339	567	761	1,640	922	3,180	359	109	34	39	52
27	42	286	900	684	1,640	851	1,910	329	112	37	41	54
28	42	201	839	624	989	802	1,500	322	121	35	38	59
29	56	160	1,360	576		775	1,310	317	123	34	37	53
30	72	139	1,530	533		754	1,170	298	114	34	34	52
31	92		893	502		921		282		32	33	
Total	1,320	5,070	40,073	93,800	60,596	77,929	61,570	17,638	5,283	1,767	915	1,873
Mean	43	169	1,293	3,026	2,164	2,514	2,052	569	176	57	30	62
Max	97	944	8,340	16,700	9,640	12,100	5,980	1,090	279	102	53	140
Min	21	59	94	502	519	754	1,060	282	109	32	20	37
AC-FT	2,618	10,056	79,484	186,049	120,190	154,570	122,122	34,984	10,479	3,505	1,815	3,715

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1978 to Sept 1979

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	47	59	124	95	140	3,350	609	1,070	205	38	12	73
2	44	65	133	99	135	1,610	551	889	194	37	10	68
3	39	69	115	97	135	1,330	509	733	188	37	11	63
4	37	68	109	98	135	1,090	478	695	182	44	11	55
5	38	68	108	99	135	881	467	1,540	154	47	12	52
6	38	72	106	97	133	803	491	1,530	142	47	8.0	48
7	42	67	102	101	133	793	509	1,810	126	48	9.1	32
8	44	65	100	432	133	766	462	1,200	114	46	12	27
9	50	61	109	770	135	713	461	991	113	40	10	26
10	47	56	108	1,100	133	654	451	821	107	34	10	25
11	45	67	106	5,770	150	609	432	719	101	36	11	23
12	46	81	105	1,130	188	576	418	657	87	35	12	17
13	41	107	104	539	9,770	550	416	618	76	32	11	16
14	39	106	101	2,590	10,300	534	439	611	71	27	11	15
15	41	100	98	5,650	2,040	824	438	586	72	27	18	12
16	51	99	98	1,320	3,350	1,250	502	577	76	19	14	14
17	52	101	116	686	1,480	1,030	800	539	80	20	13	14
18	49	103	213	457	3,610	1,730	679	505	83	21	13	14
19	45	125	139	346	1,930	1,190	510	496	84	22	16	15
20	51	427	116	298	4,460	846	462	478	78	23	20	16
21	55	334	109	267	5,640	702	437	465	78	19	23	19
22	54	274	108	239	4,640	665	443	456	73	19	21	20
23	51	182	104	217	3,850	580	585	437	69	18	25	19
24	52	148	103	204	2,210	522	1,610	393	63	20	22	15
25	49	133	105	192	1,300	496	868	367	60	20	17	22
26	54	124	104	176	1,570	487	712	349	57	18	19	38
27	48	119	103	162	998	1,180	1,000	317	54	19	10	40
28	51	117	101	156	4,980	1,070	742	296	47	23	17	32
29	55	116	97	146		902	655	269	42	18	54	30
30	54	114	88	146		1,050	610	246	37	17	95	31
31	57		91	147		723		223		13	111	
Total	3,477	3,627	3,423	23,826	63,813	29,506	17,746	20,883	2,913	884	658	891
Mean	112	121	110	769	2,279	952	592	674	97	29	21	30
Max	2,060	427	213	5,770	10,300	3,350	1,610	1,810	205	48	111	73
Min	37	56	88	95	133	487	416	223	37	13	8.0	12
AC-FT	6,897	7,194	6,789	47,258	126,571	58,524	35,199	41,421	5,778	1,753	1,305	1,767

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1979 to Sept 1980

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	30	164	292	2,910	576	1,740	458	438	200	80	28	40
2	29	152	268	1,570	550	1,580	445	417	201	74	30	33
3	28	171	254	1,100	1,610	1,710	433	405	201	83	32	31
4	28	665	234	856	1,000	2,030	450	384	217	87	33	31
5	27	1,070	214	756	759	4,410	885	380	256	84	31	31
6	30	707	199	709	702	3,130	734	377	233	77	31	31
7	32	399	191	616	627	2,070	564	362	214	72	31	30
8	34	296	185	595	591	1,640	510	356	196	71	32	26
9	36	242	177	1,110	559	1,380	515	448	184	69	29	27
10	38	208	169	1,820	533	1,210	525	555	170	71	31	33
11	34	186	159	3,260	513	1,100	470	437	169	67	27	36
12	42	172	154	7,770	493	974	450	411	201	60	28	36
13	49	158	149	10,900	474	898	439	408	236	58	30	40
14	49	151	146	10,900	477	2,630	438	421	214	57	34	63
15	90	145	144	9,620	1,080	3,150	430	385	190	56	34	67
16	164	310	141	6,430	2,320	1,470	422	354	170	52	36	59
17	94	2,200	136	5,790	7,450	1,200	425	330	152	52	35	53
18	81	704	134	3,580	6,090	1,100	433	317	142	52	29	68
19	227	415	136	2,460	11,400	941	459	303	133	54	29	97
20	382	318	188	1,890	9,940	862	509	292	129	48	34	80
21	247	270	850	1,510	6,520	800	744	284	128	48	34	78
22	174	330	458	1,250	5,030	734	593	284	124	42	35	76
23	164	719	3,740	1,100	3,480	687	550	286	121	38	38	74
24	172	2,980	15,900	992	2,410	643	535	281	125	34	40	72
25	2,060	1,750	8,430	909	1,920	628	514	266	115	36	36	65
26	1,040	1,630	3,140	837	1,630	600	498	251	100	37	36	59
27	385	730	1,430	793	1,540	564	495	241	98	36	36	55
28	270	509	976	733	4,410	529	494	228	94	35	33	50
29	212	399	738	687	2,180	506	482	225	89	31	30	48
30	185	331	3,200	621		489	461	214	86	32	38	45
31	174		7,130	602		468		214		29	41	
Total	6,607	18,481	49,662	84,676	76,864	41,873	15,360	10,554	4,888	1,722	1,021	1,534
Mean	213	616	1,602	2,731	2,650	1,351	512	340	163	56	33	51
Max	2,060	2,980	15,900	10,900	11,400	4,410	885	555	256	87	41	97
Min	27	145	134	595	474	468	422	214	86	29	27	26
AC-FT	13,105	36,657	98,503	167,952	152,457	83,054	30,466	20,934	9,695	3,416	2,025	3,043

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1980 to Sept 1981

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	42	94	159	165	693	677	1,380	321	101	16	12	7.4
2	40	95	504	161	537	579	951	309	99	18	15	10
3	37	93	4,180	162	454	508	789	281	98	18	14	13
4	36	90	2,230	191	408	2,550	695	266	96	17	7.7	11
5	36	92	637	170	389	1,660	621	254	89	20	10	15
6	35	90	368	160	393	934	582	230	88	22	10	12
7	35	87	279	154	350	718	543	216	74	25	7.2	11
8	39	131	229	144	318	611	515	205	73	24	6.3	8.2
9	42	115	208	143	308	527	488	197	87	16	5.9	12
10	43	105	193	140	288	473	464	184	70	12	3.5	14
11	47	103	182	136	486	429	446	158	62	17	1.1	14
12	93	102	176	135	477	406	424	146	69	21	2.6	18
13	156	99	168	131	2,310	926	405	140	66	16	6.9	15
14	247	98	162	130	7,010	575	391	139	65	17	10	16
15	152	92	157	129	1,860	1,190	388	141	58	17	12	14
16	123	96	155	136	1,240	3,070	379	146	59	14	13	10
17	110	95	153	419	1,320	1,270	363	147	56	13	12	10
18	103	95	151	437	914	1,200	352	381	53	12	8.8	12
19	100	99	148	401	819	2,910	615	493	47	8.8	10	15
20	98	92	145	514	875	2,350	603	339	48	7.3	13	16
21	96	97	191	662	677	5,700	448	247	46	5.8	9.2	17
22	92	103	350	1,010	592	3,900	407	217	34	11	13	16
23	87	109	225	2,230	546	2,070	395	205	27	13	15	16
24	86	115	193	1,580	1,390	1,370	391	189	25	11	14	21
25	86	103	190	751	3,580	5,560	389	203	27	10	15	39
26	121	97	205	992	1,490	3,950	609	218	27	14	17	48
27	109	97	189	7,130	1,100	2,020	514	198	19	12	13	56
28	96	97	205	4,190	824	1,470	403	152	16	11	11	130
29	92	104	189	3,420		1,210	365	143	17	8.2	12	99
30	92	165	177	1,790		1,020	345	129	19	8.1	9.1	58
31	93		170	974		963		115		10	7.1	
Total	2,664	3,050	12,868	28,887	31,648	52,796	15,660	6,709	1,715	444	316	754
Mean	86	102	415	932	1,130	1,703	522	216	57	14	10	25
Max	247	165	4,180	7,130	7,010	5,700	1,380	493	101	25	17	130
Min	35	87	145	129	288	406	345	115	16	5.8	1.1	7.4
AC-FT	5,284	6,050	25,523	57,296	62,773	104,719	31,061	13,307	3,402	881	626	1,495

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Streamflow (cfs), Water Year Oct 1981 to Sept 1982

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	43	170	837	4,240	1,010	3,260	4,340	932	344	357	71	58
2	40	150	733	2,720	891	5,090	3,760	915	356	321	71	60
3	47	134	641	2,020	852	2,430	3,460	880	344	391	70	60
4	46	123	576	2,970	767	1,790	2,430	850	364	259	70	62
5	50	116	533	3,560	683	1,440	1,970	816	372	219	70	60
6	51	111	630	2,120	634	1,240	1,770	788	334	200	70	58
7	200	106	1,200	1,550	602	1,130	1,540	784	318	182	69	56
8	200	104	833	1,340	568	1,110	1,330	769	295	166	73	55
9	121	104	2,380	1,300	534	1,070	1,190	724	274	155	72	55
10	180	107	2,970	1,300	516	1,690	2,040	682	261	141	67	56
11	344	112	1,360	1,240	493	2,260	5,900	649	243	124	67	55
12	190	156	1,730	1,140	465	1,580	2,880	625	260	111	69	55
13	137	927	4,830	1,020	3,040	1,370	2,170	607	273	111	67	56
14	117	1,630	5,490	953	9,720	3,920	3,620	598	254	99	63	52
15	106	8,420	3,700	872	12,100	2,130	2,230	587	227	99	63	53
16	98	19,500	2,260	813	9,880	2,340	1,760	559	206	87	62	59
17	91	4,470	1,640	764	4,630	2,280	1,520	566	199	81	62	70
18	89	2,310	6,170	801	3,300	1,710	1,350	582	202	84	60	85
19	86	1,470	16,800	1,120	3,040	1,930	1,220	544	199	82	60	150
20	81	1,090	7,540	2,770	2,480	1,610	1,150	528	194	78	60	116
21	78	2,100	6,910	2,050	2,330	1,340	1,120	509	184	79	61	99
22	82	5,100	3,190	1,330	2,500	1,180	1,080	498	170	79	60	90
23	82	9,660	2,210	1,130	1,980	1,080	1,070	481	165	80	60	85
24	79	5,680	1,710	1,050	1,730	1,000	1,070	470	155	80	58	95
25	81	2,640	1,400	1,080	1,560	962	1,080	470	158	82	58	164
26	80	2,360	1,510	4,180	1,460	960	1,060	474	161	84	60	133
27	91	3,250	1,860	2,170	1,380	1,100	1,030	457	160	80	62	121
28	904	1,840	1,390	4,110	1,250	1,650	1,030	420	173	78	61	108
29	555	1,260	8,820	1,880		1,530	985	395	384	76	64	107
30	279	976	4,550	1,400		2,690	940	373	269	74	64	98
31	199		4,910	1,180		6,150		358		71	60	
Total	4,827	76,176	101,313	56,173	70,395	61,022	58,095	18,890	7,498	4,210	2,004	2,431
Mean	156	2,539	3,268	1,812	2,514	1,968	1,937	609	250	136	65	81
Max	904	19,500	16,800	4,240	12,100	6,150	5,900	932	384	391	73	164
Min	40	104	533	764	465	960	940	358	155	71	58	52
AC-FT	9,574	151,093	200,951	111,417	139,626	121,035	115,230	37,468	14,872	8,350	3,975	4,822

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1982 to Sept 1983

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	101	183	1,330	517	1,780	19,600	2,520	2,110	964	351	120	213
2	99	162	846	480	1,510	11,900	2,520	1,810	1,100	441	119	189
3	105	149	993	446	1,320	9,540	1,920	1,480	919	355	124	149
4	98	145	705	421	1,170	5,370	1,660	1,450	912	331	122	135
5	89	144	586	401	1,320	4,230	1,460	1,450	851	318	124	132
6	94	142	500	381	5,320	3,830	1,330	1,950	815	295	120	116
7	124	141	427	372	6,260	5,740	1,230	1,450	786	281	118	109
8	119	158	366	358	6,070	4,250	1,160	1,220	751	278	120	108
9	101	200	336	342	5,390	2,960	1,120	1,140	734	264	118	101
10	96	172	317	327	11,300	2,620	1,170	1,060	751	244	111	103
11	93	150	297	315	4,960	5,120	1,040	983	835	235	107	100
12	88	145	288	307	6,180	9,170	995	938	711	219	107	103
13	87	142	354	300	5,220	12,900	929	925	655	199	103	97
14	88	142	304	293	3,740	5,270	876	881	602	193	106	92
15	90	141	4,300	291	3,420	3,560	841	881	575	191	100	93
16	88	141	3,430	321	3,430	3,120	815	863	541	187	106	95
17	93	191	3,940	375	2,820	5,310	801	830	517	185	101	90
18	89	4,010	2,020	2,290	5,240	4,420	794	833	541	187	99	90
19	91	1,240	1,170	4,250	3,730	2,830	953	869	517	175	96	86
20	98	565	5,630	1,450	3,010	2,470	1,060	931	485	177	121	86
21	114	373	9,910	1,020	2,630	3,460	998	1,010	463	171	134	88
22	198	307	6,140	2,750	2,360	5,940	944	1,010	429	166	131	106
23	246	274	3,940	2,780	2,260	3,010	1,140	1,020	421	161	131	306
24	237	246	1,890	10,800	2,680	3,600	2,510	1,040	414	151	130	223
25	195	226	1,430	3,040	7,210	2,670	1,860	990	408	151	114	164
26	409	209	1,190	12,600	5,720	2,100	1,410	1,020	392	151	115	153
27	266	223	983	8,420	10,800	3,870	1,770	1,020	377	154	110	146
28	187	2,970	782	3,510	8,120	2,540	3,140	1,020	361	146	111	145
29	181	3,920	667	3,550		3,160	2,170	1,040	351	140	112	136
30	390	3,350	602	3,530		4,680	1,840	1,030	337	137	113	139
31	256		551	2,270		4,300		1,020		131	116	
Total	4,610	20,561	56,224	68,507	124,970	163,540	42,976	35,274	18,515	6,765	3,559	3,893
Mean	149	685	1,814	2,210	4,463	5,275	1,433	1,138	617	218	115	130
Max	409	4010	9910	12600	11300	19600	3140	2110	1100	441	134	306
Min	87	141	288	291	1170	2100	794	830	337	131	96	86
AC-FT	9144	40782	111519	135882	247874	324377	85242	69965	36724	13418	7059	7722

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1983 to Sept 1984

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	162	220	405	2,140	387	608	520	411	277	81	53	68
2	164	244	443	1,740	375	613	469	577	268	78	52	51
3	158	196	5,650	1,480	366	586	438	540	254	73	51	51
4	151	185	1,860	1,320	361	560	425	618	268	73	51	49
5	150	186	1,020	1,210	354	549	422	569	356	69	51	47
6	138	186	3,780	1,120	350	526	414	512	407	69	51	45
7	146	281	6,550	1,040	344	520	392	474	381	69	49	43
8	145	206	3,110	971	341	509	586	465	357	64	48	43
9	145	229	7,740	907	445	495	485	453	292	65	48	43
10	146	1,750	5,610	856	509	490	595	431	263	62	46	44
11	136	1,710	9,260	808	396	480	576	442	244	59	43	41
12	130	1,510	3,540	755	472	477	464	526	219	59	42	41
13	128	1,720	2,560	715	3,370	1,130	428	486	202	61	43	43
14	125	891	2,050	673	1,450	1,260	408	467	175	60	43	44
15	126	494	1,640	662	3,320	1,330	407	454	160	59	45	44
16	131	1,370	1,660	682	3,340	1,160	400	417	155	57	47	44
17	132	3,000	1,970	613	1,400	1,490	414	400	147	60	42	44
18	125	1,010	1,310	578	1,060	929	580	376	144	60	43	44
19	128	1,530	1,110	556	899	796	1,360	367	138	64	44	45
20	126	1,580	989	535	806	742	904	366	138	63	45	54
21	124	759	850	536	1,760	694	710	368	132	60	45	60
22	125	547	762	522	1,050	643	612	353	129	57	41	50
23	147	1,370	765	492	872	609	544	337	114	60	40	49
24	207	5,400	8,560	474	858	591	476	337	113	59	40	48
25	155	1,690	15,400	458	844	566	451	334	113	58	40	45
26	135	891	11,700	442	738	550	431	329	106	61	43	46
27	132	650	7,300	430	693	523	419	322	96	59	44	46
28	136	540	3,320	428	655	504	400	317	99	58	43	46
29	137	468	2,450	414	631	481	389	304	93	55	44	45
30	201	426	5,490	402		471	374	291	85	55	47	81
31	235		2,930	396		506		273		54	103	
Total	4,526	31,239	121,784	24,355	28,446	21,388	15,493	12,916	5,925	1,941	1,467	1,444
Mean	146	1,041	3,929	786	981	690	516	417	198	63	47	48
Max	235	5,400	15,400	2,140	3,370	1,490	1,360	618	407	81	103	81
Min	124	185	405	396	341	471	374	273	85	54	40	41
AC-FT	8,977	61,962	241,555	48,307	56,422	42,422	30,730	25,618	11,752	3,850	2,910	2,864

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1984 to Sept 1985

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	162	151	686	246	177	221	789	228	166	29	23	19
2	119	217	666	238	184	230	634	231	180	31	23	18
3	104	499	1,440	232	182	212	563	236	161	30	23	21
4	109	274	760	225	178	215	509	225	139	28	24	20
5	114	201	640	217	169	238	521	212	131	30	21	20
6	115	285	532	214	170	293	522	212	124	29	21	23
7	120	434	460	300	758	626	524	208	107	29	21	29
8	120	1,150	411	360	4,310	635	511	198	94	24	21	336
9	121	612	393	358	1,080	487	501	184	77	26	21	481
10	143	1,040	1,170	381	639	766	501	182	74	26	19	296
11	800	3,150	1,880	301	487	632	493	187	56	25	18	160
12	254	1,930	989	270	420	464	483	168	50	24	16	127
13	170	3,580	752	253	388	381	461	168	45	26	14	106
14	151	1,420	608	244	344	337	455	163	44	26	13	104
15	132	761	708	240	320	312	460	146	43	24	16	99
16	156	1,260	1,180	233	308	291	445	148	43	22	17	94
17	279	785	753	222	298	282	409	150	41	23	17	88
18	178	1,310	636	219	281	280	373	153	39	23	19	84
19	175	881	536	217	272	269	363	147	38	24	21	89
20	166	1,580	465	214	257	261	333	133	41	22	21	82
21	157	1,300	435	209	249	260	341	120	42	22	19	82
22	146	676	394	203	247	253	361	114	40	25	20	76
23	138	510	368	198	244	244	323	123	39	30	21	72
24	135	6,390	347	198	242	368	293	114	37	28	20	62
25	128	1,420	328	190	235	378	273	108	35	29	22	50
26	126	849	314	192	231	432	262	102	33	26	20	52
27	126	2,430	298	188	227	905	250	102	34	26	18	52
28	128	2,980	287	193	221	1,320	247	99	32	26	18	55
29	209	1,190	271	208		1,140	243	238	31	22	18	56
30	242	837	265	185		1,050	235	180	29	19	20	53
31	171		261	178		952		154		22	19	
Total	5,394	40,102	19,233	7,326	13,118	14,734	12,678	5,133	2,045	796	604	2,906
Mean	174	1,337	620	236	469	475	423	166	68	26	19	97
Max	800	6,390	1,880	381	4,310	1,320	789	238	180	31	24	481
Min	104	151	261	178	169	212	235	99	29	19	13	18
AC-FT	10,699	79,541	38,148	14,531	26,019	29,224	25,146	10,181	4,056	1,579	1,198	5,764

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1985 to Sept 1986

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	56	119	839	193	2,870	1,330	647	309	238	74	47	39
2	52	118	5,410	251	5,900	1,220	609	297	221	71	47	36
3	50	117	3,340	294	4,550	1,110	572	901	209	71	44	31
4	49	114	894	387	2,640	1,030	548	873	210	72	41	32
5	46	115	1,560	1,600	1,710	980	531	889	207	69	36	33
6	49	113	1,050	1,330	1,300	924	512	933	202	62	35	31
7	69	114	1,660	705	1,060	4,110	546	646	196	65	34	32
8	97	113	998	504	901	19,100	604	574	184	67	33	32
9	74	110	575	437	789	5,030	537	534	174	65	30	33
10	74	121	438	384	705	10,300	500	535	165	64	32	32
11	85	129	361	341	647	4,630	479	495	152	63	34	36
12	82	115	328	316	3,750	3,450	491	458	144	57	34	35
13	76	112	292	292	5,780	3,350	468	434	138	59	34	38
14	74	108	275	285	11,600	2,580	442	415	125	55	33	41
15	67	111	259	441	8,010	5,910	476	392	119	52	32	41
16	65	126	236	4,530	6,240	4,250	692	370	122	57	31	59
17	59	119	226	3,970	21,400	2,200	752	354	114	57	33	101
18	55	115	216	2,240	9,330	1,630	538	336	106	56	33	187
19	61	110	205	1,330	10,600	1,370	486	329	109	55	33	184
20	68	109	187	1,330	7,190	1,210	458	326	112	54	30	140
21	228	110	178	863	5,860	1,100	451	318	107	49	33	112
22	245	110	174	704	4,200	1,010	438	306	104	44	33	108
23	489	117	178	1,090	3,130	938	425	298	90	43	32	97
24	291	209	173	762	2,550	957	400	288	78	47	32	110
25	187	383	170	605	2,130	887	398	286	85	46	35	182
26	156	222	165	520	1,830	817	377	265	78	46	31	211
27	136	171	167	477	1,630	769	354	258	92	45	32	419
28	129	1,470	162	453	1,460	744	350	254	83	48	35	186
29	124	3,850	157	3,650		701	337	246	79	46	35	139
30	126	1,020	178	6,050		670	328	242	77	44	33	123
31	121		209	3,580		649		237		46	35	
Total	3,540	9,970	21,260	39,914	129,762	84,956	14,746	13,398	4,120	1,749	1,072	2,880
Mean	114	332	686	1,288	4,634	2,741	492	432	137	56	35	96
Max	489	3,850	5,410	6,050	21,400	19,100	752	933	238	74	47	419
Min	46	108	157	193	647	649	328	237	77	43	30	31
AC-FT	7,021	19,775	42,169	79,168	257,379	168,508	29,248	26,575	8,172	3,469	2,126	5,712

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1986 to Sept 1987

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	118	135	106	536	564	234	480	230	65	26	16	12
2	113	129	106	623	1,850	231	465	253	62	24	16	11
3	107	121	108	1,980	1,410	314	460	221	61	25	15	15
4	106	121	108	4,060	690	319	444	195	56	19	16	16
5	106	120	151	818	504	3,750	419	180	52	20	14	17
6	100	113	175	457	415	2,440	397	156	50	24	11	16
7	92	113	149	343	357	1,160	386	150	49	26	12	16
8	100	113	130	272	319	818	377	144	57	22	12	17
9	97	112	118	227	300	678	370	151	54	22	11	18
10	96	114	114	205	366	687	369	153	45	19	7.8	19
11	92	110	112	191	1,320	3,320	403	136	42	20	10	20
12	85	110	111	183	3,080	11,700	375	129	41	18	11	22
13	82	110	111	173	8,450	8,260	363	121	39	17	8.9	22
14	88	108	124	163	2,280	4,470	345	111	35	12	12	21
15	79	109	126	157	3,640	3,150	347	105	34	17	13	20
16	80	107	113	138	1,460	1,860	339	103	36	10	12	23
17	103	107	112	144	916	1,380	322	121	30	11	9.2	22
18	150	104	117	150	684	1,180	318	100	33	25	13	22
19	113	109	149	145	555	1,010	289	98	35	38	14	21
20	106	112	185	139	476	849	273	88	31	32	17	17
21	106	153	148	135	425	1,190	257	85	32	25	15	17
22	107	142	152	135	381	1,010	250	92	35	20	15	18
23	101	117	206	161	347	1,930	234	87	34	28	16	16
24	106	110	157	1,880	326	1,260	214	86	31	26	15	19
25	116	109	139	1,880	298	933	209	90	27	22	14	18
26	112	111	132	853	274	778	207	90	25	23	15	18
27	121	106	134	746	259	672	210	91	25	19	15	20
28	133	106	125	2,470	247	607	205	89	24	18	17	20
29	125	114	122	753		558	211	89	26	18	20	21
30	205	114	123	2,010		520	216	83	30	18	21	19
31	166		132	912		496		75		12	18	
Total	3,411	3,459	4,095	23,039	32,193	57,764	9,754	3,902	1,196	656	432	553
Mean	110	115	132	743	1,150	1,863	325	126	40	21	14	18
Max	205	153	206	4,060	8,450	11,700	480	253	65	38	21	23
Min	79	104	106	135	247	231	205	75	24	10	7.8	11
AC-FT	6,766	6,861	8,122	45,697	63,854	114,573	19,347	7,739	2,372	1,301	856	1,097

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1987 to Sept 1988

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	17	60	2,360	342	530	784	124	306	199	52	14	15
2	17	89	3,490	300	447	486	121	269	246	44	11	17
3	20	90	1,170	3,170	389	335	126	253	201	36	11	14
4	19	76	526	7,960	348	297	138	235	182	34	11	12
5	19	74	614	3,170	319	287	122	245	176	34	14	13
6	27	74	1,780	2,200	294	354	119	250	207	36	16	12
7	26	78	1,070	2,080	281	348	124	410	306	34	17	12
8	20	83	1,140	3,410	265	303	123	1,130	390	32	13	11
9	20	105	6,010	4,220	255	288	118	840	285	30	12	11
10	21	110	6,290	3,100	245	275	116	509	252	27	12	11
11	24	89	1,750	2,800	236	254	108	402	223	26	14	9.2
12	28	83	843	1,320	234	241	102	353	202	25	16	11
13	32	112	554	956	231	231	105	348	185	27	16	12
14	31	207	425	797	227	223	153	313	155	26	15	12
15	30	123	353	1,840	224	220	185	283	155	26	16	14
16	34	102	554	2,500	216	211	155	333	134	23	18	14
17	34	107	474	1,580	209	200	155	711	117	24	18	11
18	33	113	328	959	202	193	216	417	108	20	18	13
19	28	98	276	707	196	190	491	330	98	20	20	12
20	30	103	243	566	193	188	683	287	89	18	17	13
21	30	165	227	482	190	190	546	260	82	17	17	13
22	32	131	247	421	187	196	1,260	237	84	15	18	13
23	40	110	255	381	186	193	1,050	219	71	12	17	14
24	49	104	210	356	183	191	558	212	67	12	17	15
25	47	94	192	329	181	180	430	189	64	13	17	17
26	44	96	185	308	179	179	364	172	64	16	18	18
27	37	94	177	292	182	170	327	164	58	18	16	22
28	43	97	253	283	190	164	301	178	52	17	13	23
29	54	93	1,060	673	195	147	287	346	46	17	12	23
30	54	158	641	1,240		143	357	237	49	16	15	22
31	61		403	647		128		198		13	15	
Total	1,001	3,118	34,100	49,389	7,214	7,789	9,064	10,636	4,547	760	474	429
Mean	32	104	1,100	1,593	249	251	302	343	152	25	15	14
Max	61	207	6,290	7,960	530	784	1,260	1,130	390	52	20	23
Min	17	60	177	283	179	128	102	164	46	12	11	9.2
AC-FT	1,985	6,184	67,636	97,962	14,309	15,449	17,978	21,096	9,019	1,507	940	851

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1988 to Sept 1989

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	23	38	251	740	354	364	1,490	511	167	65	24	27
2	23	48	223	623	324	6,310	3,000	467	158	64	22	21
3	23	152	204	599	291	2,070	2,880	449	152	62	25	24
4	22	145	190	584	270	1,310	1,910	438	140	56	25	25
5	23	89	178	984	221	4,120	1,610	431	142	53	25	23
6	21	78	169	841	196	3,340	1,370	417	152	51	23	24
7	21	78	157	698	213	2,120	1,240	406	148	46	22	23
8	19	74	158	662	205	7,670	1,160	388	140	42	24	25
9	23	87	153	1,060	219	9,680	1,100	384	130	39	19	23
10	22	277	149	2,950	213	5,140	1,020	500	126	38	22	23
11	24	248	144	1,330	213	7,950	940	484	121	37	21	23
12	27	143	140	786	201	3,480	888	374	118	33	21	26
13	32	311	142	609	192	2,920	822	350	115	37	21	25
14	33	463	136	501	184	2,010	775	331	112	35	19	26
15	36	209	128	416	175	1,620	756	311	112	31	20	23
16	34	677	127	380	174	3,140	726	285	121	33	20	28
17	32	761	127	394	176	2,050	687	274	109	36	20	191
18	30	261	124	418	201	3,300	653	265	104	34	21	832
19	29	173	133	505	1,440	4,880	622	248	99	32	21	187
20	31	147	241	492	658	2,380	608	238	87	30	22	113
21	28	155	761	433	472	1,820	690	223	77	30	22	94
22	24	6,410	1,530	2,010	736	1,530	744	211	76	28	20	87
23	22	5,260	954	2,250	1,170	1,380	1,460	314	68	27	30	82
24	25	968	1,040	922	704	4,660	1,580	285	64	25	35	83
25	26	1,530	947	649	555	5,220	977	247	58	23	31	85
26	21	883	651	529	473	2,630	895	227	56	20	28	84
27	26	593	470	455	421	1,950	715	207	54	23	28	88
28	31	449	391	401	380	2,150	625	203	57	24	25	88
29	32	368	376	367		1,720	560	202	59	20	24	96
30	33	292	372	363		1,390	529	189	67	21	25	100
31	37		778	361		1,500		174		24	25	
Total	833	21,367	11,544	24,312	11,031	101,804	33,032	10,033	3,189	1,119	730	2,599
Mean	27	712	372	784	394	3,284	1,101	324	106	36	24	87
Max	37	6,410	1,530	2,950	1,440	9,680	3,000	511	167	65	35	832
Min	19	38	124	361	174	364	529	174	54	20	19	21
AC-FT	1,652	42,381	22,897	48,222	21,880	201,925	65,518	19,900	6,325	2,220	1,448	5,155

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1989 to Sept 1990

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	100	152	128	109	882	266	281	133	1,760	59	17	18
2	94	143	126	130	515	728	269	122	1,080	54	17	19
3	88	139	125	116	624	1,690	251	118	843	54	18	18
4	86	136	123	108	1,390	1,540	248	113	703	51	15	17
5	86	134	123	106	657	2,370	261	97	579	49	14	17
6	86	131	123	106	710	1,090	254	84	494	51	13	16
7	85	130	126	4,780	528	794	246	79	443	49	12	19
8	83	129	118	9,010	425	913	252	74	380	45	13	20
9	84	129	122	1,880	372	709	276	72	334	41	14	21
10	81	128	118	851	347	2,280	241	68	288	39	13	19
11	80	125	115	544	331	1,350	226	64	257	38	12	22
12	80	123	115	2,390	305	875	222	63	216	34	9.4	23
13	78	121	111	4,320	266	692	210	63	197	34	11	21
14	80	122	112	2,510	240	628	203	70	176	32	11	21
15	81	118	113	1,060	222	578	186	70	154	28	11	22
16	78	118	113	2,380	297	511	191	65	170	27	12	23
17	78	119	111	1,120	364	471	189	63	167	33	13	23
18	78	117	108	689	412	441	185	56	149	33	29	22
19	74	117	106	525	464	423	169	60	130	30	26	25
20	78	117	106	433	400	409	170	82	115	30	20	21
21	86	113	106	368	371	398	161	120	110	28	19	21
22	134	113	106	325	501	384	164	129	107	25	19	21
23	1,090	114	106	293	442	390	216	668	94	24	19	17
24	2,340	127	106	266	381	380	366	344	85	26	16	24
25	1,550	197	106	245	343	370	227	211	80	22	12	27
26	401	438	105	230	319	358	188	207	76	23	18	29
27	376	197	102	213	293	349	176	1,260	70	23	19	31
28	309	153	104	200	279	340	164	1,560	69	19	20	31
29	212	138	104	194		319	150	1,630	67	18	21	27
30	179	130	105	223		306	144	4,920	63	18	23	25
31	163		104	244		296		4,510		19	22	
Total	8,498	4,268	3,496	35,968	12,680	22,648	6,486	17,175	9,456	1,056	508	660
Mean	274	142	113	1,160	453	731	216	554	315	34	16	22
Max	2,340	438	128	9,010	1,390	2,370	366	4,920	1,760	59	29	31
Min	74	113	102	106	222	266	144	56	63	18	9.4	16
AC-FT	16,856	8,465	6,934	71,341	25,150	44,922	12,865	34,066	18,756	2,095	1,008	1,309

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1990 to Sept 1991

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	23	144	76	73	73	282	353	191	109	27	3.2	2.9
2	26	88	72	74	305	513	337	193	99	23	2.7	1.5
3	24	79	73	79	515	1,600	316	185	90	19	0.44	0.59
4	26	77	73	74	327	4,360	278	174	86	14	1.3	0.52
5	23	77	74	74	824	2,050	265	170	77	13	1.7	1.2
6	23	74	74	73	286	605	444	168	72	11	3.2	3.2
7	23	71	74	84	173	371	440	166	66	8.7	2.4	1.6
8	24	73	72	91	138	270	341	164	61	8.8	4.5	1.4
9	24	74	73	87	123	221	295	180	55	11	6.6	0.84
10	24	71	80	88	110	512	256	157	52	7.5	3.0	0.16
11	25	70	108	85	105	709	230	137	51	8.1	0.85	0.92
12	24	72	95	87	101	2,770	222	128	41	6.2	0.11	6.5
13	26	69	82	112	96	3,220	210	158	36	3.5	2.4	6.5
14	24	79	78	123	96	1,130	204	244	31	4.4	1.7	4.0
15	26	88	82	97	96	834	200	179	29	2.9	0.03	3.6
16	26	80	86	87	94	510	200	170	29	5.5	0.29	3.8
17	27	78	83	83	91	520	196	215	27	7.1	0.90	5.5
18	28	80	81	80	90	1,100	192	257	30	5.7	1.6	4.9
19	33	76	80	79	91	683	181	252	27	5.5	1.1	4.6
20	31	76	78	77	89	567	185	224	25	6.4	2.8	4.5
21	33	77	59	75	88	488	213	210	21	6.9	5.0	4.0
22	35	75	53	74	88	384	195	194	18	7.0	4.6	0.48
23	34	73	58	75	87	900	201	178	17	7.5	3.9	2.4
24	28	73	73	74	88	2,740	225	177	17	3.8	2.8	5.7
25	29	75	83	73	85	3,100	284	169	19	6.8	0.05	5.1
26	32	84	88	73	84	2,920	268	154	21	7.2	0.82	5.2
27	33	76	80	71	83	1,330	247	137	21	4.3	3.7	4.5
28	34	74	70	69	90	805	230	128	22	2.4	5.6	4.8
29	35	73	68	69		579	212	112	31	4.7	8.1	7.6
30	34	76	63	70		467	200	133	34	5.3	8.2	6.4
31	95		69	71		405		146		3.6	6.0	
Total	932	2,352	2,358	2,501	4,516	36,945	7,620	5,450	1,314	258	90	105
Mean	30	78	76	81	161	1,192	254	176	44	8.3	2.9	3.5
Max	95	144	108	123	824	4,360	444	257	109	27	8.2	7.6
Min	23	69	53	69	73	221	181	112	17	2.4	0.03	0.16
AC-FT	1,849	4,665	4,677	4,961	8,957	73,279	15,114	10,810	2,606	511	178	208

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1991 to Sept 1992

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	6.2	42	61	160	614	357	221	134	7.3	32	3.4	0.77
2	5.3	42	61	123	473	347	216	128	14	38	1.9	0.47
3	4.8	44	59	106	252	301	206	115	13	25	1.2	0.23
4	5.5	44	56	674	192	281	203	103	15	18	0.71	0.17
5	5.3	44	57	1,790	164	664	206	79	8.3	16	1.4	0.34
6	5.3	43	61	496	149	1,310	189	68	7.6	15	2.8	1.1
7	4.8	45	81	1,100	143	840	176	76	5.5	13	4.4	1.3
8	4.1	46	81	507	141	543	169	77	12	12	2.3	1.2
9	4.4	55	67	291	150	420	168	58	14	12	1.3	4.8
10	3.8	59	64	217	562	351	193	54	7.7	11	1.2	4.5
11	3.4	49	63	179	1,560	314	205	50	6.0	9.0	1.2	2.5
12	4.3	47	62	158	4,840	285	696	50	14	7.4	1.2	4.4
13	3.0	48	62	141	1,710	263	827	46	17	5.6	1.2	2.3
14	4.2	47	61	134	2,440	298	475	49	23	13	1.1	1.3
15	4.8	45	60	129	2,990	1,190	364	44	24	13	1.2	5.6
16	8.7	48	60	121	1,670	4,370	341	40	21	10	1.1	4.1
17	9.2	61	60	117	3,930	2,190	991	37	26	5.7	1.2	4.1
18	11	119	246	114	2,080	1,020	629	50	17	3.0	1.2	3.7
19	11	84	221	108	5,190	681	443	53	19	2.7	1.4	3.5
20	12	74	113	104	3,880	528	364	46	16	7.5	2.2	3.2
21	7.4	83	86	101	3,080	434	315	55	6.4	4.5	1.9	3.2
22	7.0	73	78	101	3,040	392	286	45	7.3	9.1	1.7	3.3
23	8.0	65	73	98	1,370	405	240	27	9.0	5.9	2.4	3.2
24	13	62	70	97	875	344	213	33	14	4.8	3.2	3.4
25	24	61	68	98	648	311	205	25	15	3.7	1.2	6.5
26	109	59	67	99	524	283	185	33	7.5	1.4	1.4	4.4
27	117	62	66	96	438	262	174	32	9.1	0.82	2.9	4.0
28	55	73	215	113	377	243	160	21	4.9	1.2	2.0	3.5
29	49	64	1,860	137	342	233	145	19	16	5.7	0.56	4.6
30	46	60	620	116		228	145	17	28	6.1	0.75	9.9
31	44		250	105		235		13		3.8	0.92	
Total	601	1,748	5,109	7,930	43,824	19,923	9,350	1,677	405	316	53	96
Mean	19	58	165	256	1,511	643	312	54	13	10	1.7	3.2
Max	117	119	1,860	1,790	5,190	4,370	991	134	28	38	4.4	9.9
Min	3.0	42	56	96	141	228	145	13	4.9	0.82	0.56	0.17
AC-FT	1,191	3,467	10,134	15,729	86,924	39,517	18,545	3,326	803	627	104	190

Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1992 to Sept 1993

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.1	756	73	9,630	488	798	1,650	916	3,500	238	88	79
2	9.9	379	78	1,810	464	741	1,390	919	1,800	215	95	68
3	12	188	87	888	426	768	1,220	1,330	1,370	198	88	57
4	14	112	71	624	388	695	3,160	1,270	2,370	187	73	54
5	11	88	59	600	387	613	1,950	1,010	2,240	176	74	54
6	11	77	945	615	624	676	1,540	959	1,740	174	73	49
7	11	72	1,550	3,100	456	595	1,320	941	1,990	166	68	63
8	10	69	3,730	2,790	1,220	600	1,480	855	1,530	158	77	63
9	14	63	6,100	2,140	3,930	630	2,470	806	1,220	152	76	76
10	14	59	8,000	2,870	1,860	650	1,530	851	1,060	134	73	63
11	8.3	58	2,880	1,410	2,940	660	1,310	839	945	150	69	55
12	7.0	64	1,400	971	3,530	675	1,190	822	840	136	80	51
13	12	73	695	4,980	1,780	665	1,080	717	756	126	78	49
14	18	73	469	9,130	1,260	732	1,050	676	687	124	71	49
15	9.5	72	365	3,260	995	965	1,050	640	642	132	84	49
16	8.6	71	297	3,780	838	1,180	976	630	584	122	100	49
17	12	71	291	2,060	1,960	10,800	4,710	620	565	119	92	52
18	18	70	275	1,520	5,620	6,470	3,120	605	532	116	90	67
19	18	73	214	1,230	8,270	3,320	1,720	595	494	115	86	59
20	22	75	256	13,500	4,640	2,380	1,400	590	468	112	184	56
21	53	74	243	11,200	2,780	1,930	1,260	595	422	99	147	53
22	55	88	222	7,330	2,970	1,600	1,180	620	382	109	100	54
23	36	90	192	2,770	4,520	2,760	1,080	588	376	121	91	58
24	35	68	186	1,810	2,610	8,110	1,490	570	342	102	89	59
25	33	61	166	1,320	1,720	3,170	1,130	533	327	99	83	49
26	37	61	158	1,050	1,310	2,170	1,110	541	299	90	78	50
27	39	60	158	885	1,060	1,760	999	622	277	84	73	62
28	48	60	1,290	743	913	1,570	994	646	279	89	84	54
29	117	73	914	626		1,370	946	583	263	99	67	52
30	1,820	73	602	557		1,250	946	536	251	88	63	65
31	299		5,460	519		1,170		7,560		87	65	
Total	2,819	3,271	37,426	95,718	59,959	61,473	46,451	29,985	28,551	4,117	2,659	1,718
Mean	91	109	1,207	3,088	2,141	1,983	1,548	967	952	133	86	57
Max	1,820	756	8,000	13,500	8,270	10,800	4,710	7,560	3,500	238	184	79
Min	7.0	58	59	519	387	595	946	533	251	84	63	49
AC-FT	5,592	6,488	74,233	189,854	118,927	121,930	92,134	59,474	56,630	8,166	5,274	3,408

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1993 to Sept 1994

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	70	121	267	159	204	927	264	212	121	24	3.4	8.2
2	56	115	199	178	193	738	257	200	124	20	6.0	8.9
3	50	114	175	164	184	648	247	191	112	17	6.2	7.3
4	59	114	169	163	177	588	244	208	99	18	5.9	5.2
5	61	114	164	202	170	685	228	339	95	19	6.0	5.3
6	76	114	160	184	782	605	233	386	114	16	3.7	7.3
7	68	114	169	168	3,000	515	266	646	119	15	2.6	8.7
8	64	108	927	163	2,280	464	253	537	98	17	5.3	9.9
9	67	103	919	206	954	431	623	442	89	16	6.6	11
10	97	101	514	184	3,380	439	384	389	81	15	8.1	9.3
11	132	127	2,560	169	1,480	547	306	355	69	13	5.4	10
12	157	127	1,320	160	841	422	278	330	63	14	4.7	13
13	133	127	605	153	632	388	266	300	58	13	2.9	14
14	166	127	3,190	149	505	371	259	262	50	12	2.4	16
15	543	127	1,070	148	433	365	250	259	48	11	2.4	16
16	2,520	127	543	143	393	504	228	314	52	11	4.1	14
17	508	127	395	137	2,220	770	239	297	50	10	4.0	12
18	267	127	324	136	1,610	502	240	260	47	8.7	4.9	11
19	208	127	282	136	2,120	470	241	325	44	11	4.7	11
20	175	125	249	132	2,950	420	245	352	44	11	3.1	10
21	158	119	230	134	2,500	390	237	285	43	9.7	3.6	7.6
22	150	116	208	137	1,530	382	234	252	41	8.2	3.2	8.8
23	133	113	186	616	1,010	359	230	217	37	7.6	4.9	11
24	127	108	174	2,220	783	341	282	190	36	7.6	6.1	10
25	127	105	168	991	684	321	324	171	33	9.0	8.3	13
26	127	107	166	685	958	304	431	166	28	8.6	7.4	17
27	127	107	162	443	2,820	286	300	163	33	8.2	7.7	18
28	127	112	157	345	1,300	280	257	146	32	8.0	8.8	19
29	127	242	152	290		280	230	138	26	7.1	8.0	22
30	126	678	150	251		277	221	134	23	5.4	9.3	26
31	122		152	224		271		120		5.9	9.8	
Total	6,928	4,193	16,106	9,570	36,093	14,290	8,297	8,586	1,909	377	169.5	360.5
Mean	223	140	520	309	1,289	461	277	277	64	12	5.5	12
Max	2,520	678	3,190	2,220	3,380	927	623	646	124	24	9.8	26
Min	50	101	150	132	170	271	221	120	23	5.4	2.4	5.2
AC-FT	13,741	8,317	31,946	18,982	71,589	28,344	16,457	17,030	3,786	748	336	715

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1994 to Sept 1995

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	22	47	141	296	8,410	532	1,150	10,200	533	233	91	69
2	20	65	173	266	4,280	6,060	1,090	4,670	541	181	87	65
3	20	63	2,440	256	2,750	6,310	1,020	2,860	524	175	89	64
4	22	59	1,520	845	2,030	2,730	974	2,190	500	180	85	68
5	32	89	475	933	1,640	1,760	967	1,870	499	204	82	65
6	30	106	401	1,430	1,410	1,350	2,250	1,660	452	190	77	63
7	29	115	365	5,340	1,250	1,130	2,690	1,410	430	186	77	61
8	28	93	249	8,070	1,450	2,680	2,400	1,240	407	181	73	62
9	27	173	194	14,200	1,140	12,300	1,890	1,190	384	178	71	61
10	27	378	167	9,520	994	10,100	1,540	1,120	379	178	75	60
11	28	173	173	3,650	908	6,170	1,370	1,170	407	174	74	61
12	30	123	1,020	5,060	849	5,260	1,270	1,040	358	173	72	62
13	27	118	1,860	14,000	1,490	8,190	1,760	1,140	352	183	75	64
14	27	100	1,800	6,260	1,220	14,600	1,390	957	457	166	77	60
15	27	133	1,590	4,010	948	9,360	1,210	930	889	163	74	61
16	28	306	1,400	3,060	819	4,430	1,110	894	997	161	72	63
17	27	191	867	2,020	746	3,240	1,030	862	803	156	71	59
18	28	147	877	1,490	717	3,190	1,510	863	1,110	140	70	59
19	30	115	652	1,180	666	3,010	1,130	787	840	152	68	58
20	30	103	452	1,010	616	6,950	1,090	751	661	136	66	51
21	32	99	364	903	578	5,480	976	732	582	122	64	56
22	29	95	310	3,330	552	5,250	899	719	531	112	64	62
23	31	92	276	7,230	539	4,420	853	703	485	116	66	62
24	33	93	485	4,850	531	3,550	818	680	437	116	66	60
25	32	319	576	2,530	519	2,520	813	662	398	114	58	65
26	32	362	370	3,470	503	1,940	803	632	305	110	62	68
27	35	205	323	4,940	494	1,670	955	619	300	114	59	70
28	37	209	1,180	6,420	485	1,490	1,060	612	343	106	62	73
29	38	168	595	3,380		1,360	8,950	582	344	104	66	74
30	37	143	412	8,490		1,260	3,750	559	336	97	68	67
31	41		336	10,000		1,170		542		94	68	
Total	916	4,482	22,043	138,439	38,534	139,462	48,718	44,846	15,584	4,695	2,229	1,893
Mean	30	149	711	4,466	1,376	4,499	1,624	1,447	519	151	72	63
Max	41	378	2,440	14,200	8,410	14,600	8,950	10,200	1,110	233	91	74
Min	20	47	141	256	485	532	803	542	300	94	58	51
AC-FT	1,817	8,890	43,722	274,590	76,431	276,619	96,631	88,951	30,910	9,312	4,421	3,755

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1995 to Sept 1996

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	63	88	139	651	1,360	1,450	2,010	647	501	138	59	40
2	62	90	190	490	1,100	1,170	2,270	610	448	128	57	40
3	63	91	144	408	1,010	1,050	1,400	578	409	123	51	42
4	61	91	238	366	9,930	2,500	1,080	539	377	109	45	45
5	61	95	239	335	7,170	2,690	936	517	358	112	51	45
6	64	100	241	309	2,780	1,680	840	487	332	103	50	49
7	67	97	186	285	1,970	1,360	788	459	311	97	52	46
8	68	95	160	272	1,590	1,160	752	440	284	95	52	50
9	66	100	146	311	1,370	1,030	714	429	263	96	51	46
10	68	102	151	588	1,210	976	739	402	258	93	45	45
11	69	98	567	359	1,090	1,760	673	393	238	84	41	45
12	83	97	6,150	299	980	3,570	629	383	218	86	40	45
13	81	101	1,460	273	909	1,690	581	379	205	84	39	74
14	75	101	749	256	845	1,320	553	443	205	95	39	97
15	71	99	7,720	782	788	1,100	551	571	196	86	40	92
16	67	99	1,320	7,720	1,160	1,010	1,130	748	185	82	40	99
17	69	102	674	2,480	1,350	922	1,200	1,310	186	81	39	85
18	69	103	472	2,590	1,570	868	2,100	5,230	185	103	41	73
19	62	106	373	3,590	5,530	825	1,170	2,260	177	94	42	70
20	65	110	316	3,970	6,500	796	1,520	1,320	173	85	38	74
21	71	114	275	4,560	6,660	772	1,080	2,010	166	75	39	69
22	66	119	252	1,700	2,900	746	969	3,290	165	76	43	63
23	68	116	238	1,360	2,010	706	854	1,660	168	80	44	69
24	69	111	220	3,490	2,520	657	1,840	1,260	169	82	40	67
25	71	116	206	3,600	1,560	629	1,360	1,040	176	76	42	62
26	77	138	198	1,560	1,280	588	1,060	884	187	69	49	58
27	78	130	195	3,780	1,170	594	908	971	212	65	55	50
28	78	121	237	2,820	1,340	1,050	803	780	205	64	58	46
29	76	119	871	1,790	1,950	686	726	697	173	73	48	51
30	83	119	1,750	2,290		607	680	638	148	66	47	49
31	85		1,060	1,790		575		600		61	45	
Total	2,176	3,168	27,137	55,074	71,602	36,537	31,916	31,975	7,278	2,761	1,422	1,786
Mean	70	106	875	1,777	2,469	1,179	1,064	1,031	243	89	46	60
Max	85	138	7,720	7,720	9,930	3,570	2,270	5,230	501	138	59	99
Min	61	88	139	256	788	575	551	379	148	61	38	40
AC-FT	4,316	6,284	53,825	109,238	142,020	72,470	63,304	63,421	14,436	5,476	2,820	3,542

Kilarc-Cow Creek Project, FERC No 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1996 to Sept 1997

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	52	122	177	15,600	1,650	367	373	371	121	97	34	44
2	53	116	185	15,900	1,390	476	356	327	117	89	29	47
3	59	115	158	7,780	1,240	410	344	302	130	78	29	47
4	59	114	189	3,230	1,190	402	328	275	293	72	31	41
5	58	118	2,950	2,260	1,110	398	308	264	219	67	29	42
6	58	116	758	1,730	996	385	299	258	165	67	29	42
7	57	111	1,130	1,440	926	328	321	252	141	66	31	40
8	54	112	2,200	1,240	871	338	299	236	125	61	28	41
9	53	112	3,180	1,090	792	325	297	230	130	54	25	43
10	56	112	4,120	982	790	316	305	214	133	58	26	42
11	56	113	2,830	897	705	320	282	206	122	53	35	47
12	53	114	3,170	837	666	333	258	201	121	48	33	45
13	60	115	2,990	740	613	325	252	192	123	48	32	43
14	58	114	1,230	692	578	327	245	185	113	48	30	62
15	59	112	777	669	555	336	234	176	109	45	29	153
16	62	116	587	644	535	558	215	173	103	46	29	104
17	63	154	469	620	787	2,250	213	166	96	45	33	88
18	76	296	386	590	641	969	231	163	89	43	35	98
19	100	263	339	571	570	697	556	158	89	39	33	91
20	95	492	306	605	566	627	568	142	84	40	53	80
21	92	241	367	2,800	507	595	752	139	81	43	74	79
22	95	528	1,170	12,600	480	545	749	138	81	40	63	76
23	98	420	944	3,410	443	511	1,810	172	76	35	52	68
24	109	244	583	2,100	424	470	822	213	72	32	55	62
25	119	202	450	9,320	405	454	628	165	71	31	57	60
26	117	175	3,670	10,600	393	440	560	154	64	33	50	57
27	105	160	3,320	4,800	388	436	489	152	65	31	48	52
28	104	152	2,290	5,530	391	416	442	149	69	37	45	50
29	148	147	4,020	2,920		390	419	141	69	39	45	50
30	208	140	6,690	2,050		387	388	131	82	36	43	47
31	136		12,000	1,780		409		116		36	43	
Total	2,572	5,446	63,635	116,027	20,602	15,540	13,343	6,161	3,353	1,557	1,208	1,841
Mean	83	182	2,053	3,743	736	501	445	199	112	50	39	61
Max	208	528	12,000	15,900	1,650	2,250	1,810	371	293	97	74	153
Min	52	111	158	571	388	316	213	116	64	31	25	40
AC-FT	5,101	10,802	126,218	230,136	40,863	30,823	26,465	12,220	6,651	3,088	2,396	3,652

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1997 to Sept 1998

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	51	100	1,000	232	7,910	1,430	1,780	1,070	2,030	526	197	119
2	77	97	659	1,410	6,540	1,580	1,570	1,530	1,830	510	193	117
3	88	100	461	1,910	18,500	1,910	1,900	1,390	3,970	491	200	118
4	70	98	350	3,680	5,530	1,410	2,200	1,340	2,280	484	173	112
5	70	97	327	1,430	6,100	1,290	2,290	1,310	1,850	435	152	112
6	73	101	436	1,370	8,560	1,260	2,560	1,240	1,640	420	162	122
7	81	117	3,140	2,120	6,170	1,230	3,520	1,150	1,570	410	166	124
8	99	121	2,440	1,400	4,140	1,410	2,330	1,340	1,500	400	154	128
9	435	119	1,210	1,180	2,740	1,240	2,420	1,960	1,530	390	154	119
10	449	118	682	2,780	4,040	1,100	2,230	1,610	1,420	380	155	130
11	239	135	510	7,620	4,390	1,030	1,820	1,380	2,840	365	146	124
12	156	154	434	11,300	4,230	1,000	1,610	1,630	1,890	355	149	113
13	130	149	379	4,710	4,130	1,840	2,710	1,510	1,860	345	146	115
14	117	227	1,630	7,790	13,100	1,380	2,100	1,640	1,540	330	127	111
15	111	211	2,030	9,100	5,410	1,210	1,800	2,220	1,350	320	129	109
16	108	320	962	8,580	4,140	1,470	1,470	6,870	1,220	310	138	107
17	106	1,060	1,710	12,000	4,980	1,320	1,340	3,200	1,110	300	139	104
18	104	387	1,230	10,300	3,410	1,180	1,240	2,260	1,040	290	147	106
19	102	1,260	731	7,060	8,040	1,080	1,160	1,870	1,000	275	145	108
20	100	789	576	4,600	6,100	1,040	1,060	2,040	946	260	149	104
21	96	347	589	2,790	6,680	1,240	1,110	1,610	892	250	153	113
22	96	270	483	2,030	5,420	9,200	1,070	1,420	843	240	136	112
23	94	442	399	1,700	4,740	4,700	1,080	1,300	803	230	135	114
24	97	1,010	372	1,790	4,420	3,750	1,720	1,250	755	235	134	116
25	94	2,680	317	1,760	2,780	5,620	1,130	4,230	746	226	135	117
26	95	2,310	298	9,660	2,180	3,250	961	3,220	730	220	134	144
27	96	1,350	278	7,200	1,840	2,540	937	4,390	660	219	133	153
28	97	734	254	3,050	1,590	2,250	959	6,280	615	203	126	156
29	98	637	251	5,620		1,890	981	5,580	582	204	130	143
30	101	3,090	267	4,130		1,640	1,020	3,350	551	202	126	137
31	100		259	3,060		1,930		2,450		208	116	
Total	3,830	18,630	24,664	143,362	157,810	64,420	50,078	73,640	41,593	10,033	4,579	3,607
Mean	124	621	796	4,625	5,636	2,078	1,669	2,375	1,386	324	148	120
Max	449	3,090	3,140	12,000	18,500	9,200	3,520	6,870	3,970	526	200	156
Min	51	97	251	232	1,590	1,000	937	1,070	551	202	116	104
AC-FT	7,597	36,952	48,920	284,354	313,011	127,775	99,328	146,063	82,498	19,900	9,082	7,154

Kilarc-Cow Creek Project, FERC No 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1998 to Sept 1999

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	137	173	3,660	296	585	4,120	922	650	410	129	74	65
2	141	168	3,640	279	512	2,560	819	732	494	124	74	64
3	141	171	6,910	271	486	2,620	760	780	579	117	70	62
4	135	168	2,310	266	487	1,950	709	705	477	120	67	61
5	135	168	1,420	263	455	1,620	786	642	420	119	66	54
6	130	173	1,150	258	1,940	1,420	828	615	383	119	65	57
7	127	338	991	252	5,590	1,270	736	622	354	111	85	57
8	134	412	1,050	241	4,250	1,170	937	592	332	108	81	57
9	140	274	841	233	14,800	2,090	941	547	318	98	79	57
10	141	284	692	231	3,710	1,580	985	529	304	109	80	58
11	139	548	620	230	2,250	1,300	1,710	511	288	101	91	65
12	140	270	568	231	1,680	1,150	1,030	495	277	102	89	56
13	142	225	584	229	1,340	1,050	887	501	275	90	90	60
14	135	208	1,020	230	1,450	984	814	499	270	83	86	62
15	138	198	639	254	1,190	916	781	474	262	81	83	59
16	140	200	545	462	3,850	849	774	431	254	88	76	63
17	137	1,050	503	2,560	5,460	804	782	411	243	90	56	62
18	135	487	470	3,380	2,950	787	791	406	237	84	54	63
19	131	304	430	1,900	2,200	760	792	416	227	90	53	59
20	127	245	407	2,310	3,230	789	814	425	213	82	54	60
21	121	976	353	1,870	6,400	781	803	432	216	87	51	59
22	124	2,160	361	1,180	2,930	812	760	437	204	83	45	59
23	127	3,090	334	2,780	2,150	808	728	461	186	85	47	57
24	202	2,000	323	1,570	1,740	2,400	725	473	181	80	47	61
25	266	816	322	1,080	3,480	2,970	729	494	178	84	53	64
26	180	2,000	321	1,040	2,100	1,550	758	500	176	76	49	59
27	171	3,890	311	885	1,760	1,180	813	496	168	74	53	59
28	171	1,220	301	730	3,870	1,000	744	489	163	69	52	51
29	178	4,070	294	648		925	668	483	150	71	53	53
30	166	9,440	288	591		961	649	461	128	72	51	58
31	165		296	614		1,030		425		75	58	
Total	4,596	35,726	31,954	27,364	82,845	44,206	24,975	16,134	8,367	2,901	2,032	1,781
Mean	148	1,191	1,031	883	2,959	1,426	833	520	279	94	66	59
Max	266	9,440	6,910	3,380	14,800	4,120	1,710	780	579	129	91	65
Min	121	168	288	229	455	760	649	406	128	69	45	51
AC-FT	9,116	70,861	63,380	54,276	164,321	87,681	49,537	32,001	16,596	5,754	4,030	3,533

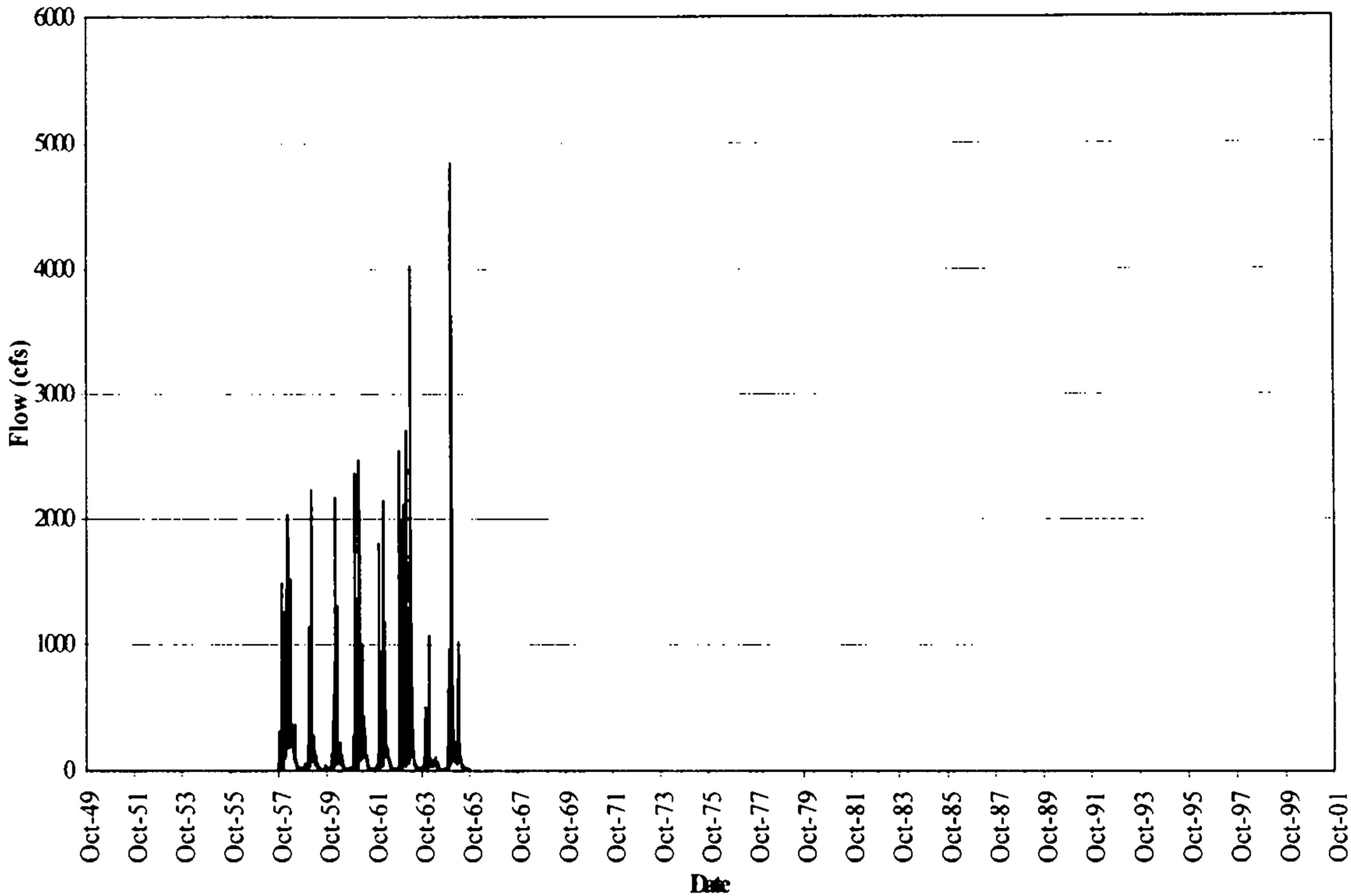
Kilarc-Cow Creek Project, FERC No. 606

11374000 Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1999 to Sept 2000

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	57	110	1,450	140	2,190	2,630	476	429	171	76	33	79
2	60	111	520	144	1,340	2,250	500	433	159	77	33	183
3	60	111	429	140	1,160	1,830	527	425	145	77	33	126
4	66	114	296	141	1,710	1,880	540	422	146	77	32	118
5	67	116	247	143	1,760	6,370	535	405	141	97	32	92
6	78	119	218	137	1,430	3,010	522	379	139	96	34	78
7	98	124	206	135	996	2,240	502	405	134	88	34	75
8	93	180	196	135	806	2,680	523	453	199	85	32	70
9	79	180	255	134	695	5,680	574	404	214	79	29	65
10	76	269	411	139	1,290	3,760	527	380	202	71	32	61
11	77	471	284	593	2,100	3,220	494	349	177	66	34	64
12	72	227	249	513	5,870	2,190	484	320	162	61	33	55
13	78	172	328	491	12,700	1,680	649	338	146	62	28	53
14	79	150	285	801	9,560	1,410	768	334	127	64	29	50
15	74	152	232	8,140	3,900	1,210	617	371	114	64	28	58
16	64	175	210	3,270	2,500	1,050	649	439	102	63	26	58
17	67	502	198	1,320	1,870	994	1,740	369	102	61	26	53
18	69	263	190	1,160	1,460	895	1,890	317	105	60	26	48
19	74	381	181	3,860	1,180	837	1,260	297	105	56	31	42
20	70	1,380	175	4,980	1,130	790	865	293	94	61	30	37
21	67	596	171	1,540	1,810	772	719	274	89	51	33	36
22	79	337	164	1,200	2,230	749	647	264	94	49	30	42
23	86	268	160	2,750	4,240	714	597	246	90	44	28	72
24	78	232	157	6,510	1,990	694	547	240	92	45	29	67
25	83	202	153	3,780	1,780	671	512	239	91	42	31	59
26	87	199	150	2,000	5,570	640	502	247	97	40	32	52
27	102	188	147	1,230	5,070	626	498	234	86	45	27	57
28	295	182	144	919	3,310	612	502	214	78	40	26	57
29	178	181	142	746	3,750	589	465	209	75	36	29	57
30	133	1,840	141	2,660		555	438	191	70	33	31	52
31	117		140	2,490		506		181		32	33	
Total	2,763	9,532	8,229	52,341	85,397	53,734	20,069	10,101	3,746	1,898	944	2,016
Mean	89	318	265	1,688	2,945	1,733	669	326	125	61	30	67
Max	295	1,840	1,450	8,140	12,700	6,370	1,890	453	214	97	34	183
Min	57	110	140	134	695	506	438	181	70	32	26	36
AC-FT	5,480	18,906	16,322	103,817	169,382	106,580	39,806	20,035	7,430	3,765	1,872	3,999

Little Cow Creek at Ingot



Average Daily Flow for Little Cow Creek at Ingot.

Average Monthly Flow Little Cow Creek Near Ingot, Water Years 1958-1965

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1958	55	117	225	439	953	501	484	164	93	28	13	11
1959	13	23	39	266	344	107	79	41	13	6.7	6.5	10
1960	8.0	13	24	137	380	273	94	93	25	7.4	8.2	6.6
1961	9.2	94	231	161	498	322	177	114	45	10	8.2	8.2
1962	13	72	218	91	627	271	147	73	24	7.7	7.5	6.4
1963	261	65	379	166	297	201	844	226	47	20	12	10
1964	17	134	38	155	56	50	62	54	29	8.2	5.8	6.2
1965	8.8	152	636	501	123	75	425	100	32	15	14	10
Average	48	84	224	240	410	225	289	108	39	13	9.4	8.7
Max	261	152	636	501	953	501	844	226	93	28	14	11
Min	8.0	13	24	91	56	50	62	41	13	6.7	5.8	6.2

11373300 Little Cow C Nr Ingot Ca

Streamflow (cfs), Water Year Oct 1957 to Sep 1958

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	41	30	36	138	485	395	1,200	196	87	43	18	8.4
2	26	29	36	312	818	348	1,210	203	95	47	19	8.4
3	25	29	36	178	964	313	1,300	211	108	42	18	8.8
4	25	28	35	142	844	280	1,510	196	89	36	17	8.8
5	100	28	36	125	691	258	893	199	83	36	15	9.2
6	55	28	34	114	611	241	927	196	80	35	14	8.8
7	51	28	32	104	952	221	580	189	81	32	13	10
8	33	29	32	104	770	223	454	185	101	31	14	15
9	35	28	30	99	972	201	385	185	241	31	15	14
10	38	37	31	983	725	192	351	192	109	30	14	13
11	31	38	30	567	653	178	345	298	96	28	12	13
12	29	32	29	1,120	2,030	180	335	252	358	26	11	13
13	306	1,480	28	539	833	241	329	189	133	25	12	13
14	163	652	29	326	1,460	299	326	167	104	23	12	12
15	63	176	129	292	1,520	365	313	161	90	24	10	11
16	42	111	579	234	1,840	255	316	156	84	24	11	9.2
17	34	87	827	201	997	319	365	158	78	28	14	10
18	31	80	550	176	996	226	351	156	74	27	12	10
19	28	77	289	161	1,330	201	329	154	86	25	12	9.2
20	27	65	537	150	812	917	322	144	77	25	13	10
21	27	57	1,250	136	625	1,440	319	134	68	25	12	10
22	27	50	431	125	534	749	313	142	65	24	11	13
23	88	47	252	131	521	1,110	272	152	61	29	11	18
24	105	45	196	594	1,850	1,300	244	133	63	26	11	13
25	57	42	161	542	1,130	866	223	122	54	23	11	13
26	46	41	211	927	710	576	213	114	52	22	11	12
27	39	38	152	450	550	462	206	109	50	19	11	13
28	36	38	375	1,170	458	514	196	101	47	17	11	12
29	32	36	255	1,710		869	199	95	45	18	12	10
30	32	36	187	1,050		1,130	194	90	43	18	12	10
31	32		154	715		662		93		17	10	
Total	1,704	3,522	6,989	13,615	26,681	15,531	14,520	5,072	2,802	856	399	337
Mean	55	117	225	439	953	501	484	164	93	28	13	11
Max	306	1,480	1,250	1,710	2,030	1,440	1,510	298	358	47	19	18
Min	25	28	28	99	458	178	194	90	43	17	10	8.4
AC-FT	3,380	6,986	13,862	27,005	52,921	30,805	28,800	10,060	5,558	1,698	791	669

11373300 Little Cow C Nr Ingot Ca

Streamflow (cfs), Water Year Oct 1958 to Sep 1959

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	8.0	16	22	30	116	148	129	70	21	8.4	6.2	6.9
2	8.4	16	22	28	103	142	120	60	20	8.4	6.2	7.2
3	9.2	16	22	25	95	136	114	58	20	8.8	6.2	7.2
4	9.2	16	22	24	92	125	111	53	20	8.8	6.2	7.2
5	10	16	22	41	86	120	113	51	20	8.4	6.5	7.2
6	10	16	22	401	83	116	106	49	20	8.0	6.2	7.2
7	10	16	22	539	83	111	99	48	18	8.0	6.2	7.2
8	10	14	22	902	80	104	92	45	17	7.2	6.2	7.2
9	9.2	21	23	1,130	81	99	90	45	16	7.2	6.2	7.2
10	9.2	49	22	269	248	95	86	43	16	6.9	6.2	7.2
11	9.2	24	22	249	234	89	78	43	15	7.2	6.2	6.9
12	10	24	22	1,130	158	90	74	42	14	6.5	6.2	7.2
13	10	26	21	395	133	90	72	45	13	6.5	6.2	7.6
14	11	34	21	187	236	86	70	53	11	6.2	6.2	8.0
15	11	27	21	123	480	81	66	49	10	5.9	6.2	9.2
16	11	25	20	96	2,230	80	59	43	10	5.9	6.2	8.8
17	11	23	20	80	688	81	59	43	10	5.6	6.5	8.8
18	27	24	20	69	602	80	58	41	9.2	5.6	6.5	36
19	26	28	20	60	594	77	53	38	9.2	5.6	6.5	20
20	18	25	20	53	730	76	52	35	8.4	5.6	6.5	15
21	16	24	28	50	636	80	53	32	8.4	5.6	6.5	12
22	16	23	23	47	505	98	53	32	8.0	5.9	6.5	12
23	16	22	22	47	351	113	52	35	8.4	5.9	6.5	12
24	16	22	28	114	269	92	53	32	8.4	5.9	6.5	11
25	16	22	68	417	218	84	69	30	8.4	5.9	6.9	11
26	16	22	196	220	189	127	116	31	8.8	6.2	6.9	10
27	16	22	186	524	165	95	84	30	8.4	6.2	6.9	10
28	16	22	112	473	154	90	72	28	8.4	6.5	6.9	10
29	16	22	47	223		87	65	26	8.8	6.5	7.2	10
30	15	22	36	165		268	65	25	8.8	6.2	7.2	8.8
31	16		32	131		156		23		6.2	6.9	
Total	412	679	1,206	8,242	9,639	3,316	2,383	1,278	382	208	200	305
Mean	13	23	39	266	344	107	79	41	13	6.7	6.5	10
Max	27	49	196	1,130	2,230	268	129	70	21	8.8	7.2	36
Min	8.0	14	20	24	80	76	52	23	8.0	5.6	6.2	6.9
AC-FT	817	1,347	2,392	16,348	19,119	6,577	4,727	2,535	757	412	397	605

Kilarc-Cow Creek Project, FERC No. 606

11373300 Little Cow C Nr Ingot Ca

Streamflow (cfs), Water Year Oct 1959 to Sep 1960

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	9.2	8.4	19	18	850	59	111	103	53	10	10	4.7
2	9.2	8.8	18	17	330	55	106	218	48	10	10	7.2
3	9.2	9.2	17	19	405	141	104	154	45	10	9.2	8.0
4	8.4	10	17	18	371	561	106	150	43	10	9.2	7.6
5	8.4	10	17	19	474	893	104	120	36	9.2	8.8	7.6
6	8.0	11	18	20	252	584	103	108	35	8.4	8.8	7.2
7	8.0	11	17	22	2,040	1,300	103	125	36	7.6	8.4	6.9
8	8.6	11	17	164	2,170	630	99	111	46	6.9	8.4	6.9
9	9.2	11	17	63	960	406	98	104	33	6.9	8.0	6.9
10	10	11	18	51	739	289	93	99	28	7.6	8.0	6.5
11	7.9	11	18	394	365	244	95	96	28	7.6	8.8	6.5
12	7.9	11	19	112	249	358	84	92	25	7.2	9.2	7.6
13	7.9	11	20	55	234	301	76	80	25	7.6	9.2	6.9
14	7.9	12	20	47	167	221	84	69	24	7.2	9.2	6.5
15	7.9	12	19	40	140	189	72	66	22	6.9	9.2	6.5
16	6.2	13	19	35	122	165	64	63	21	5.2	9.2	6.9
17	7.3	13	19	33	109	154	63	60	20	6.2	8.0	6.2
18	7.3	13	19	32	163	152	61	57	20	5.9	6.9	6.2
19	7.3	13	18	35	122	144	65	53	18	5.6	6.9	6.5
20	7.3	13	18	39	101	140	60	59	16	4.9	6.9	7.2
21	7.3	16	18	135	92	138	60	63	14	4.4	7.2	8.0
22	7.3	16	18	600	84	136	60	55	15	4.1	7.2	6.9
23	7.3	19	27	212	77	134	89	81	14	5.6	7.2	6.5
24	7.3	19	129	131	73	134	99	116	13	6.2	7.2	5.9
25	7.3	18	59	266	72	133	114	108	12	7.6	6.9	4.9
26	7.3	18	28	286	69	134	106	96	11	7.6	7.6	5.6
27	7.3	18	24	400	65	133	182	87	11	8.4	8.0	5.9
28	8.4	18	21	431	63	148	122	78	10	7.6	7.6	6.2
29	8.4	19	20	156	59	116	125	72	10	9.2	7.6	6.2
30	8.4	20	19	279		146	98	65	10	8.8	8.0	6.5
31	8.4		18	120		125		60		8.4	8.4	
Total	247	404	745	4,249	11,017	8,463	2,806	2,868	742	228	254	199
Mean	8.0	13	24	137	380	273	94	93	25	7.4	8.2	6.6
Max	10	20	129	600	2,170	1,300	182	218	53	10	10	8.0
Min	6.2	8.4	17	17	59	55	60	53	10	4.1	6.9	4.7
AC-FT	491	802	1,478	8,428	21,852	16,786	5,566	5,689	1,471	452	505	395

Kilarc-Cow Creek Project, FERC No. 606

11373300 Little Cow C Nr Ingot Ca

Streamflow (cfs), Water Year Oct 1960 to Sep 1961

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.2	6.6	2,360	39	660	102	224	144	100	14	7.3	8.7
2	6.8	6.8	524	36	839	99	221	134	118	13	7.5	9.0
3	6.8	7.7	228	35	563	94	230	126	93	14	7.1	8.4
4	6.4	7.7	119	34	343	89	239	119	85	14	7.4	8.4
5	7.6	9.1	81	34	258	143	232	116	81	14	7.7	8.2
6	21	13	62	34	235	118	209	134	73	14	8.1	7.7
7	14	19	52	34	215	99	189	125	68	13	8.4	7.4
8	12	16	47	39	402	330	174	108	62	12	8.4	7.0
9	10	15	42	65	2,060	334	168	112	58	12	9.0	7.1
10	10	14	39	50	791	321	158	147	55	12	8.4	7.4
11	10	21	36	42	1,960	266	151	268	53	12	8.6	7.3
12	11	60	33	38	674	182	167	151	52	11	8.5	6.9
13	10	278	31	37	565	157	149	127	46	11	7.8	6.8
14	10	114	30	34	743	303	137	115	41	9.3	7.4	7.1
15	10	50	33	34	817	454	130	112	38	8.0	7.2	7.7
16	9.3	34	298	33	507	298	130	107	34	7.8	7.4	11
17	10	32	1,350	32	379	520	132	102	32	7.5	7.9	12
18	10	258	586	31	299	269	129	97	30	9.1	8.1	11
19	8.4	51	323	31	253	479	116	103	27	9.4	8.6	9.3
20	8.4	35	176	29	220	448	107	108	25	8.8	10	8.9
21	8.4	30	124	28	194	288	113	104	23	8.5	8.5	8.2
22	8.4	26	100	28	176	255	172	100	23	7.5	8.1	8.1
23	7.2	31	81	33	159	263	423	91	23	7.8	8.2	8.1
24	8.9	58	70	33	147	841	296	84	20	7.7	8.0	7.8
25	8.0	755	64	31	137	487	202	82	18	7.6	8.0	8.1
26	8.0	468	57	35	126	996	157	103	17	6.9	8.3	8.0
27	8.4	147	52	76	115	565	136	87	17	6.8	8.4	7.9
28	8.4	74	47	50	109	369	127	78	16	6.8	8.6	8.0
29	8.0	55	46	519		302	144	75	15	7.4	9.4	7.7
30	6.8	140	44	953		262	143	93	15	7.6	9.2	7.6
31	6.8		41	2,470		237		85		7.5	9.4	
Total	286	2,832	7,176	4,997	13,946	9,970	5,305	3,537	1,358	308	254	247
Mean	9.2	94	231	161	498	322	177	114	45	10	8.2	8.2
Max	21	755	2,360	2,470	2,060	996	423	268	118	14	10	12
Min	6.4	6.6	30	28	109	89	107	75	15	6.8	7.1	6.8
AC-FT	566	5,617	14,233	9,911	27,661	19,775	10,522	7,016	2,694	611	505	490

11373300 Little Cow C Nr Ingot Ca

Streamflow (cfs), Water Year Oct 1961 to Sep 1962

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.9	16	1,800	51	52	159	149	98	50	12	7.6	5.7
2	8.7	16	536	49	50	257	152	99	48	11	7.3	5.9
3	8.3	16	210	46	48	228	155	99	46	10	6.8	6.0
4	8.2	16	117	45	48	265	157	100	41	10	7.7	6.2
5	8.2	15	85	44	47	1,100	163	94	37	10	8.2	5.9
6	7.9	15	67	43	65	1,170	164	91	35	8.8	8.2	5.9
7	7.9	15	58	43	1,390	595	169	89	34	8.2	8.7	6.4
8	8.4	14	51	46	2,030	406	180	96	33	8.0	10	6.3
9	8.2	15	46	44	1,170	310	178	96	32	8.6	12	6.5
10	8.6	15	43	44	1,160	243	163	84	30	8.3	10	6.7
11	18	16	40	44	1,790	201	159	79	28	8.1	9.4	7.5
12	19	16	40	49	1,700	172	159	73	25	7.9	9.3	7.2
13	12	16	38	44	2,140	159	164	79	23	7.2	8.4	7.1
14	11	15	38	42	1,110	149	173	71	25	6.8	8.1	7.2
15	10	15	35	40	1,110	144	177	68	24	5.7	7.9	6.9
16	10	15	33	39	713	157	159	63	22	5.6	7.6	5.6
17	10	15	157	40	506	154	150	61	20	5.8	6.7	5.1
18	10	15	212	43	428	134	140	70	18	5.4	7.0	4.4
19	10	16	942	806	357	131	146	73	16	7.1	6.9	5.2
20	12	20	834	421	320	148	130	64	14	7.6	6.5	5.3
21	14	17	435	117	253	159	114	60	14	7.3	6.6	5.4
22	11	20	203	95	207	475	112	59	13	7.1	6.8	5.5
23	12	28	142	79	180	244	118	62	13	7.6	6.5	5.7
24	12	77	111	76	168	187	124	57	13	7.4	6.4	5.8
25	11	688	94	77	150	162	118	56	13	6.7	6.3	4.9
26	12	420	81	69	122	158	110	56	13	6.5	6.0	4.7
27	41	140	72	63	117	150	165	53	13	6.4	5.8	5.8
28	28	64	65	60	119	152	156	51	12	6.8	5.7	12
29	17	274	60	57		149	119	53	12	7.4	5.8	12
30	16	126	55	54		146	101	55	12	8.1	5.8	8.4
31	16		52	53		147		53		7.3	5.6	
Total	394	2,166	6,752	2,823	17,550	8,411	4,424	2,262	729	240	232	193
Mean	13	72	218	91	627	271	147	73	24	7.7	7.5	6.4
Max	41	688	1,800	806	2,140	1,170	180	100	50	12	12	12
Min	7.9	14	33	39	47	131	101	51	12	5.4	5.6	4.4
AC-FT	781	4,296	13,392	5,599	34,810	16,683	8,775	4,487	1,446	476	459	383

Kilarc-Cow Creek Project, FERC No. 606

11373300 Little Cow C Nr Ingot Ca

Streamflow (cfs), Water Year Oct 1962 to Sep 1963

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.2	26	65	87	1,780	100	496	240	82	29	14	11
2	6.8	25	1,970	85	719	95	335	231	73	29	13	10
3	10	25	867	85	635	93	269	305	70	28	13	9.2
4	8.9	25	315	78	439	92	232	274	69	28	13	10
5	8.0	26	208	75	335	87	1,520	255	65	28	12	9.2
6	7.6	25	158	70	272	87	3,300	240	64	27	12	9.2
7	7.6	24	127	68	229	84	4,020	653	60	29	11	10
8	10	24	110	65	213	82	1,530	541	57	27	12	10
9	96	30	100	61	186	79	1,180	436	54	25	13	10
10	315	24	90	57	196	76	1,020	348	52	23	13	10
11	2,020	28	84	50	172	72	756	319	50	23	13	9.2
12	2,540	28	76	61	213	69	595	270	48	22	12	9.2
13	867	27	72	52	413	66	640	240	47	22	11	9.2
14	1,080	26	78	52	309	75	1,770	219	43	21	11	10
15	249	34	1,270	51	238	75	1,110	202	43	20	11	10
16	148	25	926	50	227	92	720	190	42	18	10	10
17	105	24	2,110	50	240	98	550	185	43	18	10	10
18	84	24	778	48	186	102	566	180	38	18	11	11
19	66	23	459	44	167	105	1,160	172	36	18	10	11
20	57	24	322	45	172	102	565	170	34	18	10	11
21	51	24	252	45	152	88	428	162	35	16	10	10
22	45	24	206	44	137	84	404	154	36	17	11	10
23	41	22	179	43	129	222	322	148	38	16	12	11
24	37	22	152	43	123	213	291	138	34	16	14	11
25	35	23	135	42	118	123	284	128	32	15	14	10
26	33	715	123	40	114	109	280	120	30	13	12	10
27	32	310	116	39	107	876	280	113	30	13	11	10
28	31	127	109	40	103	871	240	102	36	13	12	10
29	29	87	103	44		359	234	99	35	14	11	10
30	28	73	100	828		386	237	94	30	14	11	10
31	26		95	2,700		1,170		88		13	11	
Total	8,081	1,944	11,755	5,142	8,324	6,232	25,334	7,016	1,406	631	364	298
Mean	261	65	379	166	297	201	844	226	47	20	12	10
Max	2,540	715	2,110	2,700	1,780	1,170	4,020	653	82	29	14	11
Min	6.8	22	65	39	103	66	232	88	30	13	10	9.2
AC-FT	16,029	3,856	23,316	10,199	16,510	12,361	50,249	13,916	2,789	1,252	721	592

Kilarc-Cow Creek Project, FERC No. 606

11373300 Little Cow C Nr Ingot Ca

Streamflow (cfs), Water Year Oct 1963 to Sep 1964

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	8.9	18	44	38	91	60	81	78	30	11	5.2	11
2	8.5	19	41	39	83	59	69	59	29	11	5.5	9.3
3	10	20	40	36	78	51	64	106	28	11	5.5	7.1
4	10	66	38	35	74	49	64	74	28	11	6.7	6.7
5	10	66	38	34	71	46	64	61	29	10	6.1	5.9
6	10	101	36	34	67	44	61	55	42	10	5.7	6.1
7	10	71	35	34	65	42	57	53	51	8.8	5.7	5.8
8	10	266	35	32	62	41	60	52	47	8.1	5.6	5.9
9	11	403	41	36	58	42	66	53	69	8.9	4.9	6.2
10	12	150	39	44	58	41	74	54	60	8.8	5.3	5.8
11	31	63	35	37	56	45	69	52	45	8.4	6.4	5.7
12	26	45	35	36	54	77	67	55	37	8.0	6.5	5.5
13	19	52	34	35	53	65	61	59	34	8.5	5.9	5.7
14	17	280	34	39	52	53	67	58	31	8.6	5.6	5.7
15	17	264	34	37	60	50	69	58	30	9.1	5.6	5.3
16	16	106	34	39	56	47	76	58	28	8.8	5.6	5.4
17	15	71	33	109	52	47	70	55	27	8.0	5.5	6.0
18	15	57	33	147	48	48	66	54	25	8.5	4.9	6.0
19	16	160	33	461	49	47	58	53	24	8.3	5.3	5.6
20	16	300	49	1,070	46	47	58	53	23	8.3	5.5	5.4
21	17	150	43	706	45	47	58	49	21	8.0	5.9	5.3
22	18	80	38	301	45	52	57	47	19	7.7	5.7	5.4
23	39	500	36	220	44	52	56	44	16	7.1	6.1	5.9
24	23	250	34	201	45	57	52	41	13	6.7	6.2	5.6
25	21	150	34	241	43	53	50	39	12	6.1	6.0	5.8
26	19	100	34	192	43	50	47	40	12	5.5	5.9	5.6
27	18	62	35	146	43	50	47	49	11	5.7	6.3	6.0
28	19	56	43	123	44	47	50	46	12	6.6	5.7	6.2
29	20	51	46	115	44	47	56	40	12	7.1	5.6	6.4
30	20	47	40	104		49	61	37	12	6.2	6.1	6.6
31	19		39	93		53		34		5.2	6.7	
Total	519	4,024	1,163	4,814	1,629	1,558	1,855	1,666	857	255	179	185
Mean	17	134	38	155	56	50	62	54	29	8.2	5.8	6.2
Max	39	500	49	1,070	91	77	81	106	69	11	6.7	11
Min	8.5	18	33	32	43	41	47	34	11	5.2	4.9	5.3
AC-FT	1,030	7,981	2,307	9,548	3,231	3,090	3,679	3,304	1,700	505	355	367

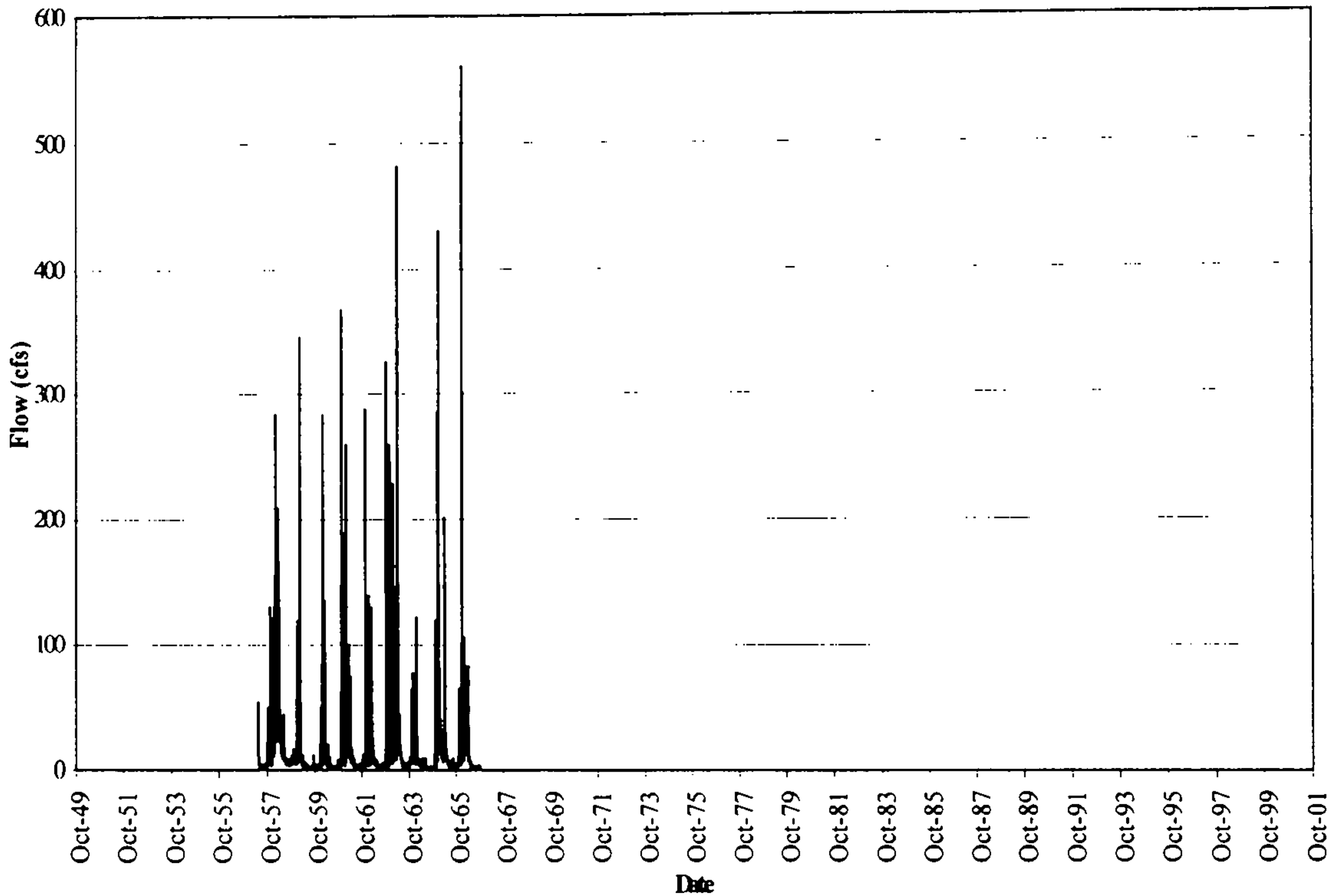
11373300 Little Cow C Nr Ingot Ca

Streamflow (cfs), Water Year Oct 1964 to Sep 1965

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	6.6	46	401	440	179	91	165	203	51	20	13	11
2	6.3	94	413	402	168	84	310	180	48	20	13	11
3	6.8	36	191	424	157	84	152	163	45	19	13	11
4	6.7	25	121	899	152	88	121	154	42	19	13	11
5	5.6	24	92	3,620	230	79	114	144	41	18	13	11
6	5.6	23	76	1,580	196	76	458	136	39	18	12	11
7	6.3	23	66	666	161	72	224	128	37	17	12	11
8	7.0	34	61	420	149	69	453	120	38	17	12	11
9	6.8	636	59	335	139	69	1,020	111	35	16	12	11
10	6.9	639	354	341	132	69	595	108	32	16	13	11
11	7.1	524	311	566	124	68	371	104	32	16	16	11
12	7.6	250	138	393	117	76	275	100	31	15	20	11
13	7.7	89	99	311	114	71	269	103	31	15	17	11
14	8.1	60	84	280	110	66	268	100	33	15	16	11
15	8.0	47	74	280	104	65	385	98	36	14	15	11
16	8.2	42	70	265	98	64	894	92	31	14	14	10
17	8.0	37	61	245	96	64	460	88	36	14	15	10
18	7.9	34	63	239	93	62	898	83	35	14	16	10
19	8.0	33	615	235	89	60	913	84	31	13	15	10
20	8.3	31	381	224	86	58	738	83	30	13	15	10
21	8.1	30	1,580	216	85	59	773	80	30	13	16	10
22	8.1	33	4,840	199	85	61	554	81	28	13	16	10
23	7.3	30	1,670	665	82	60	418	72	26	13	16	10
24	7.9	34	1,320	544	80	60	347	67	25	13	16	10
25	8.1	76	1,530	362	78	61	307	63	24	13	16	10
26	8.4	131	1,410	294	79	91	284	61	23	13	15	10
27	10	94	925	255	165	167	264	59	22	13	14	10
28	14	961	757	231	103	97	252	58	21	13	14	10
29	23	262	702	211		80	243	56	21	13	13	10
30	20	176	690	198		73	224	55	20	13	12	10
31	14		567	192		73		53		13	11	
Total	272	4,554	19,721	15,532	3,451	2,317	12,749	3,087	974	466	443	313
Mean	8.8	152	636	501	123	75	425	100	32	15	14	10
Max	23	961	4,840	3,620	230	167	1,020	203	51	20	20	11
Min	5.6	23	59	192	78	58	114	53	20	13	11	10
AC-FT	540	9,033	39,116	30,807	6,845	4,596	25,287	6,123	1,932	924	879	621

Kilarc-Cow Creek Project, FERC No. 606

Oak Run Creek at Oak Run



Average Daily Flow for Oak Run Creek at Oak Run.

Average Monthly Flow. Oak Run Creek Near Oak Run, Water Years 1957-1966

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1957								18	4.3	2.7	2.6	4.2
1958	8.8	15	25	52	103	62	49	14	13	6.4	5.3	5.4
1959	6.4	7.6	9.0	35	46	8	4.1	3.9	2.0	1.2	1.4	2.6
1960	3.1	3.2	3.8	17	45	28	6.8	7.6	3.0	1.3	1.1	1.9
1961	3.5	17	32	18	57	33	16	8.2	4.3	2.1	2.3	2.8
1962	5.0	9.4	27	11	41	34	8.3	5.6	2.8	1.7	2.5	2.7
1963	32	7.0	42	19	30	22	96	20	6.7	4.3	3.6	4.3
1964	7.0	21	7.0	21	7.2	5.4	3.2	3.5	3.4	0.93	0.79	1.4
1965	1.6	22	48	59	15	10	65	10	5.1	4.5	4.5	3.5
1966	3.7	16	14	63	33	28	16	4.7	2.3	1.6	1.4	2.3
Average	8	13	23	33	42	26	29	10	4.7	2.7	2.6	3.1
Max	32	22	48	63	103	62	96	20	13	6.4	5.3	5.4
Min	1.6	3.2	3.8	11	7.2	5.4	3.2	3.5	2.0	0.93	0.79	1.4

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1956 to Sep 1957

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1									8.4	2.6	3.1	2.6
2									6.3	3.2	2.9	2.3
3									6.4	2.9	2.4	2.3
4									6.2	2.4	2.8	2.4
5									5.8	2.8	3.2	2.4
6									5.3	3.1	3.2	2.6
7									5.0	3.4	2.6	2.4
8									4.6	2.9	3.0	2.6
9									4.4	2.3	3.2	2.5
10									4.3	2.3	3.3	2.9
11									3.7	2.5	2.9	2.8
12									4.1	2.5	2.8	2.6
13								14	4.6	2.4	2.0	2.4
14								15	4.6	2.6	2.2	2.7
15								13	4.1	2.8	2.2	3.6
16								12	3.2	2.8	3.0	3.1
17								13	3.4	2.4	2.9	3.0
18								54	3.6	2.5	2.8	3.4
19								43	4.2	3.0	2.4	3.0
20								26	4.1	3.2	2.8	2.8
21								22	3.6	2.8	3.0	2.8
22								19	3.4	2.8	2.7	2.8
23								16	3.5	2.6	2.1	2.4
24								15	3.4	2.8	1.9	2.4
25								15	3.2	2.8	2.3	3.2
26								13	3.0	2.8	2.3	7.5
27								12	2.9	2.8	2.2	21
28								10	3.4	2.7	2.2	14
29								10	3.4	2.6	2.0	7.0
30								10	2.7	2.1	2.8	8.1
31								10		2.3	2.9	
Total								342	129	84	82	126
Mean								18	4.3	2.7	2.6	4.2
Max								54	8.4	3.4	3.3	21
Min								10	2.7	2.1	1.9	2.3
AC-FT								678	255	166	163	249

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1957 to Sep 1958

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.9	5.0	4.5	16	59	41	148	14	10	8.5	5.4	4.3
2	6.0	5.0	4.5	32	112	36	160	14	11	8.5	6.1	3.7
3	5.0	5.0	4.5	17	122	34	107	14	11	8.0	6.0	4.3
4	6.0	5.0	4.5	14	111	30	86	16	10	7.5	5.4	5.0
5	8.5	5.5	4.0	13	74	29	118	16	8.9	7.5	4.7	4.4
6	8.5	5.5	4.0	12	63	28	127	15	8.8	7.5	5.0	3.9
7	8.5	6.0	4.0	11	82	27	69	20	10	7.0	5.0	4.7
8	6.0	6.0	4.0	11	65	27	54	20	14	6.9	5.2	7.9
9	6.0	7.0	4.0	11	96	24	47	13	44	6.4	4.8	6.2
10	11	8.0	4.0	90	65	24	42	14	16	6.2	5.4	6.3
11	7.0	8.0	4.0	70	78	23	38	30	17	5.8	5.4	6.1
12	6.0	9.0	4.0	130	283	25	36	21	32	5.6	5.0	5.9
13	50	130	4.0	70	90	34	34	16	17	5.3	4.5	5.8
14	25	120	4.0	45	207	45	32	14	15	5.4	4.8	5.8
15	10	15	30	35	183	51	31	13	13	5.8	5.5	5.2
16	9.0	12	70	27	137	31	30	13	12	6.7	4.8	4.6
17	8.0	10	90	22	84	49	32	12	12	6.9	5.8	5.0
18	7.0	9.0	60	19	105	31	29	11	11	6.4	5.5	4.9
19	6.0	8.0	30	18	143	29	27	11	13	5.2	6.0	4.7
20	5.0	7.0	63	17	75	130	25	10	11	5.5	6.3	5.0
21	5.0	6.5	121	16	60	151	25	10	10	6.2	6.4	5.0
22	5.0	6.0	35	14	55	209	25	11	10	6.5	6.2	7.2
23	5.0	6.0	24	22	56	125	23	14	10	8.3	5.1	6.9
24	10	5.5	19	125	202	112	22	13	10	6.5	4.5	6.4
25	8.0	5.5	16	64	97	82	20	11	10	6.3	5.0	6.2
26	7.0	5.5	28	107	66	60	18	11	8.5	6.3	5.2	6.0
27	6.0	5.0	16	49	54	52	17	11	8.5	6.0	5.3	5.1
28	5.5	5.0	62	147	46	64	18	11	8.5	5.3	5.3	4.9
29	5.0	5.0	26	155		121	18	10	8.5	5.6	5.1	5.2
30	5.0	5.0	20	129		118	16	10	8.5	4.5	5.1	4.9
31	5.0		16	91		84		10		5.4	4.2	
Total	273	441	784	1,599	2,870	1,926	1,474	429	387	200	164	162
Mean	8.8	15	25	52	103	62	49	14	13	6.4	5.3	5.4
Max	50	130	121	155	283	209	160	30	44	8.5	6.4	7.9
Min	5.0	5.0	4.0	11	46	23	16	10	8.5	4.5	4.2	3.7
AC-FT	541	875	1,555	3,172	5,693	3,820	2,924	851	768	396	325	320

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1958 to Sep 1959

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	5.2	7.7	6.2	6.6	14	15	5.5	5.8	4.2	1.6	0.80	1.6
2	5.3	7.8	6.1	6.3	12	14	5.2	5.6	3.1	1.5	1.1	1.3
3	5.8	7.8	6.1	6.2	10	12	5.0	4.8	2.7	1.5	1.0	1.6
4	5.3	7.8	6.1	6.0	10	11	4.9	4.2	2.9	1.4	1.1	1.6
5	5.6	7.9	6.1	39	9.1	11	4.7	4.0	2.7	1.8	0.70	1.6
6	5.4	7.9	6.0	109	8.9	10	4.4	4.0	3.0	1.6	0.60	2.0
7	5.3	7.8	6.0	47	8.6	10	4.2	2.9	2.4	1.2	0.50	1.6
8	5.0	7.8	6.1	77	8.3	9.4	4.4	3.0	1.3	1.2	0.50	1.7
9	4.8	13	6.1	101	9.0	9.1	4.2	3.4	1.9	0.70	1.0	1.6
10	5.0	16	5.9	26	33	8.6	4.0	3.3	1.3	0.90	1.3	1.5
11	5.4	9.4	5.9	25	32	8.3	3.5	3.2	1.6	1.3	1.4	1.0
12	5.3	7.3	5.8	119	16	8.2	4.2	2.7	1.4	0.90	1.6	1.4
13	5.6	8.2	5.7	34	13	7.9	3.1	2.9	1.2	1.2	1.4	1.7
14	5.7	7.9	5.7	20	17	7.6	2.9	4.2	1.9	1.3	1.3	2.7
15	5.9	6.8	5.4	16	55	7.4	2.9	3.6	1.5	1.2	1.0	2.5
16	5.8	6.5	5.7	13	345	6.7	3.0	3.7	1.3	1.5	0.70	2.9
17	6.0	6.4	5.6	11	68	6.0	2.9	4.2	1.8	0.80	0.50	2.8
18	11	6.4	5.7	10	65	5.9	2.9	3.9	1.9	1.1	1.1	11
19	9.0	6.8	5.7	8.6	157	5.3	3.2	3.6	1.9	1.0	1.8	4.2
20	6.8	6.4	5.8	8.2	99	4.9	2.9	3.7	2.0	1.3	2.4	3.4
21	6.5	6.5	7.0	7.9	79	5.3	2.9	3.7	1.6	1.1	2.4	3.1
22	6.8	6.4	5.9	7.6	69	6.6	3.3	3.6	1.9	1.0	2.2	2.9
23	7.1	6.3	5.9	7.4	41	6.8	3.4	4.2	1.4	1.0	2.1	2.7
24	7.4	6.3	7.3	22	32	6.1	3.4	3.9	1.2	1.2	1.9	2.9
25	7.1	6.3	14	79	27	7.8	4.8	3.9	1.6	1.1	1.8	2.9
26	7.3	6.3	56	28	23	10	6.3	4.2	1.9	1.2	1.6	3.1
27	7.3	6.2	29	109	20	6.6	5.0	4.2	1.9	1.2	1.6	3.0
28	7.1	6.2	13	69	17	5.3	4.9	3.7	1.9	1.0	1.5	2.9
29	7.1	6.2	8.5	29		5.3	5.2	3.5	1.7	0.60	1.5	3.1
30	7.4	6.2	7.3	21		11	4.9	3.7	1.6	1.3	1.7	3.1
31	7.4		6.8	17		6.2		4.1		0.70	2.2	
Total	198	227	278	1,085	1,298	255	122	119	59	36	42	79
Mean	6.4	7.6	9.0	35	46	8.2	4.1	3.9	2.0	1.2	1.4	2.6
Max	11	16	56	119	345	15	6.3	5.8	4.2	1.8	2.4	11
Min	4.8	6.2	5.4	6.0	8.3	4.9	2.9	2.7	1.2	0.60	0.50	1.0
AC-FT	392	449	552	2,153	2,574	505	242	237	116	72	84	157

Kilarc-Cow Creek Project, FERC No. 606

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1959 to Sep 1960

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	4.0	3.3	2.6	2.6	105	6.1	8.0	9.0	4.6	2.2	1.7	0.80
2	4.3	3.4	2.4	2.6	24	6.0	7.6	20	4.5	2.4	1.5	0.80
3	3.7	3.6	2.5	2.5	66	21	7.5	12	3.8	1.5	1.2	1.5
4	1.9	3.7	2.4	2.3	38	73	6.8	12	3.4	1.8	1.2	0.70
5	2.4	3.6	2.5	2.3	53	100	6.5	9.3	2.3	1.7	1.2	0.90
6	2.5	3.6	2.4	2.4	25	41	6.5	8.6	3.3	1.0	0.80	1.9
7	2.8	3.0	2.5	3.2	283	135	6.5	9.3	2.8	1.3	1.3	2.4
8	3.3	2.7	2.6	19	271	55	6.2	8.0	3.6	1.1	1.5	2.5
9	3.7	3.0	2.6	8.8	88	38	6.5	7.5	3.4	1.3	1.1	3.0
10	3.4	3.2	2.6	6.9	95	30	6.5	7.0	3.4	2.0	1.4	3.0
11	3.2	3.3	2.8	50	37	29	5.8	6.8	3.5	1.6	1.6	2.4
12	3.2	3.2	3.2	11	26	53	5.0	6.7	3.2	1.2	1.4	2.5
13	3.1	3.0	3.2	5.0	28	35	4.7	6.5	3.2	2.0	1.3	2.0
14	3.3	3.3	3.0	5.0	19	24	5.2	6.4	3.4	1.1	1.0	0.90
15	3.1	3.2	3.0	5.4	16	22	4.7	4.3	3.3	1.1	0.70	1.3
16	2.8	3.6	3.1	5.3	13	18	4.4	4.7	3.2	1.0	1.0	2.2
17	3.2	3.8	3.4	5.1	11	17	4.4	5.2	2.8	0.90	0.50	1.9
18	3.2	3.2	3.3	4.7	16	16	3.2	5.2	3.0	1.1	0.60	1.2
19	3.1	3.2	3.3	4.4	12	14	3.6	4.8	2.7	1.2	1.0	1.2
20	3.0	3.8	3.2	4.9	10	13	3.4	5.6	3.1	0.60	0.30	1.7
21	3.0	3.3	3.2	33	9.0	12	3.7	6.7	2.2	0.50	0.30	1.7
22	3.5	2.9	3.2	84	8.2	11	3.7	5.2	2.6	0.80	0.30	1.6
23	3.2	3.2	5.2	18	7.8	11	8.1	7.8	2.6	1.0	0.90	1.8
24	3.2	2.8	20	13	7.4	10	11	9.0	2.0	1.2	1.5	2.5
25	3.2	2.5	7.0	22	7.3	9.3	9.2	8.8	3.1	1.5	1.6	2.0
26	3.2	2.6	4.2	19	7.0	9.0	9.0	8.0	2.4	1.9	1.2	2.0
27	3.0	2.6	3.8	56	6.7	9.0	15	7.0	2.6	1.7	1.0	2.5
28	2.8	2.8	3.6	54	6.6	11	11	6.7	2.6	1.0	1.6	2.8
29	2.9	2.9	3.4	19	6.2	8.6	10	6.2	2.5	1.2	1.6	2.9
30	3.0	2.7	3.3	31		10	8.8	5.9	1.9	1.5	0.90	1.8
31	3.2		3.4	11		8.6		5.6		1.3	0.80	
Total	97	95	117	513	1,302	856	203	236	91	42	34	56
Mean	3.1	3.2	3.8	17	45	28	6.8	7.6	3.0	1.3	1.1	1.9
Max	4.3	3.8	20	84	283	135	15	20	4.6	2.4	1.7	3.0
Min	1.9	2.5	2.4	2.3	6.2	6.0	3.2	4.3	1.9	0.50	0.30	0.70
AC-FT	193	188	232	1,018	2,583	1,697	402	468	180	83	67	112

Kilarc-Cow Creek Project, FERC No. 606

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1960 to Sep 1961

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1.8	3.6	367	5.5	50	12	24	10	8.6	2.7	3.2	1.9
2	1.8	3.6	77	5.3	120	12	22	10	9.4	1.8	3.3	2.4
3	1.6	3.1	31	5.2	60	12	20	8.6	7.2	1.4	2.9	1.8
4	1.8	2.9	18	5.0	36	11	19	7.7	6.6	2.9	2.4	1.1
5	3.0	2.3	12	5.0	27	19	18	7.7	6.5	2.8	2.6	1.2
6	7.6	2.6	10	4.9	26	14	16	10	6.5	3.4	2.2	1.3
7	5.3	4.0	7.9	5.2	22	12	15	9.0	6.2	2.7	2.0	2.0
8	4.8	3.0	7.6	5.8	41	34	14	8.8	5.9	1.4	1.4	1.8
9	4.5	2.8	6.9	10	246	30	14	10	5.8	1.3	1.6	2.4
10	5.0	2.8	6.9	6.6	73	28	13	11	5.2	1.5	1.6	2.7
11	4.9	4.8	6.4	5.5	259	21	12	16	4.7	1.7	1.8	2.6
12	4.8	18	5.9	5.2	69	18	12	11	5.3	1.8	2.4	2.6
13	4.2	62	5.8	4.9	64	16	11	10	5.2	2.2	2.9	3.0
14	4.0	20	5.6	4.9	78	37	11	8.8	4.7	2.1	2.9	3.1
15	3.5	9.4	6.4	4.9	92	39	10	8.3	4.5	2.2	2.5	3.3
16	3.5	6.6	48	4.8	50	29	8.5	7.9	3.9	2.2	1.7	5.0
17	2.4	8.2	188	4.6	40	48	7.9	7.7	2.6	1.8	1.7	4.8
18	2.6	30	55	4.3	34	27	7.9	7.4	2.8	2.2	3.9	4.4
19	3.1	7.7	28	4.2	30	54	6.2	7.4	2.2	2.7	4.4	4.1
20	2.8	6.1	19	4.2	26	38	7.6	7.6	2.4	2.7	4.1	3.8
21	1.8	5.5	14	4.1	23	28	10	6.8	1.6	2.6	3.4	3.5
22	2.7	4.3	12	4.0	21	27	24	5.9	1.6	2.2	2.0	3.1
23	3.0	5.9	10	5.3	19	34	74	6.1	1.6	2.3	1.3	3.4
24	2.8	7.7	9.2	4.8	18	100	20	5.9	1.8	2.2	1.7	3.1
25	3.1	147	8.3	4.5	17	46	15	4.1	2.5	1.4	1.5	2.4
26	4.1	81	7.7	6.6	14	89	13	7.6	2.4	1.4	1.4	2.2
27	3.7	19	6.9	13	14	54	11	6.8	2.7	1.6	1.2	2.0
28	3.0	10	6.6	7.2	13	39	10	6.4	3.3	1.6	1.2	2.4
29	3.4	8.3	6.2	95		34	12	6.6	3.0	1.9	2.5	2.8
30	3.2	23	6.1	102		30	11	8.6	2.6	2.2	2.2	3.4
31	3.5		5.9	195		27		7.2		3.4	1.8	
Total	107	515	1,005	547	1,582	1,019	469	256	129	66	72	84
Mean	3.5	17	32	18	57	33	16	8.2	4.3	2.1	2.3	2.8
Max	7.6	147	367	195	259	100	74	16	9.4	3.4	4.4	5.0
Min	1.6	2.3	5.6	4.0	13	11	6.2	4.1	1.6	1.3	1.2	1.1
AC-FT	213	1,022	1,993	1,085	3,138	2,021	930	507	256	132	142	166

Kilarc-Cow Creek Project, FERC No. 606

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1961 to Sep 1962

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	2.6	4.6	287	5.6	5.3	30	13	6.4	3.8	1.4	1.5	2.9
2	4.1	4.6	54	5.3	5.2	64	12	6.2	3.8	1.4	1.6	2.8
3	3.3	4.5	23	5.2	5.1	41	12	5.9	3.9	1.5	1.8	1.9
4	3.3	4.2	14	4.8	5.0	38	11	5.4	4.0	2.2	2.6	1.8
5	3.9	4.2	10	4.7	4.8	130	11	4.6	3.7	2.3	1.8	2.6
6	3.6	4.1	8	4.7	8.7	117	10	4.6	3.3	2.0	2.0	2.1
7	3.8	4.1	6.9	4.6	46	70	10	4.3	3.4	2.2	2.2	2.0
8	3.6	4.1	6.4	4.5	62	51	10	5.3	3.4	1.7	3.0	2.0
9	4.0	4.0	5.9	4.2	98	41	10	5.2	2.2	1.3	4.2	2.1
10	4.4	4.0	5.6	4.1	106	34	9.0	5.0	2.3	1.8	3.6	2.3
11	7.9	3.8	5.2	4.1	54	29	8.5	6.4	2.4	2.1	3.4	2.6
12	7.2	3.4	5.2	4.7	53	25	5.4	6.4	2.6	1.7	2.8	2.6
13	5.7	3.3	5.1	4.4	126	23	5.9	7.8	2.2	1.6	2.4	2.3
14	5.1	3.3	4.8	4.1	100	22	6.5	7.3	3.3	1.6	2.6	2.7
15	4.8	3.2	4.6	4.0	94	22	7.2	7.6	3.2	1.3	2.5	3.3
16	4.8	3.2	4.5	4.0	61	28	7.6	6.8	3.3	1.5	2.6	3.2
17	4.8	3.4	11	4.0	44	23	7.6	6.5	2.3	1.6	2.0	2.8
18	3.8	3.5	22	7.5	51	20	7.2	6.8	3.0	1.6	2.0	2.9
19	3.2	4.0	137	139	41	19	8.6	6.5	3.2	2.0	2.1	3.1
20	5.4	4.7	84	39	30	20	8.6	6.4	2.6	1.9	2.1	3.6
21	5.7	3.9	40	12	24	21	7.6	6.0	2.4	1.6	1.8	3.2
22	5.3	4.8	19	9.2	21	38	6.7	5.9	2.4	1.6	1.3	2.6
23	5.3	4.7	14	9.0	19	24	6.4	5.9	2.6	1.3	3.1	2.2
24	5.3	10	11	9.2	18	20	6.4	5.8	2.5	1.6	5.2	2.2
25	5.4	69	10	8.8	16	19	6.2	5.6	1.9	1.4	4.4	2.0
26	6.5	39	8.5	7.6	14	18	5.8	5.6	2.0	1.6	2.2	1.8
27	12	12	7.6	6.8	13	16	7.8	4.0	2.0	1.7	2.2	2.4
28	7.1	7.4	7.1	6.2	14	15	7.3	3.4	2.4	1.6	2.2	5.3
29	5.2	39	6.6	5.8		15	6.5	3.4	2.0	1.6	2.6	4.5
30	4.8	13	6.2	5.7		14	6.5	3.2	1.2	1.4	2.4	3.9
31	4.6		5.8	5.4		13		3.9		1.3	2.5	
Total	157	281	840	348	1,139	1,060	248	174	83	51	79	82
Mean	5.0	9.4	27	11	41	34	8.3	5.6	2.8	1.7	2.5	2.7
Max	12	69	287	139	126	130	13	7.8	4.0	2.3	5.2	5.3
Min	2.6	3.2	4.5	4.0	4.8	13	5.4	3.2	1.2	1.3	1.3	1.8
AC-FT	310	557	1,666	691	2,259	2,102	491	345	165	102	156	162

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1962 to Sep 1963

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	3.5	4.0	6.2	10	128	11	56	20	10	4.7	3.4	3.8
2	3.7	4.2	259	10	70	11	38	19	9.5	5.3	4.0	3.4
3	4.4	4.0	85	10	58	11	33	22	8.8	5.9	3.9	3.0
4	3.9	4.0	28	9.0	42	10	28	20	8.8	6.5	3.6	3.6
5	3.9	4.0	18	8.3	33	10	176	18	8.6	6.0	3.9	3.8
6	3.7	3.9	14	8.0	28	10	481	18	8.3	5.8	2.6	4.6
7	3.7	3.9	11	7.8	23	10	300	44	8.6	5.4	3.0	4.4
8	4.6	3.9	10	7.6	24	10	200	39	8.1	5.2	3.0	3.3
9	16	4.5	9.0	7.6	21	10	150	32	7.6	5.2	3.8	4.2
10	30	4.4	8.3	7.5	24	9.3	100	39	7.2	5.2	3.8	3.4
11	268	4.0	7.8	6.4	20	9.0	95	33	6.7	3.9	3.9	3.8
12	325	3.9	7.5	7.6	34	8.8	80	27	6.5	3.6	3.0	2.7
13	96	3.9	7.2	6.7	40	8.6	70	24	7.0	3.6	2.6	4.2
14	113	3.7	7.2	6.8	36	9.9	200	22	7.3	4.0	2.7	4.8
15	20	3.7	158	6.7	26	9.3	150	20	7.0	3.9	2.7	4.4
16	12	3.6	107	6.5	28	14	90	19	6.2	3.0	3.4	4.7
17	9.0	3.5	245	6.4	26	16	59	18	3.6	4.0	3.7	5.2
18	7.3	3.5	77	6.2	21	12	64	18	3.5	3.7	3.7	5.2
19	6.5	3.4	43	5.8	19	11	120	16	3.9	4.3	4.3	5.3
20	6.2	3.4	30	5.9	20	10	57	15	4.7	3.4	4.0	5.3
21	5.9	3.4	25	6.0	17	10	47	15	5.3	3.3	4.0	5.8
22	5.4	3.4	21	6.0	16	10	45	14	6.4	3.4	3.8	4.8
23	5.0	3.4	18	5.9	15	34	36	14	6.5	3.8	4.0	4.8
24	4.8	3.4	16	5.8	14	21	33	14	5.9	4.8	4.6	5.0
25	4.8	3.4	14	5.9	14	14	35	13	5.6	4.6	3.6	4.8
26	4.8	76	13	5.8	13	12	33	10	5.4	3.0	3.8	4.8
27	4.7	18	12	5.6	12	82	30	10	5.4	3.2	2.7	3.0
28	4.6	9.3	12	5.8	12	73	27	10	5.9	2.8	3.4	3.8
29	4.5	7.0	11	8.5		31	24	10	5.8	2.9	3.8	4.2
30	4.3	6.2	11	143		35	22	10	5.8	3.7	4.6	5.4
31	4.2		10	228		135		10		3.7	4.2	
Total	993	211	1,301	576	834	667	2,879	612	200	132	112	130
Mean	32	7.0	42	19	30	22	96	20	6.7	4.3	3.6	4.3
Max	325	76	259	228	128	135	481	44	10	6.5	4.6	5.8
Min	3.5	3.4	6.2	5.6	12	8.6	22	10	3.5	2.8	2.6	2.7
AC-FT	1,970	418	2,581	1,143	1,654	1,323	5,710	1,214	396	261	221	257

Kilarc-Cow Creek Project, FERC No. 606

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1963 to Sep 1964

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	5.2	9.3	8.2	6.4	12	8.6	8.2	5.2	2.7	0.60	1.0	2.8
2	4.4	10	8.0	6.4	11	6.4	5.8	4.5	2.6	1.0	1.0	2.3
3	4.8	10	7.6	5.9	10	5.2	5.3	9.1	2.2	0.90	1.0	2.2
4	4.4	23	7.6	5.9	10	4.8	4.8	5.8	2.6	0.80	0.60	1.9
5	4.4	18	7.5	5.6	9.1	4.5	3.4	5.4	2.2	1.2	0.80	1.6
6	4.8	16	7.3	5.8	8.5	4.5	4.2	5.3	3.6	1.0	1.2	1.3
7	5.6	11	7.0	5.8	8.0	4.3	4.5	4.8	5.2	1.5	1.1	1.7
8	4.4	64	7.5	5.4	8.0	4.3	4.5	4.3	5.2	1.7	0.90	1.4
9	6.5	46	8.7	6.5	7.6	5.2	4.2	3.2	9.3	1.7	1.0	1.1
10	7.3	14	7.2	6.4	7.6	5.0	3.5	3.0	6.7	1.3	0.80	1.4
11	10	10	6.7	5.6	7.3	5.6	3.9	2.7	4.8	1.2	0.60	1.3
12	7.2	8.9	6.4	5.6	7.0	7.5	3.9	3.0	4.3	1.2	0.90	1.6
13	7.2	17	6.4	6.7	6.8	6.4	3.7	2.7	4.0	0.80	1.1	1.4
14	7.2	34	6.2	7.0	6.8	5.8	2.7	2.9	4.2	0.70	1.1	1.0
15	7.2	36	6.2	5.9	7.8	5.4	2.5	2.8	4.3	0.60	1.2	0.80
16	6.7	14	6.2	7.2	7.2	5.0	2.3	3.2	4.0	1.0	1.0	1.2
17	6.5	11	6.0	23	6.8	5.0	1.6	2.7	4.0	1.0	0.80	1.3
18	6.7	10	6.0	21	6.4	4.7	1.5	2.6	3.8	0.40	0.80	1.1
19	6.5	54	6.7	113	6.0	4.7	1.4	2.9	3.0	1.1	0.70	1.2
20	7.2	28	11	122	5.9	4.7	1.5	3.4	3.0	1.0	1.0	1.2
21	7.2	14	7.2	56	5.9	5.0	1.4	3.4	2.4	1.1	0.90	1.3
22	10	12	6.5	36	5.9	6.4	1.8	2.9	1.8	1.0	0.60	1.3
23	10	77	6.2	26	5.6	6.0	2.1	3.0	2.3	1.0	0.60	1.2
24	7.8	29	6.2	27	5.8	6.7	2.8	2.8	2.0	0.80	0.10	0.80
25	7.5	16	6.2	32	5.4	5.9	3.0	2.9	2.0	0.80	0.20	1.2
26	7.2	13	6.0	23	5.4	5.6	2.5	2.3	2.0	0.80	0.30	1.2
27	6.8	11	6.7	19	5.6	5.4	1.6	2.1	1.9	0.50	0.60	1.2
28	7.5	10	8.5	16	5.6	5.2	1.7	2.8	1.5	0.40	0.30	1.3
29	9.3	9.1	7.2	16	5.4	4.8	2.2	3.0	1.6	0.50	0.50	1.0
30	9.3	8.7	6.5	14		4.8	2.4	3.0	1.4	0.50	0.70	1.1
31	9.1		6.4	13		5.3		2.2		0.60	1.1	
Total	216	643	218	655	210	169	95	110	101	29	25	41
Mean	7.0	21	7.0	21	7.2	5.4	3.2	3.5	3.4	0.93	0.79	1.4
Max	10	77	11	122	12	8.6	8.2	9.1	9.3	1.7	1.2	2.8
Min	4.4	8.7	6.0	5.4	5.4	4.3	1.4	2.1	1.4	0.40	0.10	0.80
AC-FT	428	1,275	432	1,299	417	335	188	218	200	57	49	82

Kilarc-Cow Creek Project, FERC No. 606

11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1964 to Sep 1965

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.60	2.5	46	29	18	10	25	19	5.5	4.2	5.6	2.8
2	0.90	12	34	28	17	10	57	18	5.6	4.2	3.2	2.3
3	1.2	7.0	18	43	17	10	20	17	5.8	4.0	3.0	3.4
4	1.5	5.0	12	143	17	10	15	15	6.2	3.9	3.1	3.3
5	1.2	3.3	10	430	40	10	15	12	6.0	3.7	2.5	4.2
6	1.3	2.3	8.7	187	23	10	106	12	5.6	2.4	2.8	4.3
7	1.3	6.0	7.8	97	18	10	36	12	5.8	4.2	3.1	3.5
8	1.6	37	7.8	63	17	9.2	97	12	6.1	2.9	2.9	4.7
9	1.6	44	7.5	50	15	9.0	201	12	6.2	2.4	2.9	4.1
10	1.6	95	42	46	15	9.0	120	9.2	5.4	3.6	3.9	3.9
11	1.6	120	26	84	14	8.9	72	9.2	4.9	3.5	7.6	3.6
12	1.6	50	14	48	14	11	53	9.1	4.3	4.2	5.9	3.8
13	1.6	26	12	39	14	9.2	53	8.6	4.1	4.5	4.9	3.5
14	1.6	10	11	34	14	8.5	55	7.9	4.9	3.7	4.2	3.2
15	1.6	7.4	11	32	13	8.1	68	7.2	5.5	4.4	4.5	3.3
16	1.6	5.4	9.1	30	13	8.1	168	7.1	5.5	5.5	4.5	3.7
17	1.6	4.2	7.8	28	12	8.1	69	8.0	6.4	4.5	4.6	3.8
18	1.6	3.7	20	28	12	7.8	141	8.5	5.8	4.4	9.1	2.7
19	1.6	3.1	90	28	12	7.6	115	9.0	4.5	4.6	6.1	2.5
20	1.6	3.0	29	27	11	7.5	90	9.4	4.4	4.8	5.5	2.3
21	1.6	3.5	121	27	11	7.5	82	11	4.3	5.9	5.0	1.9
22	1.6	4.1	285	25	11	7.5	59	11	4.8	6.2	4.8	2.1
23	1.6	3.2	88	81	11	7.3	46	8.6	4.5	6.3	4.8	3.5
24	1.6	4.2	65	46	10	7.2	39	8.5	4.9	5.5	4.9	3.8
25	1.8	14	98	32	10	7.5	33	8.0	4.7	4.8	5.2	4.3
26	1.8	14	113	28	11	18	29	7.4	4.3	5.1	5.1	4.1
27	2.1	15	75	26	16	32	27	7.5	4.3	4.1	4.8	3.9
28	2.4	116	63	23	11	12	25	7.5	4.1	4.2	4.3	3.9
29	2.2	27	66	22		10	23	6.3	4.1	4.3	4.2	3.9
30	2.1	26	58	20		10	21	4.0	4.1	5.7	3.3	3.3
31	2.1		42	20		10		4.6		7.8	3.0	
Total	50	673	1,498	1,844	417	309	1,960	307	153	140	139	104
Mean	1.6	22	48	59	15	10	65	10	5.1	4.5	4.5	3.5
Max	2.4	120	285	430	40	32	201	19	6.4	7.8	9.1	4.7
Min	0.60	2.3	7.5	20	10	7.2	15	4.0	4.1	2.4	2.5	1.9
AC-FT	99	1,336	2,971	3,658	827	612	3,888	608	303	277	276	205

Kilarc-Cow Creek Project, FERC No. 606

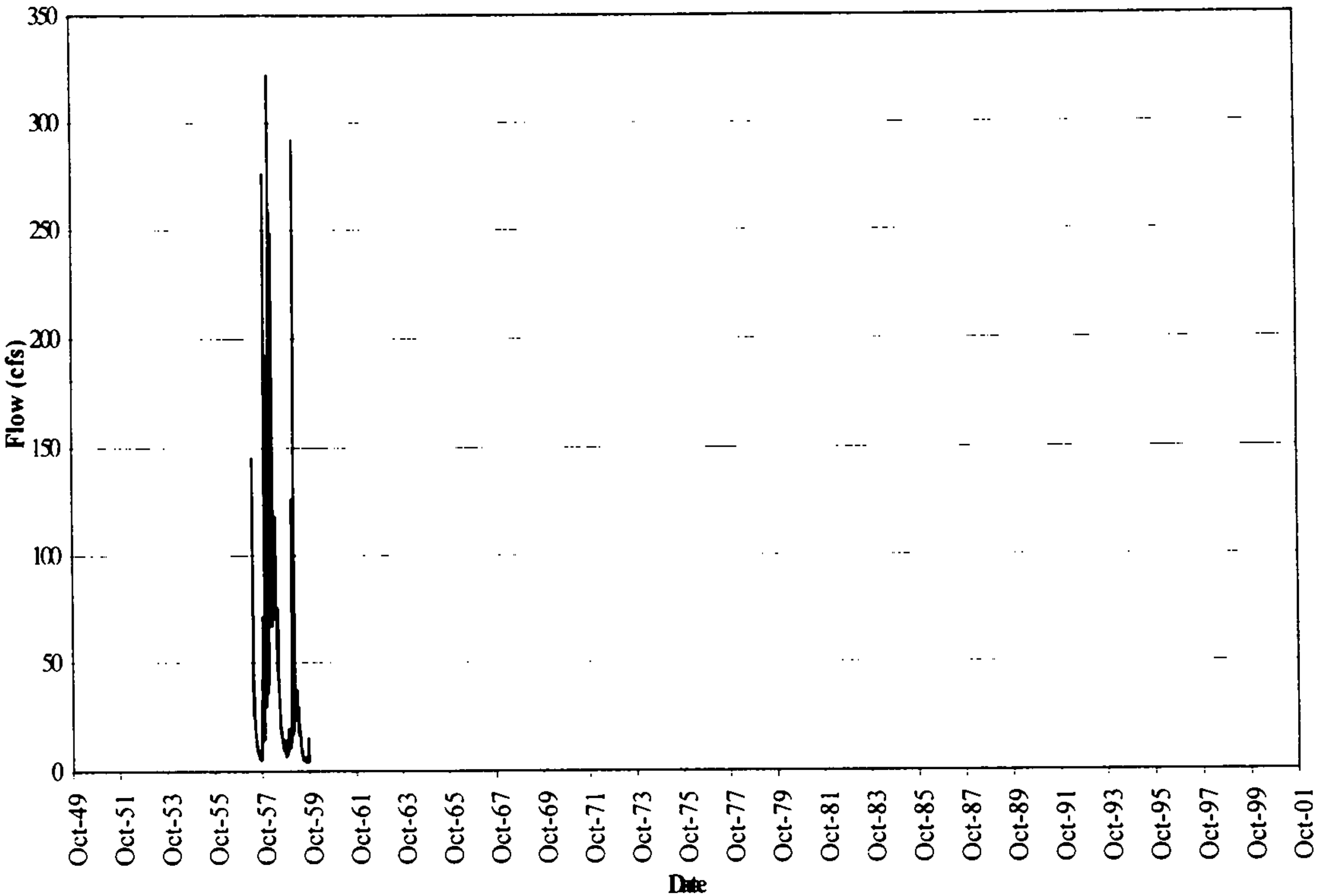
11373200 Oak Run C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1965 to Sep 1966

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	3 4	4 0	6 4	19	46	22	12	6.9	4.1	1.6	1.7	1.5
2	3 2	4 7	5.9	15	22	20	12	5.3	4.1	1.7	1.6	1 6
3	3 6	5 3	5.6	94	39	19	10	5.8	3.4	1.9	1.3	1 6
4	2.9	5.7	5.4	560	61	18	8 5	5 7	2.5	1.8	0.70	1.8
5	4.3	5.5	5.1	468	77	23	8.1	6 0	1 9	1.9	1.3	1 8
6	2.8	5.4	4.9	135	106	25	9.3	5.5	2 0	1.6	1.2	2.7
7	2 8	6 4	4 8	74	48	30	10	6.1	3.5	1.4	1.5	2.8
8	3 0	8.1	4.7	123	35	59	10	6.7	3.2	2 1	1.7	2.3
9	4.1	6.0	4.9	60	29	40	26	6.8	3.1	1.4	1 6	2.3
10	4.5	5 6	5.5	43	26	82	34	6.6	3.1	0.90	1 2	1.9
11	4 7	5.8	5.6	33	22	42	45	5.5	2 4	1.5	1.2	1.5
12	4.1	17	5 6	27	20	34	83	5.4	1.6	1.5	1.5	2.2
13	3.6	28	5.2	23	18	36	28	5.4	2.4	2.0	1.3	2.8
14	3.9	31	5.1	20	17	31	21	5.6	1.6	1 6	0.80	2 7
15	4.3	44	4.9	18	16	43	18	5.2	1.3	1.9	1.0	1.2
16	3.8	11	4.9	15	15	41	16	3 1	1 4	1.9	1 6	2.0
17	3.9	65	4.9	14	14	29	15	3.5	1.6	1.9	1.2	1.8
18	4.1	23	4.8	14	14	27	14	3.5	1.8	2.0	1.3	2.4
19	4.0	22	4.8	12	38	40	13	3.8	1 9	2.2	1.1	2.8
20	3.3	11	4.8	11	24	26	12	4.2	2.2	2.0	0.70	2.6
21	3 1	7.6	4.8	11	19	24	11	4.2	3.0	1.9	1.0	2.5
22	3 2	6.4	4.7	12	24	21	11	4.1	1.8	1.9	1 3	2.5
23	2.8	7.3	4.6	11	32	20	10	3.9	1.2	1.8	1.6	2.9
24	3.4	20	5.1	10	49	19	10	3 7	1.8	1 7	1.2	2.6
25	3.8	47	8.7	9.4	40	18	8.8	3 8	1.8	1 5	1.7	3.1
26	3.6	40	7.5	9.0	33	17	8.4	4.3	2.0	1.8	1.9	3.1
27	4.6	23	8.1	8 5	26	15	7.8	3.4	2 5	1.2	2.1	2.9
28	4.5	11	101	8	24	15	7.4	3.7	2 1	0.70	2 4	2.5
29	4.5	8 4	38	32		14	6.9	2.8	2.3	0.80	2 7	2 3
30	3.7	7 1	94	39		13	7.0	3 0	2.2	1.2	1.9	2.0
31	4.0		63	24		13		3.4		1.6	1.6	
Total	116	492	443	1,952	934	876	492	147	70	51	45	69
Mean	3.7	16	14	63	33	28	16	4.7	2.3	1.6	1.4	2 3
Max	4.7	65	101	560	106	82	83	6.9	4.1	2.2	2 7	3 1
Min	2.8	4.0	4.6	8 1	14	13	6.9	2.8	1.2	0.70	0 70	1 2
AC-FT	229	976	879	3,871	1,853	1,738	976	291	138	101	89	136

Kilarc-Cow Creek Project, FERC No. 606

CLOVER CREEK AT OAK RUN



Average Daily Flow for Clover Creek at Oak Run.

Average Monthly Flow. Clover Creek Near Oak Run, Water Years 1957-1959

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1957								64	21	11	7.0	7.9
1958	21	40	49	73	171	107	98	74	42	20	13	10
1959	8.0	12	14	39	51	28	24	15	7.7	5.9	5.3	6.2
Average	15	26	31	56	111	68	61	51	24	12	8.5	8.0
Max	21	40	49	73	171	107	98	74	42	20	13	10
Min	8.0	12	14	39	51	28	24	15	7.7	5.9	5.3	6.2

11372700 Clover C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1956 to Sep 1957

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1									35	13	8.6	5.9
2									34	12	8.4	5.6
3									32	12	8.6	5.6
4									28	12	8.6	5.6
5									27	12	8.6	5.6
6									27	12	8.6	5.6
7									26	12	8.2	5.7
8									25	12	7.4	5.6
9									24	11	7.4	5.6
10									24	11	7.4	5.7
11									23	11	7.4	5.6
12									22	11	7.4	5.6
13									21	12	7.1	5.6
14									20	11	6.7	5.5
15									20	11	6.8	5.7
16									20	11	7.0	5.9
17								26	19	10	6.8	6.4
18								145	18	10	6.7	6.7
19								120	17	10	6.5	6.7
20								95	17	10	6.5	6.7
21								79	16	10	6.4	6.2
22								69	16	10	6.0	6.0
23								62	16	10	5.9	5.7
24								56	15	10	6.0	5.6
25								52	15	9.3	6.4	5.7
26								49	15	9.3	6.5	8.2
27								47	14	9.0	6.4	32
28								43	14	8.8	6.0	20
29								40	14	8.6	6.0	14
30								38	13	8.6	6.1	18
31								36		8.6	6.0	
Total								957	627	328	218	238
Mean								64	21	11	7.0	7.9
Max								145	35	13	8.6	32
Min								26	13	8.6	5.9	5.5
AC-FT								1,898	1,244	650	433	473

Kilarc-Cow Creek Project, FERC No. 606

11372700 Clover C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1957 to Sep 1958

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	16	15	32	41	114	115	180	75	46	29	16	10
2	14	15	32	54	149	107	163	77	49	30	16	10
3	14	15	32	43	148	100	144	79	51	28	16	10
4	16	15	32	39	136	91	119	81	46	26	15	10
5	42	15	32	38	119	87	114	83	44	26	15	10
6	32	15	32	36	113	82	122	84	43	26	15	10
7	22	16	32	36	126	79	101	83	43	25	15	10
8	15	16	31	36	118	77	91	82	47	25	15	11
9	15	15	30	36	135	72	87	84	75	23	14	10
10	15	20	30	95	118	69	87	87	47	21	14	10
11	14	18	30	71	122	67	88	118	47	20	14	10
12	18	19	30	93	322	69	88	109	65	20	14	10
13	71	276	30	66	177	77	88	92	47	18	14	10
14	54	107	30	54	254	83	88	83	44	18	13	10
15	23	58	48	56	252	90	87	80	43	18	13	10
16	19	49	80	51	254	80	89	78	41	19	13	10
17	18	45	192	48	213	91	97	77	40	19	12	10
18	17	44	63	45	192	75	97	75	39	18	13	10
19	16	42	56	44	215	68	95	71	43	18	14	9.3
20	16	39	71	42	163	149	96	67	38	16	12	9.3
21	16	38	80	41	136	201	98	65	36	17	12	8.5
22	16	36	59	40	130	248	98	66	34	18	11	10
23	22	36	50	41	130	163	92	68	34	20	11	14
24	22	35	46	103	258	137	86	62	35	19	11	10
25	19	35	42	89	240	124	82	57	33	18	11	11
26	18	34	48	124	177	106	79	54	31	18	11	11
27	17	33	42	75	146	98	76	53	30	16	11	10
28	16	33	69	136	128	110	72	52	30	16	11	8.8
29	16	32	52	241		136	74	49	30	17	11	8.8
30	16	32	45	194		154	75	48	29	16	11	8.5
31	16		42	151		124		47		17	10	
Total	661	1,198	1,520	2,259	4,785	3,329	2,953	2,286	1,260	635	404	299
Mean	21	40	49	73	171	107	98	74	42	20	13	10
Max	71	276	192	241	322	248	180	118	75	30	16	14
Min	14	15	30	36	113	67	72	47	29	16	10	8.5
AC-FT	1,311	2,376	3,015	4,481	9,491	6,603	5,857	4,534	2,499	1,260	801	593

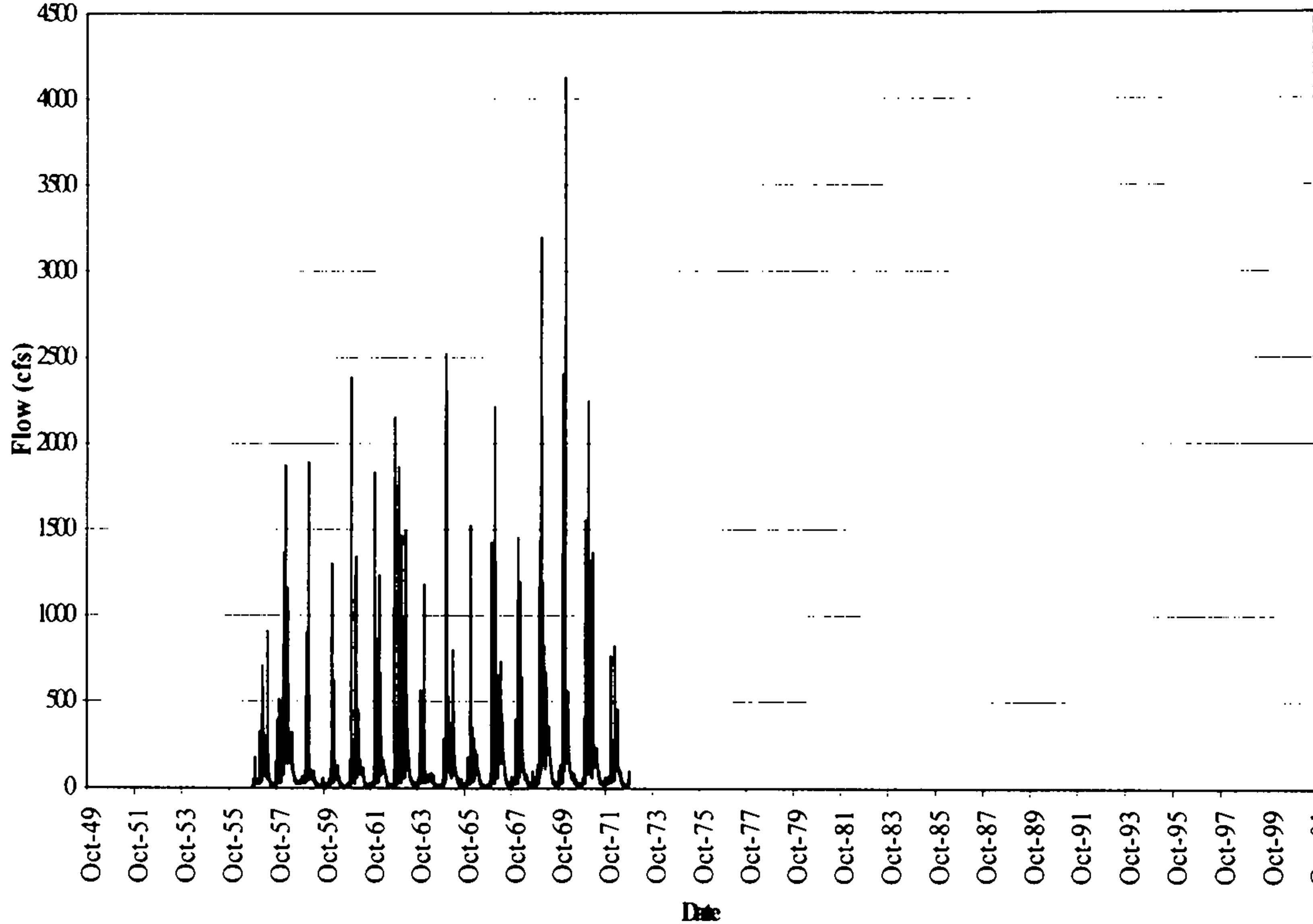
11372700 Clover C Nr Oak Run Ca

Streamflow (cfs), Water Year Oct 1958 to Sep 1959

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.8	8.5	12	16	25	34	28	22	9.0	5.5	6.0	4.3
2	7.0	8.5	11	15	23	34	28	21	9.0	5.5	5.8	4.3
3	7.3	11	11	14	22	33	29	20	8.7	5.3	5.8	4.3
4	7.3	12	12	14	21	32	29	19	8.7	5.5	5.6	4.5
5	7.5	9.3	11	21	20	32	30	19	9.4	5.6	5.6	5.1
6	7.5	9.3	11	44	20	30	30	19	10	5.8	5.1	4.8
7	7.8	9.3	11	49	19	29	29	18	9.6	6.1	5.3	4.9
8	7.8	9.0	12	62	19	28	29	18	9.4	6.0	5.5	4.8
9	7.3	19	12	94	19	27	29	17	9.2	6.1	5.5	4.8
10	7.5	19	11	42	30	27	28	17	9.2	6.0	5.8	4.8
11	7.5	11	11	39	31	26	28	16	8.7	6.0	5.1	4.8
12	7.3	11	11	126	26	26	27	16	7.7	6.0	4.9	4.9
13	7.3	14	11	58	25	26	25	16	7.9	6.0	5.1	5.1
14	7.3	16	11	36	30	26	24	18	7.9	6.0	5.5	6.3
15	7.3	12	11	29	57	25	23	17	7.7	5.8	5.1	6.0
16	7.3	11	11	26	292	25	23	16	7.7	6.0	5.1	5.4
17	7.3	11	11	24	87	25	23	16	7.5	5.8	5.1	5.6
18	11	11	11	22	73	25	22	15	6.7	5.8	5.1	15
19	11	12	11	20	80	25	21	15	6.5	5.8	5.3	9.4
20	8.8	12	12	18	92	24	20	14	6.5	5.8	6.3	8.3
21	8.5	13	15	18	82	25	19	13	6.5	5.8	5.8	7.7
22	8.5	12	12	18	78	27	19	13	6.3	5.6	5.1	7.7
23	8.5	12	12	17	55	29	18	13	6.5	5.5	5.1	6.7
24	8.3	12	14	25	45	26	17	13	6.7	5.6	5.1	6.7
25	8.0	12	21	76	39	26	20	13	6.5	5.8	5.1	6.7
26	8.0	12	22	39	36	31	29	11	6.5	6.3	5.1	6.7
27	8.0	12	30	87	35	25	24	11	6.3	6.3	4.9	6.3
28	8.0	12	24	68	34	25	22	10	6.1	6.3	4.9	6.7
29	8.0	12	18	39		26	20	10	6.0	6.0	4.6	7.1
30	8.3	12	16	32		37	21	10	5.6	6.0	4.6	5.1
31	8.3		16	28		30		9.2		6.0	4.6	
Total	247	357	425	1,216	1,415	866	734	475	230	182	164	185
Mean	8.0	12	14	39	51	28	24	15	7.7	5.9	5.3	6.2
Max	11	19	30	126	292	37	30	22	10	6.3	6.3	15
Min	7.0	8.5	11	14	19	24	17	9.2	5.6	5.3	4.6	4.3
AC-FT	491	708	843	2,412	2,807	1,718	1,456	942	456	360	324	367

Kilarc-Cow Creek Project, FERC No. 606

South Cow Creek at Millville



Average Daily Flow for South Cow Creek at Millville.

Average Monthly Flow. South Cow Creek Near Millville, Water Years 1957-1972

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1957	35	38	32	53	130	210	108	178	55	21	16	25
1958	68	81	135	290	638	349	294	180	116	50	32	30
1959	33	38	38	171	231	76	69	45	18	9.4	8.9	16
1960	17	17	21	56	205	151	71	62	22	9.0	4.9	8.4
1961	15	76	153	87	302	187	112	92	52	16	13	13
1962	16	52	182	81	332	182	109	83	33	12	10	11
1963	178	46	206	121	244	125	421	174	57	30	22	21
1964	29	103	40	124	53	46	60	58	33	14	11	12
1965	13	79	351	394	136	86	337	117	53	27	26	17
1966	18	63	63	169	125	116	125	61	23	11	6.9	12
1967	13	107	174	370	139	185	289	269	125	41	24	22
1968	31	33	71	251	365	167	90	60	29	14	22	16
1969	27	53	288	722	475	185	276	254	99	39	26	23
1970	36	47	425	855	238	224	81	60	42	27	22	21
1971	30	205	362	334	119	315	171	178	104	42	31	26
1972	30	39	85	68	161	208	140	75	34	19	13	21
Average	37	67	164	259	243	176	172	122	56	24	18	18
Max	178	205	425	855	638	349	421	269	125	50	32	30
Min	13	17	21	53	53	46	60	45	18	9.0	4.9	8.4

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1956 to Sep 1957

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	15	70	31	29	34	210	114	78	111	31	16	17
2	14	60	31	28	40	178	100	116	103	29	16	16
3	13	50	31	28	36	326	96	93	92	27	17	15
4	14	46	38	29	35	548	93	82	84	26	16	10
5	15	44	41	28	35	579	90	77	81	25	18	14
6	16	42	36	28	35	499	90	74	74	25	17	16
7	16	40	32	29	37	324	86	72	64	24	17	16
8	17	38	31	30	44	255	88	77	61	23	18	16
9	18	38	32	29	44	249	86	75	64	23	18	14
10	20	37	32	28	41	188	77	74	67	23	17	14
11	45	36	34	32	41	172	74	72	60	21	17	14
12	40	36	36	150	41	267	74	66	57	21	16	15
13	32	32	36	323	43	169	77	63	54	22	16	16
14	30	35	36	72	50	147	169	68	54	23	13	15
15	28	36	33	54	50	281	109	62	52	22	14	16
16	27	35	32	44	50	345	98	56	50	20	14	18
17	26	35	31	38	49	192	105	54	49	18	16	18
18	26	34	31	35	47	158	116	902	43	19	13	18
19	29	33	30	36	48	143	293	815	45	20	14	18
20	29	33	30	98	48	132	198	440	44	20	14	17
21	27	33	30	68	74	126	147	352	44	21	15	16
22	26	32	29	49	96	113	126	280	42	21	15	17
23	27	32	29	45	164	103	118	229	39	18	16	14
24	32	32	29	47	700	96	109	205	35	16	16	16
25	30	32	29	49	609	95	98	184	32	16	16	16
26	35	31	28	41	457	90	90	170	32	17	17	20
27	75	31	28	32	418	83	85	159	32	16	15	147
28	50	32	28	41	276	86	78	143	32	16	17	91
29	45	31	28	32		124	77	136	32	16	16	48
30	170	32	29	34		118	82	125	32	17	16	38
31	110		28	33		118		117		16	16	
Total	1,097	1,128	979	1,639	3,642	6,514	3,243	5,516	1,661	652	492	736
Mean	35	38	32	53	130	210	108	178	55	21	16	25
Max	170	70	41	323	700	579	293	902	111	31	18	147
Min	13	31	28	28	34	83	74	54	32	16	13	10
AC-FT	2,176	2,237	1,942	3,251	7,224	12,920	6,432	10,941	3,295	1,293	976	1,460

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1957 to Sep 1958

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	51	35	41	109	314	357	1,030	154	117	70	37	28
2	38	34	40	205	652	305	1,010	158	115	80	39	27
3	42	35	39	139	773	267	569	164	125	70	37	29
4	35	34	39	116	729	239	385	171	112	67	33	29
5	91	34	40	105	496	219	381	178	103	62	32	29
6	98	34	39	96	349	202	595	178	100	61	32	29
7	82	34	39	88	413	183	305	173	95	58	33	30
8	55	34	38	79	341	185	250	176	127	50	33	33
9	51	34	38	93	365	166	222	178	319	47	36	32
10	61	37	38	468	295	158	207	193	154	54	32	31
11	48	48	37	193	393	152	207	267	142	50	30	32
12	43	39	37	525	1,200	154	207	311	195	45	32	30
13	388	508	36	242	466	217	207	225	154	46	32	30
14	229	415	37	166	888	325	205	200	132	46	30	29
15	91	157	92	191	750	272	202	193	122	49	29	27
16	66	110	374	153	649	183	200	195	115	47	31	26
17	55	91	200	129	522	158	222	197	110	54	32	27
18	49	81	333	112	797	144	228	200	106	51	31	27
19	44	75	189	102	986	138	217	197	108	47	30	29
20	40	69	217	95	541	736	212	190	108	46	32	29
21	39	63	416	88	409	1,160	219	185	98	41	31	29
22	38	57	235	79	357	1,110	217	183	92	43	33	30
23	40	54	164	132	377	596	197	193	90	45	31	40
24	51	51	139	825	1,870	417	181	178	87	43	31	34
25	46	50	118	396	1,240	337	171	164	82	44	32	35
26	42	48	139	727	726	270	164	156	77	44	29	33
27	40	45	110	240	536	242	158	140	74	43	29	32
28	39	44	459	576	433	239	156	128	71	41	29	32
29	38	43	189	1,360		690	150	125	70	41	29	29
30	34	42	141	733		589	150	122	70	39	28	27
31	37		120	420		421		120		37	29	
Total	2,101	2,435	4,173	8,982	17,867	10,831	8,824	5,592	3,470	1,561	984	904
Mean	68	81	135	290	638	349	294	180	116	50	32	30
Max	388	508	459	1,360	1,870	1,160	1,030	311	319	80	39	40
Min	34	34	36	79	295	138	150	120	70	37	28	26
AC-FT	4,167	4,830	8,277	17,816	35,439	21,483	17,502	11,092	6,883	3,096	1,952	1,793

Kilarc-Cow Creek Project, FERC No. 606

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1958 to Sep 1959

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	29	35	32	39	71	100	75	70	26	10	5.8	11
2	29	34	32	39	66	103	77	69	22	10	8.7	11
3	26	34	32	37	61	103	75	64	23	11	9.1	10
4	29	35	33	36	58	100	85	59	22	13	8.0	10
5	29	34	32	172	56	95	88	55	23	13	6.1	8.7
6	30	33	32	245	54	92	86	53	26	13	8.3	8.3
7	31	33	32	120	52	89	82	51	24	12	7.6	10
8	29	33	32	286	50	83	77	48	22	8.0	6.4	9.1
9	29	39	33	521	50	80	75	51	22	8.7	6.4	9.1
10	27	61	32	144	86	77	73	51	21	12	7.2	8.7
11	29	40	32	112	148	73	75	46	21	11	7.2	9.1
12	31	36	32	894	95	72	73	40	19	11	8.7	8.3
13	32	36	32	287	80	72	80	36	19	8.3	9.1	8.7
14	32	55	32	134	89	70	70	48	20	6.9	9.1	8.3
15	31	41	32	96	334	69	65	54	20	8.3	10	11
16	31	41	32	80	1,890	65	61	43	19	10	8.7	8.7
17	32	40	32	69	453	66	59	47	19	12	8.7	8.7
18	46	40	32	62	347	66	56	46	20	10	4.0	56
19	41	43	32	57	308	65	52	41	18	10	4.4	33
20	38	41	32	54	533	54	51	40	18	10	10	25
21	35	40	41	51	487	63	52	36	17	7.6	15	22
22	35	39	38	49	298	63	51	40	16	9.1	11	21
23	35	39	33	47	193	72	52	46	12	9.1	12	19
24	34	34	36	318	150	70	52	42	11	8.7	9.1	20
25	34	33	51	528	132	65	56	37	11	6.1	10	20
26	34	32	54	164	112	85	91	32	13	6.6	10	20
27	34	32	96	173	106	68	83	33	12	8.3	10	19
28	34	32	63	214	101	66	72	33	12	8.0	11	18
29	34	32	49	115		68	69	31	8.7	8.3	11	18
30	34	32	44	93		77	68	30	10	5.0	12	19
31	34		41	80		73		28		8.7	11	
Total	1,008	1,129	1,188	5,316	6,460	2,364	2,081	1,400	547	292	275	468
Mean	33	38	38	171	231	76	69	45	18	9.4	8.9	16
Max	46	61	96	894	1,890	103	91	70	26	13	15	56
Min	26	32	32	36	50	54	51	28	8.7	5.0	4.0	8.3
AC-FT	1,999	2,239	2,356	10,544	12,813	4,689	4,128	2,777	1,084	580	545	928

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1959 to Sep 1960

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	20	18	18	20	863	35	75	72	36	7.0	7.8	6.2
2	20	17	18	18	240	34	72	123	32	5.4	6.6	7.0
3	19	18	18	20	185	43	71	95	31	13	6.2	9.9
4	19	18	18	20	111	341	78	103	27	14	7.4	10
5	16	17	18	20	178	456	72	84	28	15	7.4	9.9
6	15	16	18	20	108	232	68	78	25	12	4.6	8.6
7	13	16	18	23	1,300	619	69	82	26	10	4.8	7.8
8	18	16	18	47	870	375	71	80	38	11	3.8	6.2
9	20	16	18	43	341	229	71	76	30	11	0.80	7.0
10	20	16	18	40	392	168	71	71	26	11	0.80	9.0
11	18	16	19	100	170	143	72	69	27	10	1.6	8.6
12	14	16	20	59	124	235	68	67	24	8.6	5.8	8.2
13	12	17	20	33	157	201	64	63	23	9.4	4.8	6.6
14	13	17	19	34	106	132	69	55	21	9.0	4.6	9.0
15	13	17	19	33	90	114	63	52	22	11	8.2	8.6
16	15	17	19	29	78	105	59	52	21	8.6	6.6	9.0
17	16	17	20	29	69	98	57	49	20	8.2	5.0	9.0
18	16	18	20	30	69	90	54	46	20	7.0	5.0	9.0
19	15	18	20	33	63	80	57	44	20	4.6	4.6	7.8
20	14	18	20	31	54	78	54	44	17	3.8	4.4	6.6
21	16	17	20	66	49	76	53	45	16	4.6	4.2	9.0
22	18	18	20	198	46	76	55	40	16	9.9	5.4	9.0
23	18	19	24	84	44	75	84	42	16	9.9	5.0	10
24	18	19	39	61	41	76	87	52	15	8.6	6.2	9.4
25	18	19	50	126	41	80	87	49	15	9.0	5.0	10
26	18	18	26	95	40	81	80	54	17	8.2	6.6	9.0
27	17	18	24	69	38	80	108	53	18	9.0	5.4	7.4
28	18	19	23	98	37	82	95	51	16	8.2	5.8	8.6
29	18	18	22	62	36	74	78	48	16	7.4	3.6	7.8
30	17	18	21	127		90	72	45	14	8.2	0.50	8.2
31	18		20	75		84		42		7.4	2.6	
Total	520	522	665	1,743	5,940	4,682	2,134	1,926	673	280	151	252
Mean	17	17	21	56	205	151	71	62	22	9.0	4.9	8.4
Max	20	19	50	198	1,300	619	108	123	38	15	8.2	10
Min	12	16	18	18	36	34	53	40	14	3.8	0.50	6.2
AC-FT	1,031	1,035	1,319	3,457	11,782	9,287	4,233	3,820	1,335	555	300	501

Kilarc-Cow Creek Project, FERC No. 606

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1960 to Sep 1961

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	8 6	15	2,380	35	327	69	133	92	92	23	13	12
2	8.2	16	390	34	760	69	133	89	113	20	10	12
3	9.0	16	181	33	287	66	144	87	98	17	11	11
4	7 8	15	117	32	191	65	156	84	92	18	12	7 5
5	11	16	92	32	147	84	150	83	84	19	13	6.6
6	22	17	75	32	145	84	140	95	80	20	14	10
7	21	21	67	32	133	73	129	100	76	23	14	12
8	21	22	60	35	166	246	118	93	72	24	9	11
9	18	20	55	38	1,230	194	115	93	66	23	12	11
10	19	18	51	39	386	162	110	103	63	23	13	10
11	20	21	48	35	1,340	127	103	108	62	16	13	11
12	17	34	45	35	410	106	117	100	61	16	15	10
13	17	160	43	34	289	98	110	98	58	15	12	10
14	16	69	42	34	275	304	101	93	51	16	13	11
15	15	35	42	33	640	359	97	95	45	14	12	11
16	15	29	69	32	292	224	98	93	43	15	12	16
17	15	28	195	31	218	448	103	93	38	11	12	20
18	15	84	132	31	178	180	106	93	39	10	13	18
19	15	51	89	31	150	180	100	100	38	12	14	17
20	15	37	71	31	134	210	93	103	35	14	12	17
21	16	35	62	31	120	162	92	97	34	13	14	16
22	15	32	57	31	112	154	110	93	33	14	13	14
23	16	31	53	32	101	165	156	89	29	15	14	15
24	16	32	49	33	93	431	105	83	24	13	13	15
25	14	615	46	31	90	258	92	76	26	13	15	15
26	16	498	44	34	83	325	90	87	26	12	12	13
27	17	116	41	55	77	280	86	84	23	12	13	12
28	15	68	39	45	72	208	86	74	22	12	15	12
29	15	47	38	287		173	89	69	20	12	18	12
30	15	90	37	348		152	89	95	20	14	15	10
31	16		35	1,090		140		97		16	12	
Total	477	2,288	4,745	2,686	8,446	5,796	3,351	2,839	1,563	495	403	377
Mean	15	76	153	87	302	187	112	92	52	16	13	13
Max	22	615	2,380	1,090	1,340	448	156	108	113	24	18	20
Min	7.8	15	35	31	72	65	86	69	20	10	9.0	6.6
AC-FT	945	4,538	9,412	5,328	16,752	11,496	6,647	5,631	3,100	981	799	748

Kilarc-Cow Creek Project, FERC No. 606

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1961 to Sep 1962

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	11	20	1,830	46	41	386	100	96	55	21	9.1	9.4
2	12	20	369	44	40	366	109	96	51	18	10	10
3	12	20	138	41	39	167	107	100	51	18	10	11
4	12	20	83	40	39	138	97	104	53	18	12	11
5	9.2	18	63	38	38	661	100	106	49	18	13	10
6	7.5	18	53	39	44	651	102	104	46	16	11	8.8
7	8.2	18	45	39	305	397	106	102	43	16	11	10
8	11	18	38	39	467	217	111	104	37	14	14	10
9	9.2	19	38	40	728	172	113	111	34	8.5	19	10
10	12	19	36	38	583	144	107	102	34	6.6	16	10
11	18	18	31	37	314	128	102	96	31	7.8	14	10
12	23	19	34	40	539	113	102	88	31	10	12	9.1
13	20	20	33	38	1,190	99	106	91	31	13	10	9.1
14	18	20	32	34	906	94	115	86	35	12	8.5	11
15	17	20	32	34	1,230	92	128	86	35	13	6.0	12
16	16	19	31	34	594	97	124	80	31	12	7.2	10.0
17	15	20	35	34	386	99	118	67	29	10	7.8	9.1
18	16	20	38	38	412	84	113	75	28	11	9.4	7.8
19	14	21	742	856	299	81	118	76	26	12	12	10
20	16	24	751	330	219	86	113	72	27	12	11	10
21	23	23	365	102	170	100	100	67	20	12	8.8	11
22	20	23	172	73	138	293	96	66	19	13	8.8	11
23	19	23	118	76	124	147	100	75	21	9.1	9.1	10
24	18	39	96	57	111	118	106	72	23	7.8	9.1	11
25	17	497	83	53	99	107	106	66	23	7.5	10	12
26	20	141	72	51	86	102	102	67	22	9.4	10	12
27	23	67	64	48	80	97	111	69	23	11	10	10
28	26	43	59	44	83	97	155	66	23	10	10	15
29	21	188	55	43		99	115	66	25	12	8.8	17
30	20	117	51	42		99	100	64	24	12	8.8	16
31	20		48	41		97		60		11	10	
Total	504	1,552	5,635	2,509	9,304	5,628	3,282	2,580	980	382	325	323
Mean	16	52	182	81	332	182	109	83	33	12	10	11
Max	26	497	1,830	856	1,230	661	155	111	55	21	19	17
Min	7.5	18	31	34	38	81	96	60	19	6.6	6.0	7.8
AC-FT	1,000	3,078	11,177	4,977	18,454	11,163	6,510	5,117	1,944	757	645	640

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1962 to Sep 1963

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	15	33	57	60	1,300	87	204	168	92	39	22	21
2	15	33	310	57	654	84	170	168	84	42	20	18
3	14	32	466	57	532	83	154	182	80	40	24	19
4	12	31	198	55	376	80	140	176	77	39	23	20
5	12	31	138	52	295	76	194	174	74	38	22	20
6	12	31	112	50	252	74	1,490	174	70	38	23	22
7	14	30	96	48	218	73	1,080	340	64	40	23	22
8	18	30	85	47	204	71	690	257	57	37	24	20
9	20	32	77	46	182	71	508	260	56	30	26	15
10	123	46	70	44	189	69	646	257	56	29	26	18
11	686	35	66	40	178	68	460	238	56	30	26	20
12	2,150	33	62	36	204	66	344	213	56	28	24	22
13	858	33	61	43	286	64	441	196	56	30	19	23
14	511	32	61	40	185	66	1,280	187	59	30	15	23
15	182	31	301	37	160	69	680	176	56	29	20	22
16	117	29	428	37	152	87	420	170	52	30	20	20
17	93	29	1,860	36	180	98	337	168	56	29	17	18
18	78	29	510	36	150	86	342	168	54	30	20	20
19	69	29	270	35	138	74	436	166	52	29	20	24
20	62	31	192	34	140	73	267	172	51	23	21	23
21	57	30	150	34	130	71	317	174	48	23	20	23
22	48	29	124	35	120	71	510	166	46	28	21	21
23	46	29	110	34	113	89	232	148	51	29	22	21
24	45	28	96	34	107	95	211	142	50	28	23	22
25	43	28	85	34	102	77	204	126	45	29	22	21
26	42	185	76	33	98	74	198	118	47	27	22	19
27	40	200	74	32	94	493	178	109	45	24	22	20
28	37	87	70	32	90	607	168	102	43	24	22	20
29	36	67	66	36		267	166	95	44	23	22	20
30	36	60	64	1,090		218	166	95	44	23	22	19
31	35		63	1,460		290		102		21	21	
Total	5,526	1,383	6,398	3,744	6,829	3,871	12,633	5,387	1,721	939	675	616
Mean	178	46	206	121	244	125	421	174	57	30	22	21
Max	2,150	200	1,860	1,460	1,300	607	1,490	340	92	42	26	24
Min	12	28	57	32	90	64	140	95	43	21	15	15
AC-FT	10,961	2,743	12,690	7,426	13,545	7,678	25,057	10,685	3,414	1,862	1,339	1,222

Kilarc-Cow Creek Project, FERC No. 606

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1963 to Sep 1964

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	20	27	47	40	89	44	73	82	39	18	10	18
2	20	28	45	42	84	46	70	70	36	19	13	18
3	20	30	43	38	78	39	64	73	32	17	11	16
4	20	75	42	38	73	39	62	70	33	18	12	16
5	20	81	40	37	71	38	62	66	34	18	11	14
6	23	95	39	37	66	38	66	64	37	17	12	14
7	23	68	38	37	62	39	58	62	43	16	11	13
8	23	196	39	36	60	38	58	62	44	15	12	12
9	26	165	43	37	59	38	58	59	65	14	13	10
10	28	76	40	37	58	38	62	60	68	14	12	10
11	46	58	38	36	56	40	59	58	52	16	12	11
12	38	50	37	35	53	68	60	56	44	16	10	12
13	31	48	37	36	52	54	60	62	39	14	8.6	12
14	30	97	37	40	49	49	62	64	38	12	8.2	5.9
15	29	126	36	38	52	46	66	64	32	14	10	8.2
16	28	74	36	39	49	45	73	62	33	14	10	11
17	27	59	36	66	46	46	71	64	32	12	11	11
18	27	53	35	92	45	48	70	60	30	12	10	12
19	27	283	37	138	44	45	66	58	30	12	12	12
20	27	184	46	1,180	45	45	64	54	30	14	12	10
21	27	73	45	382	41	45	56	48	26	15	12	9.0
22	31	59	40	240	41	50	50	48	20	14	12	9.0
23	56	562	39	166	40	50	52	46	20	16	12	8.2
24	37	163	38	149	40	53	44	45	18	14	10	8.6
25	34	84	38	196	39	50	44	44	20	15	10	10
26	30	69	38	142	38	49	46	48	19	15	10	10
27	29	60	39	116	37	49	48	52	20	14	8.6	11
28	28	56	44	100	39	49	50	58	20	14	10	13
29	30	52	45	95	39	49	58	48	19	14	8.6	13
30	29	50	42	97		50	60	44	19	10	10	12
31	28		40	88		54		40		6.8	13	
Total	892	3,101	1,239	3,850	1,545	1,431	1,792	1,791	992	449	337	349
Mean	29	103	40	124	53	46	60	58	33	14	11	12
Max	56	562	47	1,180	89	68	73	82	68	19	13	18
Min	20	27	35	35	37	38	44	40	18	6.8	8.2	5.9
AC-FT	1,769	6,151	2,458	7,636	3,064	2,838	3,554	3,552	1,968	891	667	693

Kilarc-Cow Creek Project, FERC No. 606

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1964 to Sep 1965

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	14	25	242	230	169	88	136	218	71	36	26	19
2	9.0	40	180	209	160	83	392	195	66	36	21	14
3	10	30	116	552	151	82	160	180	65	35	21	10
4	10	22	82	1,040	147	80	133	164	64	34	20	15
5	8.2	20	66	2,300	377	79	121	151	63	31	19	18
6	8.6	19	56	946	283	79	698	145	63	30	23	19
7	10	18	48	508	188	77	245	135	59	30	21	20
8	10	23	44	340	171	76	669	129	59	30	20	20
9	11	282	46	275	155	74	794	121	56	25	19	19
10	12	273	53	242	145	74	456	119	54	26	21	18
11	13	276	126	450	135	74	272	117	54	31	35	18
12	11	165	81	293	127	88	198	115	52	24	51	20
13	14	71	64	245	125	80	184	116	54	26	35	18
14	13	45	58	225	121	73	186	120	58	27	31	15
15	13	36	54	228	111	71	280	118	64	27	28	17
16	13	30	49	230	107	70	487	116	60	26	26	19
17	13	27	43	220	102	70	293	113	60	25	24	15
18	12	25	67	218	98	69	666	107	60	25	33	18
19	13	24	423	225	95	69	474	105	51	24	30	17
20	13	22	208	222	95	66	414	104	46	22	25	18
21	12	22	1,030	212	93	67	410	104	46	22	28	18
22	12	25	2,520	193	91	69	386	110	40	20	30	15
23	12	24	1,320	421	88	71	323	97	39	22	29	14
24	12	26	723	526	85	80	281	90	39	24	27	13
25	14	65	539	356	83	73	260	87	42	24	27	13
26	14	195	573	287	82	82	248	85	44	24	26	18
27	16	73	496	242	139	291	240	79	42	26	25	19
28	23	207	422	218	95	125	240	78	36	25	23	20
29	26	146	412	195		100	240	74	34	21	22	18
30	24	116	419	184		91	230	75	35	22	19	15
31	20		325	177		93		73		24	17	
Total	416	2,372	10,885	12,209	3,818	2,664	10,116	3,640	1,576	824	802	510
Mean	13	79	351	394	136	86	337	117	53	27	26	17
Max	26	282	2,520	2,300	377	291	794	218	71	36	51	20
Min	8.2	18	43	177	82	66	121	73	34	20	17	10
AC-FT	825	4,705	21,590	24,216	7,573	5,284	20,065	7,220	3,126	1,634	1,591	1,012

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1965 to Sep 1966

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	16	20	37	77	219	81	132	86	34	12	11	6.5
2	18	21	35	64	94	73	143	81	31	15	11	11
3	18	20	34	63	134	66	144	81	31	18	9.4	12
4	16	21	34	1,010	298	62	146	84	30	16	3.2	10
5	16	23	33	1,520	211	77	141	87	29	14	4.6	9.0
6	18	24	32	400	346	87	130	92	31	14	7.5	10
7	18	27	32	207	137	76	128	86	35	14	5.9	10
8	20	42	31	245	99	124	131	90	31	17	4.6	8.3
9	20	31	30	158	82	112	130	90	32	14	7.5	11
10	20	28	30	122	71	186	176	85	29	12	6.0	12
11	19	29	30	100	62	162	190	84	30	14	4.0	13
12	19	43	32	83	58	135	173	79	29	14	7.5	13
13	19	57	31	72	53	143	144	74	26	13	5.5	13
14	20	114	30	65	51	146	131	66	24	12	6.7	13
15	22	175	29	60	49	164	126	65	21	13	7.8	12
16	21	67	32	56	46	191	131	60	20	14	8.8	12
17	22	145	32	53	45	132	140	54	20	16	8.5	15
18	22	166	32	51	44	117	139	52	17	13	8.5	15
19	22	82	31	49	126	216	124	48	22	12	5.0	17
20	20	62	31	46	144	133	112	46	19	7.5	8.0	15
21	18	46	32	44	81	115	97	44	22	7.0	9.3	15
22	17	39	32	44	76	102	92	45	23	2.5	10	14
23	18	37	30	44	133	93	88	42	20	2.3	12	13
24	17	106	69	42	286	88	91	37	18	6.0	4.8	11
25	17	143	123	40	180	86	95	34	15	4.2	5.0	11
26	16	93	66	40	169	85	100	36	13	5.0	5.9	12
27	16	82	51	39	108	91	94	33	17	7.6	3.4	11
28	15	52	446	38	90	99	92	35	13	6.8	5.5	8.5
29	16	44	166	175		106	92	35	11	11	3.8	8.5
30	17	40	143	152		117	88	34	10	8.8	6.5	8.5
31	20		147	79		123		34		11	6.0	
Total	573	1,879	1,943	5,238	3,492	3,588	3,740	1,899	703	347	213	349
Mean	18	63	63	169	125	116	125	61	23	11	6.9	12
Max	22	175	446	1,520	346	216	190	92	35	18	12	17
Min	15	20	29	38	44	62	88	33	10	2.3	3.2	6.5
AC-FT	1,137	3,727	3,854	10,389	6,926	7,117	7,418	3,767	1,393	688	422	693

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1966 to Sep 1967

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	10	15	336	40	547	71	359	162	199	60	28	20
2	14	17	1,420	39	362	70	182	156	183	57	23	21
3	12	16	450	39	271	69	166	154	159	59	27	22
4	10	15	330	40	218	66	148	162	155	57	29	20
5	8.5	13	250	37	188	65	168	182	148	53	29	22
6	7.5	40	165	38	164	64	482	182	149	54	30	22
7	12	36	132	37	150	63	323	205	148	53	30	23
8	9.0	24	109	36	138	63	218	251	147	53	28	24
9	14	21	98	36	126	63	185	312	151	50	27	26
10	12	21	239	36	118	66	190	426	149	48	27	26
11	14	23	134	35	112	245	212	288	150	42	25	26
12	15	53	106	35	109	212	164	240	154	43	25	22
13	13	34	294	35	109	284	150	220	143	41	27	21
14	13	29	197	34	107	282	225	215	138	37	22	20
15	14	48	134	34	100	202	198	238	134	34	21	18
16	15	207	110	34	96	646	146	293	129	37	24	18
17	13	54	96	33	93	332	260	340	125	38	22	25
18	13	38	87	33	90	327	465	379	126	38	22	25
19	12	293	80	33	86	228	578	376	116	35	23	20
20	12	630	75	1,030	82	242	383	366	111	31	24	21
21	13	263	68	2,210	79	210	236	366	107	31	23	19
22	15	230	64	560	77	190	215	371	101	32	20	21
23	18	93	60	254	74	251	312	370	94	35	21	21
24	17	66	56	446	76	205	416	352	90	33	22	20
25	17	53	51	236	103	180	595	309	86	34	23	19
26	16	47	50	675	80	162	274	276	79	30	25	18
27	16	43	48	785	75	150	727	260	78	31	22	22
28	15	228	44	1,120	72	158	289	255	74	32	23	23
29	16	400	43	1,310		150	218	231	68	30	20	22
30	17	153	42	1,100		142	180	212	62	32	22	23
31	15		41	1,070		268		197		30	20	
Total	418	3,203	5,409	11,480	3,902	5,726	8,664	8,346	3,753	1,270	754	650
Mean	13	107	174	370	139	185	289	269	125	41	24	22
Max	18	630	1,420	2,210	547	646	727	426	199	60	30	26
Min	7.5	13	41	33	72	63	146	154	62	30	20	18
AC-FT	828	6,353	10,729	22,770	7,739	11,357	17,185	16,554	7,444	2,519	1,496	1,289

Kilarc-Cow Creek Project, FERC No. 606

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1967 to Sep 1968

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	23	27	41	38	130	221	147	71	33	16	12	14
2	41	27	37	37	546	198	137	72	35	18	12	14
3	63	28	214	35	300	180	119	72	34	15	9.4	13
4	36	28	392	34	181	165	112	72	34	14	14	11
5	35	29	246	33	144	158	112	71	48	17	11	16
6	33	30	71	33	133	144	105	67	59	14	12	17
7	30	28	203	32	129	138	100	64	48	16	12	15
8	31	28	71	33	122	134	97	64	40	16	10	17
9	31	31	52	53	130	122	95	60	36	16	8.0	16
10	30	30	45	1,080	130	111	98	55	34	17	11	16
11	30	30	42	161	121	105	103	54	30	18	13	13
12	30	30	39	104	113	202	106	60	30	17	8.9	13
13	26	31	34	139	106	203	100	74	31	17	12	14
14	26	48	40	1,280	105	158	98	74	28	17	15	16
15	28	38	46	1,450	95	139	99	66	27	13	18	18
16	26	33	34	626	170	636	97	60	27	13	17	13
17	26	31	31	315	669	265	91	58	22	14	17	14
18	25	33	38	200	269	193	87	57	20	12	17	14
19	27	49	38	149	746	165	85	59	18	10	33	14
20	29	35	35	121	972	148	80	72	20	12	92	18
21	30	32	34	107	831	138	79	61	23	16	75	20
22	32	32	34	95	814	132	68	68	25	10	44	20
23	29	31	36	88	1,190	128	65	65	25	13	30	19
24	27	30	37	84	725	123	60	61	22	10	26	19
25	30	30	38	80	492	142	61	56	23	12	23	16
26	30	30	40	75	381	134	59	55	22	11	24	13
27	29	31	49	71	323	125	63	49	22	11	23	16
28	29	33	50	68	279	120	57	41	17	8.9	22	13
29	30	45	45	524	244	120	60	42	17	12	19	15
30	28	47	42	465		120	64	38	18	14	16	20
31	27		39	181		124		35		15	16	
Total	947	985	2,193	7,791	10,590	5,191	2,704	1,873	868	434	672	467
Mean	31	33	71	251	365	167	90	60	29	14	22	16
Max	63	49	392	1,450	1,190	636	147	74	59	18	92	20
Min	23	27	31	32	95	105	57	35	17	8.9	8.0	11
AC-FT	1,878	1,954	4,350	15,453	21,005	10,296	5,363	3,715	1,722	862	1,333	926

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1968 to Sep 1969

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	21	26	58	128	290	454	304	256	166	50	32	22
2	19	43	46	166	248	438	276	247	155	49	32	19
3	11	60	40	169	220	355	269	239	149	51	32	20
4	15	46	38	161	210	257	226	217	141	49	28	18
5	21	36	37	151	487	222	665	225	135	47	28	24
6	22	32	38	145	518	200	520	245	130	51	27	24
7	19	30	36	140	302	180	321	275	123	46	28	23
8	19	28	47	134	267	165	279	299	121	36	26	22
9	17	28	62	120	657	161	253	315	130	46	28	24
10	18	27	1,160	108	578	150	231	332	126	45	28	24
11	26	29	361	1,210	1,190	137	224	354	130	44	27	23
12	34	107	181	3,190	940	129	240	351	115	40	24	22
13	61	48	179	2,430	498	121	234	342	106	42	29	19
14	57	45	625	813	739	115	225	313	98	42	28	15
15	37	67	680	465	822	113	207	280	97	37	26	23
16	29	110	282	330	514	116	202	264	84	36	29	24
17	27	71	168	257	376	132	215	264	82	37	25	24
18	26	131	128	359	373	142	288	273	84	34	26	25
19	25	89	107	1,610	305	140	254	255	89	31	34	26
20	25	59	88	2,140	297	140	255	240	81	31	28	26
21	25	48	76	2,150	266	137	270	228	77	39	26	27
22	25	44	71	1,030	230	133	292	228	73	35	22	26
23	25	44	85	624	374	136	349	230	64	36	20	25
24	24	56	1,000	481	470	136	286	232	66	36	24	25
25	25	69	1,430	714	429	140	249	221	63	34	24	24
26	25	52	438	986	457	147	227	219	60	33	21	23
27	26	45	328	631	412	158	218	211	64	35	22	21
28	26	41	548	488	820	177	221	193	59	33	22	21
29	41	38	270	389		201	239	181	56	33	22	26
30	51	50	177	348		226	246	178	53	30	21	23
31	29		137	300		272		165		28	23	
Total	851	1,599	8,921	22,367	13,289	5,730	8,285	7,872	2,977	1,216	812	688
Mean	27	53	288	722	475	185	276	254	99	39	26	23
Max	61	131	1,430	3,190	1,190	454	665	354	166	51	34	27
Min	11	26	36	108	210	113	202	165	53	28	20	15
AC-FT	1,688	3,172	17,695	44,364	26,358	11,365	16,433	15,614	5,905	2,412	1,611	1,365

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1969 to Sep 1970

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	21	35	35	147	331	558	104	63	42	30	25	22
2	19	34	36	130	298	255	102	60	41	32	24	22
3	20	35	35	122	276	221	95	60	39	28	25	21
4	24	34	35	115	258	318	93	60	43	29	24	22
5	24	126	35	106	238	256	93	55	43	29	23	23
6	25	129	35	103	221	213	94	64	38	30	21	23
7	24	88	35	102	203	331	93	65	36	29	20	23
8	26	63	44	167	191	439	90	73	42	30	23	23
9	28	53	42	1,180	179	357	87	85	49	28	23	20
10	27	46	43	540	171	435	88	75	78	30	22	20
11	27	43	103	396	165	304	87	69	51	27	22	19
12	27	44	1,350	440	224	271	85	70	47	26	24	17
13	27	41	644	620	457	247	87	70	46	26	22	21
14	31	40	227	1,120	259	237	90	59	54	21	20	20
15	59	39	148	810	208	215	86	53	47	28	20	19
16	91	39	112	2,190	431	202	84	58	45	28	20	21
17	96	38	107	1,100	403	187	81	56	42	26	19	22
18	51	38	115	810	280	174	73	60	39	24	16	23
19	44	38	2,400	755	242	169	79	65	32	28	21	22
20	40	37	1,340	822	220	162	70	64	35	24	20	21
21	38	37	1,820	1,320	204	154	62	60	34	25	22	22
22	38	37	625	1,270	189	145	68	57	33	26	23	20
23	37	36	1,040	4,120	178	139	65	59	34	26	23	20
24	37	36	670	2,760	170	134	59	56	35	26	22	24
25	36	35	615	1,210	160	130	64	52	33	26	22	20
26	36	35	388	968	154	126	71	45	35	19	23	21
27	36	35	305	1,140	149	120	71	50	37	26	23	21
28	36	35	245	631	196	115	66	50	42	26	23	22
29	36	35	205	502		113	64	49	50	23	19	21
30	35	35	179	430		109	66	46	35	24	17	21
31	35		161	374		108		44		25	22	
Total	1,131	1,396	13,174	26,500	6,655	6,944	2,417	1,852	1,257	825	673	636
Mean	36	47	425	855	238	224	81	60	42	27	22	21
Max	96	129	2,400	4,120	457	558	104	85	78	32	25	24
Min	19	34	35	102	149	108	59	44	32	19	16	17
AC-FT	2,243	2,769	26,130	52,562	13,200	13,773	4,794	3,673	2,493	1,636	1,335	1,261

Kilarc-Cow Creek Project, FERC No. 606

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1970 to Sep 1971

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	19	33	360	172	161	79	245	142	194	66	35	31
2	20	33	417	150	161	75	219	138	170	65	33	29
3	20	34	788	119	152	75	209	165	156	61	33	28
4	21	41	1,270	107	143	75	199	207	152	57	35	27
5	22	117	439	99	136	72	196	189	143	57	33	26
6	21	92	320	93	128	70	199	178	134	52	31	26
7	24	135	754	89	122	69	215	178	132	48	32	24
8	23	77	1,080	87	115	68	194	207	128	41	37	22
9	25	398	552	86	109	66	185	196	126	37	33	27
10	25	171	324	455	107	68	245	191	128	43	34	25
11	25	111	242	285	109	69	188	203	119	43	30	24
12	25	147	197	209	124	1,320	177	213	115	46	31	26
13	24	81	172	179	132	414	175	227	109	43	33	24
14	24	62	152	184	134	297	169	219	100	40	30	21
15	25	52	219	715	141	267	170	202	87	36	28	21
16	25	46	330	2,240	136	242	170	187	87	38	32	20
17	25	42	394	1,010	130	231	179	168	87	39	30	21
18	27	39	242	665	122	186	156	154	81	41	30	22
19	29	37	184	544	122	170	147	163	78	41	30	19
20	38	36	190	456	109	160	159	156	76	36	30	19
21	38	35	344	376	103	152	154	139	69	35	30	23
22	52	40	190	311	102	149	144	134	62	40	30	22
23	53	44	159	266	98	473	136	136	60	35	30	22
24	57	162	139	236	94	538	132	139	60	35	30	24
25	37	567	122	205	89	912	127	152	60	37	30	26
26	34	195	126	184	84	1,360	126	230	96	36	30	29
27	33	389	161	172	84	648	125	187	94	37	29	31
28	32	1,550	205	166	82	459	128	208	82	35	28	30
29	32	841	725	161		379	131	172	68	33	28	39
30	32	529	233	159		334	137	175	69	30	29	58
31	33		190	161		276		161		34	31	
Total	920	6,136	11,220	10,341	3,329	9,753	5,136	5,516	3,122	1,317	965	786
Mean	30	205	362	334	119	315	171	178	104	42	31	26
Max	57	1,550	1,270	2,240	161	1,360	245	230	194	66	37	58
Min	19	33	122	86	82	66	125	134	60	30	28	19
AC-FT	1,825	12,171	22,255	20,511	6,603	19,345	10,187	10,941	6,192	2,612	1,914	1,559

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1971 to Sep 1972

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	38	32	41	49	72	332	110	89	48	24	14	14
2	34	32	48	48	62	392	113	89	48	21	16	13
3	33	31	60	45	59	502	111	91	41	22	15	12
4	32	31	47	42	89	370	108	91	42	25	12	12
5	30	32	49	41	119	300	199	91	38	22	14	12
6	29	32	64	40	139	255	181	92	40	19	16	13
7	27	31	48	40	108	223	150	97	40	20	13	18
8	27	31	45	39	83	202	139	99	39	15	6.9	14
9	28	32	42	39	72	194	125	91	40	17	12	13
10	28	32	41	38	63	217	121	84	56	14	12	13
11	28	39	40	37	59	202	184	80	42	21	13	15
12	27	44	55	37	55	197	454	72	35	20	13	20
13	27	51	56	37	55	197	230	73	36	20	14	18
14	26	41	47	37	53	186	171	76	32	20	14	15
15	27	39	42	37	51	171	157	74	30	19	13	14
16	28	37	39	37	50	171	148	74	32	20	15	14
17	27	36	38	37	49	169	139	76	31	17	17	15
18	28	35	39	38	48	167	127	74	32	19	15	16
19	30	35	38	42	48	153	121	69	30	17	16	17
20	32	36	37	45	52	139	113	91	26	20	13	18
21	32	36	40	142	59	133	108	86	29	21	12	19
22	31	35	762	139	94	215	104	72	26	20	11	19
23	33	35	137	225	204	184	101	69	27	20	11	18
24	34	35	179	133	372	171	115	66	30	15	14	19
25	31	36	135	111	267	217	104	62	28	12	13	20
26	33	43	125	111	526	159	99	58	24	15	13	37
27	33	58	87	121	241	144	95	52	23	16	13	95
28	32	59	65	99	818	135	95	51	29	16	12	48
29	32	65	63	84	688	125	92	52	27	17	12	31
30	32	47	60	75		119	91	42	27	17	14	28
31	33		52	75		113		42		14	13	
Total	942	1,158	2,621	2,120	4,655	6,454	4,205	2,325	1,028	575	412	630
Mean	30	39	85	68	161	208	140	75	34	19	13	21
Max	38	65	762	225	818	502	454	99	56	25	17	95
Min	26	31	37	37	48	113	91	42	23	12	6.9	12
AC-FT	1,868	2,297	5,199	4,205	9,233	12,801	8,340	4,612	2,039	1,140	817	1,250

Kilarc-Cow Creek Project, FERC No. 606

11372200 S Cow C Nr Millville Ca

Streamflow (cfs), Water Year Oct 1972 to Sep 1973

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	27											
2	29											
3	27											
4												
5												
6												
7												
8												
9												
10												
11												
12												
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20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Total	83											
Mean	28											
Max	29											
Min	27											
AC-FT	165											

Kilarc-Cow Creek Project, FERC No. 606

KILARC-COW CREEK PROJECT

FERC NO. 606

APPENDIX B

SPECIAL-STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT AREA

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Plants				
Slender Orcutt Grass *(Orcuttia tenuis)*	FT	SE (1B)	Vernal pools underlain by volcanic substrate in grassland, blue oak woodland, and lower montane conifer forest.	Unlikely to occur. Vernal pools are not present within the Project Area.
Bogg's Lake Hedge-Hyssop *(Gratiola heterosepala)*	-	SE (1B)	Lake margins, edges of reservoirs, and stock ponds.	May occur along the edges of Kilarc Forebay and Cow Creek Forebay.
Butte Fritillary *(Fritillaeria eastwoodiae)*	-	CSC (3)	In openings on dry beaches and slopes in chaparral, woodland, and lower coniferous forests from 1600 to 4920 ft in elevation.	May occur on slopes in oak woodland and mixed conifer habitats in the Project Area.
Shasta Clarkia *(Clarkia borealis* ssp. *arida)*	-	CSC (1B)	Cismontane woodland, endemic to Shasta County.	May occur in blue oak-foothill pine woodland habitat in the Project Area.
Ahart's Paronychia *(Paronychia ahartii)*	-	CSC (1B)	Well-drained rocky outcrops or volcanic uplands, annual grassland, or oak woodlands.	May occur in blue oak-foothill pine woodland habitat in the Project Area.
Shasta Snow Wreath *(Neviusia cliftonii)*	-	CSC (1B)	Forest and riparian woodland.	May occur in blue-oak foothill pine woodland in the Project Area.
Silky Cryptantha *(Cryptantha crinita)*	-	CSC (1B)	Gravelly soils usually found in non-wetland areas. Sand and gravel deposits associated with seasonal and, less frequently, perennial streams. Generally below 1000 ft elevation.	Unlikely to occur in the Project Area. Documented occurrence is outside of the Project Area.
Four Angled Spike Rush *(Eleocharis quadrangulata)*	-	CSC (2)	Freshwater wetlands and marsh habitats.	May occur in Kilarc and Cow Creek Forebays.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Henderson's Bent Grass *(Agrostis hendersonii)*	-	CSC (1B)	Valley and foothill grasslands in riparian, wet meadows, and seeps.	Unlikely to occur in the Project Area. Documented occurrence is outside of the Project Area.
Bellinger's Meadowfoam *(Limnanthes floccosa* ssp. *bellingeriana)*	-	CSC (1B)	Meadows, seeps, riparian, and cismontane woodland.	Unlikely to occur in the Project Area. Documented occurrence is outside of the Project Area.
Red Bluff Dwarf Rush *(Juncus leiospermus* var. *leiospermus)*	-	CSC (1B)	Found in the upper Sacramento Valley on the floor and lower foothill terraces from northern Butte, Tehama, and southern Shasta counties. Occurs at the edges of vernal pools and swales. Generally found between 300 to 1000 ft.	Unlikely to occur in the Project Area. Vernal pools and swales not within the Project Area.
Legenere *(Legenere limosa)*	-	CSC (1B)	Vernal pools and seasonal marshes. Occurs on the drying clay mud of vernal pools and similar seasonal wetlands.	Unlikely to occur in the Project Area. Vernal pools and seasonal marshes not within the Project Area.
Red-flowered Lotus *(Lotus rubriflorus)*	-	CSC (1B)	Occurs in oak woodland and grasslands in Colusa and Stanislaus counties.	Unlikely due to limited distribution. Out of distribution range.
Sanford's Arrowhead *(Sagittaria sanfordii)*	-	CSC (1B)	Found in Tehama County on the east side of the Sacramento Valley, northeast of Red Bluff in grassland/oak woodlands. Occurs in shallow, standing, fresh water and sluggish waterways within the following: marshes, swamps, ponds, vernal pools and lakes, reservoirs, sloughs, ditches, canals, streams, and rivers at elevations from 10 to 2000 ft.	Unlikely to occur in the Project Area. Documented occurrence is outside the Project Area.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Long-stiped Campion *(Silene occidentalis* ssp. *longistipitata)*	-	CSC (1B)	Chaparral and coniferous forests from the high southern Cascade Ranges and Modoc Plateau to the northern High Sierra Nevada; 2300 to 7500 ft.	Unlikely to occur in the Project Area. Documented occurrence is outside Project Area.
Fish				
Central Valley Fall and Late-Fall Chinook Salmon ESU (*Oncorhynchus tshawytscha*)	Proposed	CSC	Mainly found in Sacramento River; most spawning and juvenile rearing occurs from Red Bluff upstream to Keswick Dam. Spawning typically occurs in swift, relatively shallow riffles or along edges of fast runs in loose gravel.	Occur in South Cow Creek downstream of Wagoner Canyon, may reach the Cow Creek Diversion
Central Valley Steelhead ESU (*Oncorhynchus mykiss*)	FT	-	Prefer to spawn in cool, clear well-oxygenated streams with suitable depth, current velocity, and gravel size. Typically migrate to marine waters after 2 years in fresh.	Present in South Cow Creek at, and upstream, of the Project Area.
California Roach (*Lavinia symmetricus*)	-	CSC	Found throughout the Sacramento-San Joaquin drainage system, generally in small, warm, intermittent streams.	Found in Lower reaches of Cow Creek
River Lamprey (*Lampetra ayresi*)	FSC	CSC	Distributed throughout the lower Sacramento-San Joaquin River system and along coastal streams.	No known occurrences, although there may be potential
Green Sturgeon (*Acipsenser medirostris*)	FSC	CSC	Migrates up the Sacramento River as far as Red Bluff Diversion Dam.	Not currently found nor historically reported within the Project Area of Cow Creek Watershed.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Sacramento Winter-run Chinook Salmon (*Oncorhynchus tschytscha*)	FE	SE	Historically migrated up the Sacramento River to McCloud River and lower Pit River. Currently, spawning is limited to the Sacramento River 43.5 miles immediately downstream of Kenswick Dam. Require cold, clear, spring-fed streams for incubation.	Neither the Project Area nor the Cow Creek Watershed are part of the present or past range for winter-run Chinook salmon.
Delta Smelt (*Hypomesus transpacificus*)	FT	ST	Principally found in the Sacramento-San Joaquin Delta, Suisun Marsh, Suisun Bay and San Pablo Bay. Occur above Rio Vista but largely confined to the lower Delta.	Not currently found nor historically reported within the Project Area or Cow Creek Watershed.
Sacramento Splittail (Pogonichthys macrolepidotus)	FT	CSC	Largely confined to the Sacramento-San Joaquin Delta, Suisun Bay, Suisun and Napa marshes, lower Napa River, lower Petaluma River, and other parts of the San Francisco Estuary.	Not currently found nor historically reported within the Project Area or Cow Creek Watershed.
Wildlife				
Invertebrates				
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	FE	-	Elderberry shrubs throughout the Central Valley and foothills below 3000 ft elevation.	May occur. Appropriate habitat is present in elderberry shrubs within the Project Area.
Vernal pool fairy shrimp (*Branchinecta lynchi*)	FT	-	Central Valley vernal pools, swales, slumps, basalt flow depressions. Up to 950 ft in elevation.	Unlikely to occur. No appropriate habitat present within the Project Area.
California *linderiella* fairy shrimp	-	CSC	Central Valley vernal pools, swales, slumps, and basalt flow depressions.	Unlikely to occur. No appropriate habitat present within the Project Area.
Shasta Crayfish (*Pacifastacus fortis*)	-	FE	Generally occur in cool, spring-fed headwaters characterized by clean, volcanic cobbles and boulders overlying sand or gravel substrates.	Unlikely to occur in the Project Area. Project Area located outside of species' documented distribution.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Amphibians				
California red-legged frog (*Rana aurora draytonii*)	FT	-	Breeds in quiet streams and permanent, deep, cool ponds with overhanging and emergent vegetation below 4,000 ft elevation. Known to occur adjacent to breeding habitats in riparian areas and heavily vegetated streamside shorelines, and non-native grasslands.	May occur. Appropriate habitat may be present in the south fork of Cow Creek and Old Cow Creek. The site is not within the Critical Habitat (Closest is Unit 6, about 30 mi). Within Recovery Unit Boundary, but not in Core Recovery Area (Closest is Unit 13, about 12 mi).
Foothill yellow-legged frog (*Rana boylii*)	Proposed	CSC	Breeds in rocky streams with cool, clear water in a variety of habitats, including valley and foothill oak woodland, riparian forest, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadows; occurs at elevations ranging from 0 to 6,000 ft.	May occur. Appropriate habitat may be present in the south fork of Cow Creek and Old Cow Creek.
Shasta salamander (*Hydromantes shastae*)	-	ST	Primarily inhabits isolated limestone formations and caves in volcanic and other rock outcroppings, and under woody debris on the surface during wet weather in mixed pine-hardwood stands.	Unlikely to occur. No appropriate habitat present within the Project Area.
Western spadefoot toad (*Scaphiopus hammondii*)	-	CSC	Requires vernal pools and seasonal wetlands below 4,500 ft that lack predators for breeding. Also occurs in grassland habitat and occasionally in valley-foothill oak woodlands and orchards.	Unlikely to occur. No appropriate habitat is present within the Project Area.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Reptiles				
Northwestern pond turtle (*Clemmys marmorata marmorata*)	FSC	CSC	Perennial wetlands and slow moving creeks and ponds with overhanging vegetation up to 6,000 ft; suitable basking sites such as logs and rocks above the waterline.	May occur. Appropriate habitat is present in the Kilarc and Cow Creek Forebays.
Birds				
Bald eagle (*Haliaeetus leucocephalus*)	FT	SE	Year-round in Shasta County. Occurs in low to mid-range elevations of the Sierra Nevada. Nests in large, old-growth or dominant live tree with open branches. Perches in large trees, snags or broken-topped trees near water for foraging.	Known to occur at Kilarc Forebay. Bald eagles observed roosting on a snag next to the Kilarc Forebay. May nest nearby. Juveniles have been observed nearby.
California spotted owl (*Strix occidentalis californicus*)	Proposed	CSC	Occurs in lower elevation (1,000 – 2,000 ft) coniferous forests, mixtures of conifers and hardwoods, and in foothill riparian/hardwood forests, in the western Sierra Nevada.	May forage and breed in mixed conifer and blue oak-foothill pine woodland in the Project Area
American peregrine falcon (*Falco peregrinus americana*)	-	SE	Breeds near wetlands, lakes, and rivers on high cliffs and banks.	Known to occur and has nested in the Cow Creek Watershed (SHN 2001). May forage in or near Kilarc or Cow Creek Forebays and in stream habitat in Project Area.
Golden eagle (*Aquila chrysaetos*)	-	CSC	Habitat is typically rolling foothills, mountain areas, and sage juniper flats. Grasslands and early successional forest.	May breed or forage in grasslands, oak woodland, or mixed conifer forest in Project Area.
Osprey (*Pandion haliaetus*)	-	CSC	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats. Known to breed near Shasta Lake.	Unlikely to occur in the Project Area due to a lack of large open water bodies.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Swainson's Hawk (*Buteo swainsoni*)	-	ST	Breeding resident and migrant in the Central Valley, Klamath Basin, Northeastern Plateau, Lassen County, and Mojave Dessert. Require large, open grasslands with abundant prey in association with suitable nest trees. Nests in mature riparian forest, groves of oaks, mature roadside trees.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Sharp-shinned Hawk (*Accipiter striatus*)	-	CSC	Mid-elevation habitats. Roosts in intermediate to high-canopy forest. Nests in dense, even-aged, single-layered forest canopy. Winters in woodlands. Prefers, but not restricted to, riparian habitats. All habitats except alpine, open prairie, and bare dessert used in winter.	May forage in riparian habitat or nest in mixed conifer forest in the Project Area.
Ferruginous hawk (*Buteo regalis*)	-	CSC	Forages in grasslands, sagebrush flats, desert scrub, low foothills, and pinyon-juniper in the Modoc Plateau, Central Valley, and Coast Ranges; breeds in the Great Basin and northern plains states.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Northern Goshawk (*Accipiter gentilis*)	-	CSC	Prefers middle to high elevation, mature, dense conifer forests for foraging and nesting. Casual in foothills during winter, northern deserts in pinyon-juniper woodland, and low elevation riparian habitats. Nests on north-facing slopes near water.	May forage in riparian, oak woodland, or mixed conifer habitat in Project Area. May breed near steams or forebays in the Project Area.
White-tailed kite (*Elanus leucurus*)	-	CSC	Coastal and valley lowlands. Herbaceous and open stages of most habitats; grasslands and agricultural areas are used for foraging; typically nests in tops of dense oak, willow, or other tree stands adjacent to open areas and agricultural fields.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Short-earred owl (*Asio flammeus*)	-	CSC	Occurs in open areas with few trees, such as annual and perennial grasslands, prairies, dunes, meadows, irrigated lands, and saline and fresh emergent wetlands. Requires elevated sites for perching and dense vegetation for roosting. Not found in high mountains.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Western burrowing owl (*Athene cunicularia hypugaea*)	FSC	CSC	Grasslands, oak woodlands, and ponderosa pine habitat, up to 5300 ft.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Tri-colored blackbird (*Agelaius tricolor*)	-	CSC	Breeds near freshwater, preferably in emergent wetland with tall dense cattails or tules, but also in thickets of willow, blackberry, wild rose, and tall herbs. Feeds in grassland and cropland habitats. Found throughout the Central Valley and on the coast.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Lawrence's goldfinch (*Carduelis lawrencei*)	-	CSC	Occurs in valley foothill hardwood and valley foothill hardwood-conifer. Breeds in open oak or other arid woodland and chaparral, near water.	May forage and breed in oak woodland or oak-pine woodlands near streams or forebays in the Project Area.
Vaux's swift (*Chaetura vauxi*)	-	CSC	Prefers redwood and Douglas fir habitats with nest sites in large, hollow trees and snags, especially tall, burned-out stubs. Forages over moist terrain and habitats, preferring rivers and lakes. Summer resident of northern California.	May forage and breed in mixed conifer forest near streams and forebays in the Project Area.
Black tern (*Chlidonias niger*)	-	CSC	Summer range in the Central Valley and Northeastern Plateau of California near wet meadows, wetlands, and other freshwater habitats. Restricted to freshwater habitat while breeding.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Black swift (*Cypseloides niger*)	-	CSC	Breeds very locally in Sierra Nevada and Cascade Ranges. Nests in moist crevices or caves, or on cliffs near waterfalls in deep canyons. Forages widely over many habitats; seems to avoid arid regions. Known from the high elevations of the Sierra National Forest.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Hermit warbler (*Dendroica occidentalis*)	FSC		Breeds in major mountain ranges from San Gabriel and San Bernardino mountains northward (excluding coastal ranges south of Santa Cruz). Breeds in mature ponderosa pine, montane hardwood-conifer, mixed conifer, Douglas fir, redwood, red fir, and Jeffrey pine habitats. Avoids areas with a high deciduous volume; absent from riparian areas and clearcuts.	May breed in mixed conifer forests near the Project Area. May forage in mixed conifer and oak-pine woodland in the Project Area.
Willow flycatcher (Empidonax traillii)	-	SE	Wet meadow and montane riparian habitats from 2,000 to 8,000 ft. Breeding seldom occurs below 5,000 ft (Valentine, pers. com.). Most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows.	May forage in wet meadow and riparian habitat in the Project Area.
Loggerhead shrike (*Lanius ludovicianus*)	-	CSC	Open habitats with sparse shrubs and trees (or other suitable perch sites) and bare ground and/or low, sparse herbaceous cover; oak woodlands for nesting. Found in lowlands and foothills throughout California.	May forage in oak woodlands or riparian habitat in the Project Area. May breed in oak woodlands in the Project Area.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Lewis' woodpecker (*Melanerpes lewis*)	-	CSC	Winter resident in open oak savannahs, broken deciduous, and coniferous habitats with brushy understory. Uses logged and burned areas. Winters in the Central Valley, Modoc Plateau, and the Transverse and other Ranges in Southern California. Breeds locally along eastern slopes of the Coast Ranges, and in Sierra Nevada, Warner Mts., Klamath Mts., and in the Cascade Range.	May forage or breed in oak woodland and mixed conifer habitats in the Project Area.
Long-billed curlew (*Numenius americanus*)	-	CSC	Found in wet meadow habitat in northeastern California in Siskiyou, Modoc, and Lassen Counties. Winter visitor along the California coast and in the Central and Imperial valleys.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
White-faced ibis (*Plegadis chihi*)	-	CSC	Uncommon summer resident in sections of Southern California, rare visitor in the Central Valley. Nests in dense, fresh emergent wetland. Forages in shallow water or muddy fields.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Bank swallow (*Riparia riparia*)	-	ST	Migrant found primarily in riparian and other lowland habitats in California west of the deserts. Requires vertical banks and cliffs with fine-textured or sandy soils near streams, rivers, ponds, lakes, and the ocean for nesting. Feeds primarily over riparian areas during breeding season and over grassland and cropland during migration.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Rufous hummingbird (*Selasphorus rufus*)	-	CSC	Utilizes riparian areas, open woodlands, chaparral, mountain meadows, and other habitats rich in nectar-producing flowers. Uses valley foothill hardwood, valley foothill hardwood-conifer, riparian, and chaparral habitats in migration. Breeds in Oregon and Washington and the Trinity Mountains of Trinity and Humboldt counties.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	Candidate	-	Valley foothill and desert riparian habitats in scattered locations in California; breeds along the Colorado River, Sacramento and Owens valleys, South Fork of the Kern River, Santa Ana River, and the Amargosa River.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Grasshopper sparrow (*Ammodramus savannarum*)	FSC	-	Uncommon and local summer resident and breeder in foothills and lowlands west of the Cascade-Sierra Nevada crest from Mendocino and Trinity Counties. South to San Diego County. Occurs in dry, dense grasslands.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
California thrasher (*Toxostoma redivivum*)	FSC	-	Common resident of foothills and lowlands in cismontane California. Occupies moderate to dense chaparral habitats and, less commonly, extensive thickets in young or open valley foothill riparian habitat.	May forage or breed in riparian habitats in the Project Area.
Aleutian Canada goose (*Branta canadensis leucopareia*)	D	-	Utilize pastures and grain fields along the coasts of Oregon and northern California, and in California's Central Valley. It is presumed that the geese migrate between the Aleutian Islands and wintering grounds in Oregon and California by flying non-stop over the North Pacific Ocean.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Mammals				
California wolverine (*Gulo gulo luteus*)	-	ST	Mixed conifer, red fir, and lodgepole habitats, and probably sub-alpine conifer, alpine dwarf shrub, wet meadow, and montane riparian habitats. Occurs in Sierra Nevada from 4,300 to 10,800 ft. Majority of recorded sightings are found above 8,000-ft elevation.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Sierra Nevada red fox (*Vulpes vulpes necator*)	-	CSC	Occurs throughout the Sierra Nevada at elevations above 7,000 ft in forests interspersed with meadows or alpine forests. Open areas are used for hunting, forested habitats for cover and reproduction.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Pacific fisher (*Martes pennanti pacifica*)	-	Proposed	Suitable habitat consists of large areas of mature, dense forest, red fir, lodgepole pine, ponderosa pine, mixed conifer, and Jeffery pine forests with snags and greater than 50% canopy closure. Known from 4,000 to 8,000 ft elevations.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Pine marten (*Martes americana*)	-	CSC	Known from the high elevation forested plant communities. Optimal habitats are various mixed evergreen forests with more than 40% crown closure and large trees and snags for den sites. Most commonly found in red fir and lodgepole pine forests between 4,000 and 10,600 ft elevation.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Ring-tailed cat (*Bassariscus astutus*)	-	CFP	Widely distributed, occurs in various riparian habitats, and in brush stands of most forest and shrub habitats, at low to middle elevations. Little information available on distribution and relative abundance among habitats.	May occur in forested areas near facilities in the Project Area.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Pale Townsend's big-earred bat (*Corynorhinus townsendii pallescens*)	FSC	CSC	Throughout California, but the details of its distribution are not well known. All but subalpine and alpine habitats. Most abundant in mesic habitats and requires caves, mines, tunnels, buildings, or other human-made structures for roosting.	May occur in Project facilities such powerhouses and tunnels in the Project Area.
Spotted bat (*Euderma maculatum*)	FSC	CSC	Habitats range from arid deserts and grasslands through mixed conifer forests up to 10,600 ft. Prefers sites with adequate roosting habitat, such as cliffs. Often limited by the availability of cliff habitat. Feeds over water and along marshes.	Unlikely to occur in the Project Area. Project Area is not within documented species' distribution.
Small-footed myotis bat (*Myotis ciliolabrum*)	FSC	CSC	Ranges from British Columbia and Saskatchewan to the Southwestern United States. Prefers areas where it associates with cliffs, talus fields, and steep riverbanks. Roosts tend to be in rock crevices, cliff faces, and in talus formations. Maternity roosts are found in similar sites and have been observed in buildings.	May occur in Project facilities such powerhouses and tunnels in the Project Area.
Long-eared myotis bat (*Myotis evotis*)	FSC	CSC	Year-round resident in California, occurring in mixed hardwood/conifer forest and montane conifer forest in northern California, and in pinyon-juniper, mesquite scrub, and pine/oak woodland in southern California. Typically roosts singly or in small groups in hollow trees, under exfoliating bark, crevices in rock outcrops, and occasionally in mines, caves, and buildings during the day.	May occur in Project facilities such powerhouses and tunnels in the Project Area.

Special-Status Species Potentially Occurring in the Project Area.

Species	Federal Status	State Status	Habitat Affiliation	Potential Occurrence
Fringed myotis bat (*Myotis thysanodes*)	FSC	CSC	Western North America from British Columbia to Veracruz and Chiapas. Typically occurs at mid-elevations. Along the west coast, found at low elevations and is associated with redwood forests. Maternity colonies are in caves, mines, and buildings.	May occur in Project facilities such powerhouses and tunnels in the Project Area.
Long-legged myotis bat (*Myotis volans*)	FSC	CSC	Western North America from southeast Alaska to Central Mexico from sea level to 12,000 m. Primarily coniferous forest, but also riparian and desert habitats. Maternity roosts are found in buildings, rock crevices, and under exfoliating bark. Males roost singly or in small numbers in rock crevices, buildings, and under tree bark. Night roosts are under bridges, in caves and mines, and in buildings.	May occur in Project facilities such powerhouses and tunnels in the Project Area.
Yuma myotis bat (*Myotis yumanensis*)	FSC	CSC	Year-round resident in most of California at lower elevations in a wide variety of habitats from coast to mid-elevation. Very tolerant of human habitation and survives in urbanized environments. Day roosts are in buildings, trees, mines, caves, bridges, and rock crevices. Night roosts are in buildings, bridges, and other man-made structures.	May occur in Project facilities such powerhouses and tunnels in the Project Area.

FT = Federally Threatened
FE = Federally Endangered
FSC = Federal Species of Special Concern
ST = State Threatened
SE = State Endangered
CSC = State Species of Special Concern
CFP = California Fully Protected
D = Delisted

KILARC-COW CREEK PROJECT

FERC NO. 606

APPENDIX C

STUDY PLANS

Study 1

Stream Flow Monitoring
KILARC-COW CREEK PROJECT
FERC NO. 606

Study Plan Title: Stream Flow Monitoring

Objective of Study: To collect data to simulate hydrologic record under current Project operation at selected points in the watershed and establish long-term flow monitoring.

Study Methods: The streamflow records for the Cow Creek Watershed will be summarized based on a common time scale and missing records or changes in the gages will be noted. Daily data collected by the Licensee at the head and end of the Kilarc and South Cow Creek Canals will be evaluated. The data will be evaluated for adequacy and will be used to assess the historic diversions.

The 1965 adjudication study included spot flow measurements taken at different locations of the watershed. These data provided a greater spatial coverage of flow measurements than currently exists with the long-term flow recording stations. The adjudication flow records will be supplemented with new flow records collected bimonthly in 2002 and 2003 at similar locations. The purpose of these flow records is to assess the change in streamflow within the watershed and the influence of accretions and depletions. The streamflow measurements will be collected with a Price Current Meter or similar flow measurement device at selected locations. The location will be chosen to characterize the flow levels upstream of the diversion, in the bypass reach, and downstream of the tailrace.

Products from Study: The primary product of this study will be flow data which will be summarized and analyzed in the Exhibit E of the FERC license application.

Study Schedule: The study will be completed by December 2003.

Study 2

Estimate Available Flow
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Estimate Available Flow

Objective of Study: To estimate the available streamflow at the Cow Creek and Kilarc Diversion Dams. Once this flow has been determined, the Licensee's ability to manage the resource within the bypass reach can be assessed.

Study Methods: The assessment process is outlined below.

1. Selected points along the watercourses will be used to develop available flow estimates. Based on the need to directly assess the effects of Project diversions, these points would include Old Cow Creek at Kilarc Diversion, South Cow Creek at South Cow Creek Diversion, and Cow Creek at Millville. The measured flow records at these points include the partial records at Old Cow Creek at Kilarc Diversion and South Cow Creek at South Cow Creek Diversion, plus the full flow records at Cow Creek at Millville.

2. The major diversions in the watershed will be identified and aggregated to represent the total diversion (both project and non project) for a reach of river. The reaches will be structured to accommodate the estimate of available flow and identify Project and non-Project influences on flow.

3. The magnitude and season of non-Project diversions will be evaluated from data collected for the adjudication, during 2002-2003 surveys, and discussions with local landowners. A long-term diversion record will be developed that matches the available flow record based on these data and professional judgement.

4. The estimated diversion record and the measured flow will be used to estimate the available flow for the watershed and sub-watersheds where historic data exists.

5. The flow for the reach will be divided by the area of the contributing watershed to estimate a flow per unit area. These data will be evaluated relative to precipitation data to assess if there are changes in the unit runoff because of seasonal influence. Seasonal flow-per-unit-area estimates will be developed, if appropriate.

6. These subwatershed estimates will be compared with the estimate developed for Cow Creek at Millville. Relationships between estimated for Cow Creek at Millville estimate and the subwatershed estimates will be developed. Using the relationships, flow the record for the selected points of interest (described in #1 above) will be extended to match the Millville period of record. Because these records are incomplete and may not match the period of records for other stations, the records will be lengthened and placed on a similar time scale.

7. These synthesized records for available flow will be compared with the actual measured flows. The Licensee will assess the appropriateness of the estimated flows with a mass balance using the assumed diversions.

Products of Study: The product of this study will be the estimated available flow at Cow Creek and Kilarc Diversion Dams, which will be included in the Exhibit E. The hydrologic time series of the available flow at the Licensee diversions will be used in the analysis of impacts for the Exhibit E.

Study Schedule: The study will be completed by December 2003.

Study 3

Water Quality Monitoring Study
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Water Quality Monitoring Study

Objective of Study: A water quality monitoring study will be performed to determine water quality conditions in the Kilarc-Cow Creek Project Area under existing operational and hydrological conditions. These water quality conditions will then be compared to Basin Plan standards to verify that the project is in conformance with the beneficial uses identified by the CRWQCB-CVR in the Basin Plan.

Study Methods: For the Old Cow Creek portion of the Project, water samples will be collected from six locations. For the South Cow Creek portion of the Project, water samples will be collected from six locations. The water quality field sampling investigation will include two sampling events, one during the winter and the other in the summer months. These periods represent important seasonal conditions. The winter months represent high flow conditions while the summer months are representative of lower flow conditions. Water samples will be collected for analyses of inorganic chemicals, nutrients, and dissolved metals (these analyses are summarized in Table 6.1-1) by a state-certified laboratory. In-situ water quality measurements will be collected at each sampling location at the time of sampling. The in-situ measurement will include pH, air and water temperature, specific conductance, dissolved oxygen, and turbidity. Sample locations are described below.

<u>Old Cow Creek</u>

OCC-1 will be at the North Canyon Creek Diversion. OCC-2 will be located upstream of the entrance of the North Canyon Canal on South Canyon Creek. OCC-3 will be immediately upstream of the diversion dam of Old Cow Creek to determine the water quality conditions entering the Project Area. Sample location OCC-4 will be in the Kilarc Forebay to assess water quality conditions that may have resulted due to the conveyance or retention. To assess the water quality conditions along the bypass reach, sample location OCC-5 will be immediately upstream of the Kilarc Powerhouse on Old Cow Creek. Sample location OCC-6 will be downstream of the Kilarc Powerhouse tailrace after its confluence with Old Cow Creek to assess the quality of water below the Project Area.

South Cow Creek

Sample locations SCC-1 and SCC-2 will be immediately upstream of the diversion dams of the Mill Creek and South Cow Creek to determine the water quality conditions entering the Project Area. Sample location SCC-3 will be in the Cow Creek Forebay to assess any change in water quality conditions that may have resulted due to the conveyance system. To assess the water quality conditions along the bypass reach, sample location SCC-4 will be on South Cow Creek immediately upstream of its confluence with Hooten Gulch. Sample location SCC-5 will be immediately downstream of the Cow Creek Powerhouse tailrace in Hooten Gulch to assess the quality of water below Cow Creek Powerhouse. Sample location SCC-6 will be located immediately downstream of the South Cow Creek and Hooten Gulch confluence to assess the quality of water below the Project Area.

Products of Study: The results of this study will be used to evaluate the impacts of on-going Project operations and maintenance activities on water quality and beneficial uses within the Project area. The results of this evaluation will be presented in the Exhibit E of the FERC license application.

Study Schedule: The water quality monitoring study will include two sampling events, one during the high flow period (April/May) and the other in the summer low flow period (August). Sampling will be conducted in 2003.

Study 4

Water Temperature Monitoring Study
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Water Temperature Monitoring Study

Objectives of Study: The water temperature monitoring study will evaluate water temperature during the warmer months, characterize water temperatures along bypass reaches for aquatic organisms, and characterize the ability of the Project to affect water temperatures in bypass reaches and reaches downstream of Project tailraces.

Study Methods: In order to determine whether water temperatures meet RWQCB Water Quality Objectives, the Licensee proposes to monitor stream temperatures in the Project bypass reaches. In general, the sampling approach to meet this objective will involve operating a water temperature recorder in the upstream and downstream end of each Project bypass reach. The bypass reach on Old Cow has a tributary entering about midway through the reach, Glendenning Creek. An additional temperature recorder will be located just downstream of the tributary's confluence. In order to understand the influence of meteorology and flow (including Project operations) on water temperatures, meteorology and hydrology data will also be collected. Meteorological data will be collected at one location in each of the two drainages. Hydrological data will be collected by the Licensee to characterize flows in the bypass reach during the water temperature studies. Water temperature data will be collected from July through September.

The Onset Optic Stowaway temperature recorder, or similar unit, will be used for recording water temperatures. When installed, each temperature recorder will be secured and well hidden in remote locations to avoid vandalism. Each recorder will be checked for proper function prior to being placed in operation or upon having been reset. Each unit will be checked monthly. A calibration hack will be made during this operations check. A calibration hack consists of measuring the water temperature at the location of the instrument transducer with a calibrated thermometer whose calibration is traceable to a recognized standard; the date, time, and temperature is recorded and compared to the corresponding temperature measured by the electronic recorder. Temperature values are recorded no less than hourly throughout the day. Data will be downloaded monthly from the field electronic data loggers; standard field procedures that will be followed should minimize data losses (for example, during trips to download data, each instrument is examined for tampering and a calibration check is made). The data collected from these units will be downloaded from the electronic storage into a database.

Concurrent meteorological data will be collected at one location within each subbasin. These stations will collect wind speed and solar radiation, air temperature, and relative humidity data. These data are necessary, if stream temperatures are to be simulated. Relationships of local air temperatures to those of stations with long periods of record will be used to define the historical exceedances that allow the Licensee to rank the observed water temperatures as resulting from cold, normal, or hot conditions. This ranking is important to the interpretation the temperature data collected.

Information about stream structure, which influences stream temperatures also will be collected during the aquatic habitat survey (Study 9) and the riparian surveys (Study 8). Variables such as stream slope, stream bearing, topographic, and vegetative shading have a significant influence on stream temperatures.

These stream temperature data will be tabulated and plotted to display the results of temperature monitoring. The results of water temperature monitoring will be evaluated to determine if temperature increases appear to be to in compliance with the temperature objectives in the Basin Plan. For those reaches for which Project water temperature impacts are identified, the Licensee will evaluate potential mitigation measures.

Products of Study: Daily mean, minimum, and maximum stream temperature values will be calculated from the data collected at each water temperature monitoring location.

The results of this evaluation will be presented in the Exhibit E of the FERC license application.

Study Schedule: The water temperature monitoring study will take place in July, August, and September of 2003.

Study 5

Sediment Study
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Sediment Study

Objectives of Study: Determine whether Project operations adversely affect sediment transport characteristics and stream stability of the bypassed reaches of the Old Cow and South Cow Creeks.

Study Methods: The study will consist of a review of existing information pertaining to geology and soils, hydrology, and Project operations and a review of aerial photographs. The study will identify and evaluate the Project's influence on the timing and duration of channel maintenance flows. Geologic controls, sediment sources and characteristics, sediment transport characteristics, sediment deposits, and channel stability will be evaluated.

An impact analysis of on-going Project operations and maintenance activities on water quantity, water quality, and beneficial uses within the Project area will be conducted. This analysis will include anticipated impacts associated with the continued operation of the Project, including sediment transport, siltation levels, and bank stability.

Products of Study: The results of the sediment evaluation will be presented in the Exhibit E of the FERC license application.

Study Schedule: The sediment study will be conducted during the fall of 2002 and continue into 2003.

Study 6

Vegetation Mapping
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Vegetation Mapping

Objective of Study: To provide a map showing the location of all major plant communities present within the Project Area.

Study Methods: Six major plant communities were identified in the project area, based on the Cow Creek Watershed Assessment prepared by SHN Consulting Engineers & Geologists, Inc., and Vestra Resources, Inc. (SHN 2001).

- Non-native grassland
- Agricultural lands
- Riparian forest (white alder and mixed)
- Blue oak-foothill pine woodland
- Sierran mixed coniferous forest
- Wetlands (freshwater marsh and seeps)

All occurrences of these plant communities within the immediate project vicinity will be mapped using available aerial photographs. Ground-truthing will be conducted on foot and by vehicle to verify vegetation polygons. Corrections will be mapped on Mylar overlays of the aerial photographs during the field surveys.

Any unique habitats or features, such as springs, caves, cliffs, and rock outcrops not previously identified during the aerial photographic interpretation will be added to the vegetation/cover type map during the field surveys. A description of each cover type will be provided. Any wetland communities identified will be mapped. Descriptions of the type of wetland (e.g., freshwater marsh, seep, etc.), dominant plant species present, and pesies composition will be provided. The area of coverage will include: (1) intake areas at the North Canyon Creek, South Canyon Creek, Kilarc, Mill Creek, and South Cow Creek diversion dams, (2) Kilarc Forebay, Kilarc Penstock, Kilarc Powerhouse, Cow Creek Forebay, Cow Creek, Penstock, and Cow Creek Powerhouse, (3) North Canyon Creek Canal, South Canyon Creek Canal, Kilarc Main Canal, Mill Creek, and South Cow Creek Main Canal, and (4) diverted reaches of Old Cow Creek and South Fork Cow Creek.

Products of Study: As part of the Exhibit E for the FERC license application, each cover type observed within the immediate vicinity of the project will be included and vegetation community mapped.

Study Schedule: Ground-truthing of vegetation cover maps prepared from aerial photos is scheduled for spring-summer 2003.

References:

SHN Consulting Engineers & Geologists and Vestra Resources, Inc (SHN). 2001. Cow Creek Watershed Assessment. Prepared for Western Shasta Resource Conservation District and Cow Creek Watershed Management Group.

Study 7

Special-Status Plant Surveys
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Special-Status Plant Surveys

Objective of Study: To identify the locations of endangered, threatened, rare, or other special-status plant species within the existing Project Area.

Study Methods: A literature review was conducted to determine what special-status plant species could potentially occur within the existing project boundaries. Species lists reviewed included those published by the U.S. Fish and Wildlife Service, California Department of Fish and Game, and California Native Plant Society (CNPS). For the purposes of this review, special-status plant species were defined as those species listed, proposed, or under review as rare, threatened, or endangered by the federal government or the State of California and those listed as rare or endangered by the CNPS. Based on the literature review, a list of special-status plant species that potentially could occur within the study area was prepared. These species are shown in Table C-1.

Prior to field surveys, herbarium investigations will be conducted to gather information on each species. For some species, field visits will be made to known locations of special-status plant species in the vicinity of the Project to obtain additional morphological and habitat information, if necessary.

Multiple surveys will be required to search for all potentially present special-status plant species during appropriate seasons. Survey protocol will follow CNPS "Guidelines for Assessing the Effects of Proposed Developments on Rare Plants and Plant Communities".

The locations of all special-status plant species observed within the Project boundaries will be mapped. Photographs showing diagnostic floral characteristics will be taken of any special-status plant species observed within the study area. Voucher specimens will be collected in accordance with government collecting regulations.

Products of Study: The locations of all endangered, threatened, or other special-status plant species observed within the Project Areas will be included in Exhibit E of the FERC license application. A map prepared at a scale of 1 in equals 24,000 ft. A description of each species will be included and will note current status, phenology, habitat requirements, and distribution.

Study Schedule: Surveys are scheduled for March or April, May, and August 2003.

Table C.3-1. Special Status Plant Species Potentially Occurring in the Kilarc-Cow Creek Project Area

Scientific Name	Common Name	Legal Status* Federal/State /CNPS (R-E-D)	Flowering Period	Life Form
Bogg's Lake Hedge-Hyssop	*Gratiola heterosepala*	--/SE/1B	April – June	Annual herb
Shasta Snow-Wreath	*Neviusia cliftonii*	--/--/1B(3-2-3)	May	Deciduous shrub
Four Angled Spike Rush	*Eleocharis quadrangulata*	--/--/2 (3-2-1)	July – September	Perennial herb
Ahart's Paronychia	*Paronychia ahartii*	--/--/1B (3-2-3)	April – June	Annual herb
Shasta Clarkia	*Clarkia borealis* ssp. *arida*	--/--/1B (3-3-3)	June	Annual herb
Butte County Fritillary	*Fritillaria eastwoodiae*	--/--/3 (?-2-3)	March – May	Perennial herb (bulbiferous)

FE = federally listed as Endangered
FT = federally listed as Threatened
SoC = federal Species of Concern
CE = listed by California as Endangered
CT = listed by California as Threatened
CNPS 1b = California Native Plant Society: plants rare or endangered in California and elsewhere

Study 8

Riparian Surveys
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Riparian Surveys

Objective of Study: To identify the distribution, community types, and condition of riparian vegetation in the Project Area.

Study Methods: Riparian vegetation in the Project Area will be surveyed in conjunction with other botanical surveys. The riparian vegetation will be described, and its distribution, width, species composition, estimate of the percent cover, the height of the vegetation, and mortality, if any, will be collected. Additionally, in polygons with tree species, the surveyors will record the presence or absence of seedlings and young saplings. Riparian vegetation identified during surveys will be mapped. Mapped polygons will be a minimum of 0.25 acres in size.

Products of Study: The results of the riparian surveys will identify the distribution, community types, and condition of riparian vegetation observed within the study area. Riparian vegetation mapping will include digitized maps prepared at a scale of 1 in equals 24,000 ft. The results will be included in the Exhibit E of the FERC license application.

Study Schedule: Surveys are scheduled for March or April, May, and August 2003.

Study 9

Aquatic Habitat Study
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Aquatic Habitat Study

Objective of Study: The objective of this study component is to characterize aquatic habitats of project stream.

Study Methods: Stream surveys will locate and identify aquatic mesohabitats in the stream reach of the study area. Habitats will be identified using methods described by Hawkins et al. (1993), McCain et al (1990), and Rosgen 1996.

Mesohabitat typing will be performed on the Bypass reaches of the project streams. Aquatic habitat typing will be performed using Hawkins et al. (1993) and USFS R-5's Fish Habitat Relationships Technical Bulletin (McCain et al. 1990). In general, mesohabitat is the stream channel structure aquatic organisms might use for shelter, feeding, spawning, rearing or other activity. The relative abundance and distribution of the types of structures can be linked to the particular geomorphology of the stream channel.

Rosgen channel typing-Level 1 will be applied to the bypass reach. Channel types will be evaluated using criteria developed by Rosgen (1996). Channel types are identified by slope, shape and pattern. The shape, slope and pattern of streams can be obtained by using aerial photography and existing inventories of geology, landform evolution, valley morphology, depositional history and associated river slopes. Integration of available habitat data within a study site is dependent on its relationship to the stream channel of the area.

Several habitat quality parameters will also be recorded including dominant and subdominant substrate type, percent of canopy cover for each habitat unit, and percent habitat cover and cover type for fish. Substrate data will be visually classified following the classes:

1. fines (silt/clay), <0.062 mm
2. sands, 0.062 - 2 mm
3. gravels, 2 – 64 mm
4. cobbles, 64 – 256 mm
5. boulders, 256 – 2048 mm
6. bedrock

Stream bank vegetation will be measured as the percentage of stream bank covered by vegetation: zero, 1-25, 25-50, 50-75, 75-100%.

Access to project streams is subject to obtaining permission of the landowner since most the bypass reaches are privately owned. All survey efforts will be conducted only if access is granted by the property owner.

Product of Study: The results of this evaluation will be presented in the Exhibit E of the FERC license application. The study will be used to describe the existing physical habitat conditions and to provide information for assessing the mesohabitat types present.

Study Schedule: This study will begin in October 2002.

References:

Hawkins, C., J. Kershener, P. Bisson, M. Bryant, L. Decker, S. Gregroy, D. McCullough, C. Overton, G. Reeves, R. Steedman, and M. Young. 1993. A hierarchical approach to classifying habitats in small streams. Fisheries. 18(6): 3-12.

McCain, M. D. Fuller, L. Decker, and K Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHR Currents: R-5's fish habitat relationships technical bulletin. No. 1. US Dept. of Agriculture, Forest Service, Pacific Southwest Region, Arcata, CA. 1990

Rosgen, D. L. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Co.

Study 10

Passage Barrier Survey
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Passage Barrier Survey

Objective of Study: The objective of this study component is to inventory and catalog potential passage barriers for salmonids fish in the bypass reaches

Study Methods: The barrier survey will collect information on potential barriers for fish in the bypass reaches. All potential barriers will be photographed and described. The location of the barrier will be noted on at 1:24,000 scale map. The type of barrier will be noted such as falls, weir, debris jam, cascade, riffle, etc. The flow level when the barrier would functionally impede fish passage will be estimated as low, medium, or high. In addition, the severity of the barrier will be estimated as either partial, or complete relative to the flow level. The size of the pool downstream of the barrier, if any, will be evaluated to determine if it would serve as a jump pool providing fish an opportunity to leap the barrier. In passage evaluations, the size of the fish being considered is important. For example, steelhead are able to clear higher barriers than resident trout. The size of the fish that would be impeded will also be evaluated.

Product of the Study: A map of barrier and impediments to migration will be presented in the Exhibit E of the FERC license application.

Study Schedule: This study will be conducted inconjunction with the Aquatic Habitat Survey (Study 9).

Study 11

Instream Flow Study
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Instream Flow Study

Objectives of Study: The objectives of the instream flow study are to: describe the quantity and quality of habitat available for target species using habitat simulation models and the relative types and proportions of mesohabitats available within the bypass reaches as determined by the habitat inventory studies; support the assessment of the potential impacts of the Project on stream habitat and fish populations in the Project Area; and assist in determination of appropriate mitigation recommendations for the Project bypass reaches.

Study Methods: The Licensee proposes to assess habitat versus flow relationships for several lifestages of each target species using the Physical HABitat SIMulation (PHABSIM) programs of the Instream Flow Incremental Methodology (IFIM). This approach entails developing hydraulic models that predict velocity and depth across transects placed in the various habitats present in the river (Bovee 1982). The output of these hydrologic models are then interpreted based on a set of habitat suitability criteria which evaluate the suitability of the predicted values of depth, velocity and substrate for the target species and lifestages. The Licensee proposes to use literature criteria for this study selected in coordination with CDFG, NMFS, and USFWS.

The bypass reaches to be modeled include: (1) Old Creek downstream of the Kilarc Diversion to Kilarc Tailrace, a reach length of 3.8 mi for rainbow and brown trout and (2) South Cow Creek downstream of the South Cow Creek Diversion to the confluence with Hooten Gulch, a reach length of 3.9 for steelhead and chinook salmon. These bypass reaches may be divided into one or more geomorphic reaches depending on the results of the habitat inventory.

Transects in these reaches will be selected based on the results of the habitat survey so that all important habitat types are represented in the instream flow models. This survey will be conducted in October. The description that follows will be carried out for each geomorphic reach identified in the Project area.

The PHABSIM modeling requires the collection of cross-section data, a set of velocity and depth data and water surface elevations at three flow levels. Calibration flows will be selected that will enable the models to reliably simulate flows from minimum bypass levels to 100-150 cfs.

Basic input data for the hydraulic models include depth and mean-column velocity at numerous points (verticals) across each transect. A description of substrate and cover conditions, the measured discharge, water surface elevations, energy slope, and stage of zero flow at each transect is required. Field data collection procedures and data reduction techniques that will be used in this study will follow those described by Trihey and Wegner (1981) and Trihey (1980). Transects will be surveyed to provide bed profiles for input into the IFG-4A. During bed profile measurement, energy slope, water surface elevation, and stage of zero flow information will be collected. Substrate and cover data will be collected when velocity measurements are collected.

One set of velocity data will be collected using standard methods (Trihey and Wagner 1981). The Licensee proposes to collect this velocity set at the middle calibration flow and to collect additional velocity measurements in those cells that are out of water during the middle calibration flow at the high calibration flow. This flow was selected to maximize the reliability of velocity simulations over the range of flows modeled Mean-column velocities will be measured at each vertical. The spacing and number of verticals per transect will depend on the cross-section profile and complexity of the velocity distribution along the transect. Water surface elevations will be collected at each calibration flow (low, middle, and high) for input into the water surface elevation prediction models.

The Licensee proposed to use the IFG-4A model to simulate velocities across each transect. This model was introduced in 1984 by the USFWS Instream Flow and Aquatic Systems Group as a means of simulating hydraulic conditions in streams with complex channel structure (Milhous, et al. 1989). The IFG-4A Model uses transect specific channel geometry, depth and velocity information to simulate depths and velocities at unobserved stream flows, based on Manning's Equation and a transect-specific stage-discharge relationship. This model uses the mean column velocities obtained at each vertical along the transects to calculate cell specific Manning "n" values. These "n" values are assumed to remain constant over a modest range of stream flow values, and observed or estimated water surface elevations for stream flows within that range are used as input data to calculate the corresponding sets of mean column velocities.

Habitat modeling will be conducted using the HABTAE model of the PHABSIM programs. This model uses the velocities and depths simulated at the location of the measured verticals, rather than averaging between these verticals, as does the HABTAT model. As the hydraulic simulations are calibrated for the actual vertical locations, it is more appropriate than the averaging approach used in HABTAT.

Habitat modeling will require the selection of an appropriate set of habitat suitability criteria. The selection of the habitat suitability criteria will be done in consultation with the State and Federal resource agencies. The Licensee proposes to select the most appropriate set of criteria available for the target species for use in the modeling. For the habitat models for South Cow Creek, the Licensee proposes to model habitat for three lifestages (fry, juvenile, spawning) for the two resident trout species and three lifestages of anadromous salmonids (fry, juvenile and spawning). For the habitat models for Old Cow Creek, the Licensee proposes to model habitat for four lifestages (fry, juvenile, adult, and spawning) for the two trout species.

The application of this model will result in habitat versus flow relationships for the target species for each habitat type. These results will be weighted according to the proportion of each habitat type present in each reach as determined from the habitat mapping.

Products of Study: This study will produce habitat versus flow functions for the evaluation species. The results of this evaluation will be presented in the Exhibit E of the FERC license application.

Study Schedule: This study will be conducted in 2003 with data collection in the spring and summer of 2003.

References:

Bovee, K. D. 1982. A guide to stream habitat analysis using the Instream Flow Incremental Methodology. Instream Flow Information Paper No. 12, FWS/OBS-82/26.

Milhous, R. T., D. L. Wegner, and T. Waddle. 1984. User's Guide to the Physical Habitat Simulation System (PHABSIM). Information Paper 11. U.S. Fish and Wildlife Service, Fort Collins, Colorado.

Trihey, E. W. 1980. Field Data Reduction and Coding Procedures for Use of the IFG-2 and IFG-4 Hydraulic Simulation Models; (Draft Report). U.S. Fish and Wildlife Service, Cooperative Instream Flow Service Group, Fort Collins, Colorado.

Trihey, E. W., and Wegner. 1981. Field Data Collection Procedures for Use with the Physical Habitat Simulation System of the Instream Flow Group. U.S. Fish and Wildlife Service, Cooperative Instream Flow Service Group, Fort Collins, Colorado.

Study 12

Fish Population Studies
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Fish Population Studies

Study Objective: The objective of this study is to characterize the distribution and abundance of fish species within the Project Area with emphasis on anadromous and resident salmonids, the target species.

Study Methods: The proposed sampling strategy is to sample representative units of major habitat types in locations upstream of Project diversions, in the bypass reaches and downstream of the tailrace and in the Kilarc forebay. The methods proposed vary by stream reach.

Project Streams

The proposed sampling strategy will vary depending on the potential presence of listed species. For fish population studies where anadromous salmonids may be present, snorkel surveys will be used to assess abundance and species compositions. These would include South Cow Creek, Hooten Gulch, and Mill Creek. For streams where resident fish are present, the Licensee proposes to use an approach of electrofishing in shallow habitats (less than three ft deep) and snorkeling in deeper habitats. Old Cow Creek, North and South Canyon Creeks will be sampled in this manner.

The sampling stations will be selected on the basis of providing an adequate sample of major habitats in each general area and accessibility for the types of equipment to be used in sampling. Since much of the land surrounding the project is on private property, permission of the landowner will need to be obtained for the sampling activities. Stations may need to be adjusted to accommodate the access granted by the landowner. Each station will total about 100 m in length including representative habitat types.

Sampling will occur during June to evaluate the abundance and distribution of fish when water temperatures are likely suitable. Additional surveys will occur in selected areas in September after the summer period to assess summer use of the bypass reaches.

Snorkeling Surveys

The Licensee will conduct snorkeling surveys at selected stations in the South Cow and Mill creeks to document fish species distribution and relative abundance. Habitats will be sampled through direct observation and visual counts. Snorkel surveys will be conducted to sample contiguous habitat units at each sampling site.

Each sample unit will be stratified into swimming lanes parallel to the direction of stream flow using weighted rope as lane markers. Underwater clarity will determine lane width (Hillman et al. 1992) and will be measured prior to installing lane markers. Direct underwater observation methods will be used to identify and count fish. Methods will generally be similar to those presented in Griffith (1972), Platts et al. (1983), Hicks and Watson (1985), Hankin and Reeves (1988), and Hillman et al. (1992). Surveys will be done between 0900 to 1600 hours (Hankin and Reeves 1988) to maximize the likelihood that light intensity will be suitable for observing fish.

Estimates of fish species abundance will be calculated using equations presented in Hankin and Reeves (1988). Fish species abundance will be estimated and displayed by size class (25.0 mm to 75.0 mm; 76.0 to 175.0 mm; 176.0 mm to 305.0 mm; 306.0 mm to 405 mm; and, greater than 405.0 mm) and habitat type.

Electrofishing Surveys

Electrofishing will be used in habitats sufficiently to allow adequate sampling. Electrofishing will generally be conducted as described by Reynolds (1996) and will be conducted using one or more backpack electrofishing units (depending on the width of the stream sampled). Block nets (0.25-in mesh) will be used to prevent fish moving in or out of the sampling station during data collection activities. Sampling will be conducted using three-pass depletion, in which fish are stunned and removed from the site, in three sequential passes. Sampling will be performed in an upstream direction beginning at the downstream block net and finishing at the upstream block net.

When a multiple-pass-depletion method is used to determine the population estimate, fish captured from each pass will be transferred to separate holding pens outside of the sample site. All fish captured through electrofishing or any other sampling technique will be identified to species, measured for length to the nearest millimeter total length or fork length depending on the configuration of the caudal fish, and weighed to the nearest 0.1 g for fish up to 2 kg or to the nearest 1 g for fish over 2 kg. If very large numbers (>100) of a species are captured, these measurements will be collected from a sub-sample of fish. These sub-samples will be stratified by size class, with 10 measurements collected within each 25-mm size range. Age structure of the sampled fish will be determine through length frequency distribution to generally characterize population structure.

Population estimates will be based on the maximum likelihood technique of Zippin (1958). Population estimates will be prepared for all species. Salmonids will be divided into two or more size-classes and estimates will be prepared for these size classes.

Physical Habitat Measurements

General observations will be made of habitat and physical conditions in the sampling stations. These observations will include physical measurements of water temperature, specific conductance, and dissolved oxygen. The sampling station will be measured for length and width, and photographs of the station will be taken. In addition, observations will be made to include characterization of the mesohabitats sampled. Data collected from each station will also include characterization of substrate and maximum average depth, riparian conditions, and the presence of woody debris or other cover objects.

Kilarc Forebay Sampling

Since no anadromous fish are expected to be present in the forebay, the Licensee will sample fish abundance with a combination of eletrofishing and netting. Sampling will be conducted with a boat shocker and a variety of passive net gear. To characterize the species composition and fish abundance in the Kilarc Forebay, sampling will be conducted at selected stations within the forebay and at various depths. The netting and night-time electrofishing sampling data will be used to generate a species breakdown for the forebay population. Kilarc Forebay is stocked with hatchery trout to support a "put and take" fishery. Fish collected during the abundance surveys sampling will be evaluated to determine if they were of hatchery origin or if they were naturally spawned fish.

All fish captured in the forebay through electrofishing, or netting, will be identified to species, measured for length to the nearest millimeter total length or fork length depending on the configuration of the caudal fin, and weighed to the nearest .01 g for fish and to 2 kg or to the nearest 1 g for fish over 2 kg. If very large numbers (>100) of a species are captured, these measurements will be collected from a sub-sample of fish. These sub-samples will be stratified by size class and 10 fish will be measurement for each 25-mm size class. Age structure of the sampled fish will be determined through length frequency distribution to generally characterize population sturcture.

Products of Study: This study will provide the distribution and relative abundance of fish in the Project Area. The results of the evaluation will be presented in the Exhibit E of the FERC license application.

Study Schedule: This study will be performed in 2003. Sampling will be conducted in July and in October 2003.

References:

Griffith, J. S., JR. 1972. Comparative behavior and habitat utilization of brook trout (*Salvelinus fontinalis*) and cutthroat trout (*Salmo clarki*) in small streams in northern Idaho. Journal Fishery Research Board of Canada 29:265-273.

Hankin, D.G., and G.J. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences 45:834-844.

Hicks, F. J., and N. R. N. Watson. 1985. Seasonal changes in abundance of brown trout (*Salmo trutta*) and rainbow trout (*S. gairdnerii*) assessed by drift diving in the Rangitikei River, New Zealand. New Zealand Journal of Marine and Freshwater Research 19:1-10.

Hillman, T. W. Mullan, and J. S. Griffith. 1992. Accuracy of underwater counts of juvenile chinook salmon, coho salmon, and steelhead. North American Journal of Fisheries Management 12:598-603.

Moyle, P. B. 1976. Inland fishes of California. University of California Press. Berkeley, CA 405 pp.

Platts, W. S., W. F. Megahan, and G. W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. USDA for. Serv. Gen. Tech. Rep. INT-138.

Reynolds, J. B., Chapter 8, Electrofishing. B. R. Murphy and D. W. Willis (editors). 1996. Fishery Techniques, 2nd edition. American Fisheries Society. Bethesda, MD.

Zippin, C. 1958. The removal method of population estimation. J. Wildl. Manage. 22(1):82-90.

Study 13

Potential Effects of Entrainment on Fish
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Potential Effects of Entrainment on Fish

Objective of Study: To characterize the opportunity for fish entrainment at the Old Cow Creek Diversion.

Study Methods: The Licensee will evaluate conditions that may affect potential entrainment at the Project diversions. The assessment will consider potential effects at the population level by the by evaluating the opportunity for entrainment and the fate of entrained individuals.

Potential entrainment at the Old Cow Creek Diversion will be evaluated by sampling fish transported by the Kilarc Canal. The Licensee proposed to assess the number of fish entering the forebay from the canal by sampling the canal exit with fyke nets. Nets would be fished for three days and nights in June and in October to estimate the number of fish entering the Forebay from Old Cow Creek. June was selected based on the expected timing of dispersal of young fish and when the project begins to divert 50 percent of the available flow. The October sampling period evaluates entrainment under low flow conditions.

Products of Study: The results of this evaluation will be presented in the Exhibit E of the FERC license application.

Study Schedule: This study will be performed in 2003. The sampling program will be conducted in June and October.

Study 14

Project Effects on Macroinvertebrates
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Project Effect on Macroinvertebrates

Objective of Study: The objective of this study is to evaluate the project effects on macroinvertebrate habitat in the bypass reaches on Old Cow and South Cow Creeks.

Study Methods: Macroinvertebrate habitat will be evaluated using the Instream Flow Incremental Method as described by Gore et al. (in press) and Gore and Judy (1981). Gore et al. (in press) have developed habitat suitability criteria for "EPT" fauna (Ephemeraptera, Plecoteria, and Tricheptera) for use in high gradient or low gradient within 0.005 as the breakpoint between the two. The Instream flow studies described in Study 11 will be used to evaluate macroinvertebrae habitat as a function of flow. Macroinvertebrate habitat will be evaluated using Gore et al. (in press) EPT criteria. Habitat suitability criteria developed by will be used to estimate the relationship between macroinvertebrae habitat and flow in the by pass reaches.

Products of Study: This study will provide habitat functions for EPT fauna that are important sources of food to other aquatic resources and indicators of water quality. The results of this evaluation will be presented in the Exhibit E of the FERC license application.

Study Schedule: This study will be conducted in conjunction with Study 11, Instream Flow Study. The data collection is scheduled for spring and summer of 2003.

References:

Gore, J., J. Layzer, and J. Mead (in press) Macroinvertebrate instream flow studies after 20 years: a role in stream management and restoration. Regulated Rivers.

Gore, J.A., and R.D. Judy, Jr. 1981. Predictive models of benthic macroinvertebrate density for use in insteam flow studies and regulated flow management. *Can. J. Fish. Aquat. Sci.* 38: 1363-1370.

Study 15

Fish Protection Facility Studies
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Fish Protection Facility Studies

Objective of Study: The objective of this study is to evaluate fish protection measures at the South Cow Creek Diversion.

Study Methods: For the South Cow and Mill Creeks, the effect of entrainment will focus on an evaluation of the performance of the fish screens located at the South Cow Creek Diversion. The screens were built to prevent entrainment into the main South Cow Canal and promote safe passage for young salminoids and adult steelhead for their downstream migrations. To evaluate screen effectiveness, velocity distribution across the face of the screens will be evaluated using an acoustic Doppler meter to measure three-dimensional velocities. The acoustic Doppler meter will be positioned across the screen at points located at 2-ft by 2-ft vertical and horizontal intervals. For each measurement node, the average and peak velocities in the normal and transverse (sweeping) directions will be assessed. The measured velocities will be evaluated against CDFG and NMFS screening criteria for salmonid fry and juveniles. The screening design including screen opening, cleaning method, and sweeping velocities will be compared to the relevant screen criteria.

Products of Study: The efficacy of the current screen design will be described. The results of this evaluation will be presented in the Exhibit E of the FERC license application.

Study Schedule: These studies will be performed in the spring of 2003.

Study 16

Common Wildlife Species Surveys
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Common Wildlife Species Surveys

Objective of Study: The object is to characterize general wildlife use within the immediate project vicinity.

Study Methods: The common wildlife species study will consist of a literature review, identification of habitat for common wildlife species, and a reconnaissance-level field survey. Existing information pertinent to wildlife within the project vicinity will be compiled, reviewed and summarized. A literature review will be conducted, including a review of: 1) CDFG's California Natural Diversity Database (CNDDB, DFG 2000); 2) CDFG's Wildlife Habitat Relationship System (CDFG 2000b); and other relevant documents relating to the Project area.

Wildlife habitat will be mapped in conjunction with vegetation community mapping and ground-truthing. Habitat for common wildlife species within these vegetation communities will be determined based on a review of *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer 1988).

Reconnaissance-level wildlife surveys will be conducted on foot or by vehicle, as appropriate. Wildlife observed or detected through sign (i.e., pellet, scat, track, feather, etc.) will be identified to species and recorded. Some species that are known to occur in the Project vicinity, and for which appropriate habitat is present in the Project Area, will be recorded as "expected but not observed." Wildlife taxonomy will be based on *California's Wildlife, Volumes I, II and III* (Zeiner et al. 1988-1990).

These surveys will involve traversing habitats by walking and driving on roads in representative portions of the habitat types (vegetation communities). Visual surveys will be conducted to document the occurrence of wildlife species, including birds, mammals, reptiles, amphibians, and invertebrates. Additionally, loose boards, rocks, logs, and leaf litter will be checked for amphibians and reptiles. General observations of the suitability of cover types for various special-status species will also be recorded. All observations will be recorded in field notebooks and transcribed onto data sheets for input into a GIS database.

Products of Study: Survey results will be reported in the Exhibit E of the FERC license application.

Study Schedule: Surveys will be conducted during the spring and summer 2003.

References:

California Department of Fish and Game (CDFG). 2000a. Rarefind 2, California Natural Diversity Database. Electronic database. Sacramento, California.

California Department of Fish and Game (CDFG). 2000b. Wildlife Habitat Relationship System. Electronic database. Sacramento, California.

Mayer, K.E. and W.F. Laudenslayer, Jr., editors. 1988. A Guide to Wildlife Habitats of California. California Department of Fish and Game, Sacramento, California.

Study 17

Special-Status Wildlife Surveys
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Special-Status Wildlife Survey

Objective of Study: The objective of this study is to determine the presence or absence of special-status wildlife species and prepare mitigation and conservation plans, as necessary.

Study Methods: Vegetation communities will be mapped by aerial photography and ground-truthing. See Vegetation Mapping Study Plan (Study 6) for further description of vegetation community mapping methodology. Habitat for common and special-status wildlife species within these vegetation communities will be determined based on a review of *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer 1988).

Surveys will be conducted in representative habitat for special-status wildlife species and will be timed during the raptor nesting season, in order to detect active raptor nests, especially those of bald eagle and American peregrine falcon. Special-status species with a high probability of occurrence will be specifically targeted. These species include valley elderberry longhorn beetle, California red-legged frog, foothill yellow-legged frog, northwestern pond turtle, bald eagle, California spotted owl, American peregrine falcon, willow flycatcher, California thrasher, ring-tailed cat, and several species of bats.

Surveys will be conducted on foot or by vehicle, as appropriate. Wildlife observed or detected through sign (i.e., pellet, scat, track, feather, etc.) will be identified to species and recorded. Special attention will be given to potential bald eagle and other raptor habitat by viewing snags, cliffs, and other habitats with binoculars and looking for evidence of roost or nest sites (e.g., whitewash). Each habitat in the immediate project vicinity will be visited a minimum of two times during the 2003 raptor breeding season (generally March through August). Any nests or den sites observed during field studies will be reported to resource agencies, and plans to ensure their protection will be developed on a site-specific basis.

Products from Study: Survey results will be reported in the Exhibit E of the FERC license application.

Study Schedule: Surveys will be conducted in 2003.

References:

Mayer, K.E. and W.F. Laudenslayer, Jr., editors. 1988. A Guide to Wildlife Habitats of California. California Department of Fish and Game, Sacramento, California

Study 18

California Red-Legged Frog Surveys
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: California Red-legged Frog Surveys

Objective of Study: To determine the location of habitat for and the presence or absence of California red-legged frog and develop mitigation, as necessary.

Study Methods: A site assessment and focused surveys for California red-legged frog (CRLF) will be conducted in accordance with USFWS approved protocol/guidelines. Under the current guidelines (i.e., USFWS Guidance on Site Assessment and Field Surveys for California Red-legged Frogs, February 1997), this would include the following: determine the location of CRLF within 5 mi of the project site, describe habitats on the project site and within 1 mi of the site, prepare a site assessment report, and complete focused surveys if determined necessary by USFWS. Each of these components is described below. During CRLF field surveys, all special-status amphibians and reptiles observed (including foothill yellow-legged frog and northwestern pond turtle) will be identified and mapped.

The locations of California red-legged frogs within the project area and within 8 km (5 mi) of project boundaries would be determined through consulting the California Natural Diversity Database, biological consultants, local residents, species experts, herpetologists, resource managers, and agency biologists. In addition, all habitats present within 1 mi of the project site would be identified. This would include review of recent aerial photographs and of National Wetlands Inventory (NWI) maps, followed by ground-truthing.

Following completion of the above tasks, a report would be prepared in accordance with the USFWS Guidelines that include the following: photographs of the project site, survey dates and times, names of surveyors, a description of methods, a map of the project site and vicinity indicating habitats present (e.g., aquatic and upland habitat). USFWS will determine, following receipt of this report, if focused protocol-level CRLF surveys would be necessary. If it is determined that focussed surveys are required, the Licensee will complete these surveys in accordance with the USFWS protocol/guidelines.

Products of Study: Survey results will be reported in the Exhibit E of the FERC license application.

Study Schedule: Surveys will be conducted in 2003.

Study 19

Foothill Yellow-legged Frog Surveys
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Foothill Yellow-legged Frog Surveys

Objective of Study: To determine the location of habitat for and the presence or absence of foothill yellow-legged frog and develop mitigation, as necessary.

Study Methods: Surveys for foothill yellow-legged frog (FYLF) will be conducted according to methods presented by the Licensee in their May 2002 document titled *A Standardized Approach for Habitat Assessments and Visual Encounter Surveys for the Foothill Yellow-Legged Frog (Rana boylii).* The approach consists of preliminary field planning, visual encounter surveys (VES's) and site habitat assessments.

During the preliminary field planning phase, survey sites with potentially suitable FYLF habitat would be identified and the timing of surveys would be selected. The selection of survey sites will depend on identification of potentially suitable habitat in the study area, the results of preliminary habitat assessments, and existing data on FYLF in the study area. Survey site selection would be based on information obtained from all available resources including, but not limited to: literature on habitat requirements and life history of FYLFs, historical records, knowledgeable biologists, topographic maps, aerial photographs, and habitat information obtained during preliminary ground surveys. Sites identified for surveys during the initial site selection process will be in representative sections of the study area that contain moderate-to high-value habitats for FYLFs, based on species-specific criteria.

Since the primary objective of the study is to determine presence of FYLF, two surveys would be conducted. These two surveys would include a tadpole survey in the late spring/early summer followed by a second survey for juveniles/subadults and adults in the late summer.

During the VES phase, the presence or absence of FYLF would be determined. This would include an overall site evaluation to determine habitats to be included in the VES, the selection of the appropriate survey method, and selection of preliminary site boundaries for the VES. At the beginning of the initial site visit, an overall site evaluation would be conducted from a distance so as not to disturb amphibians. Specific habitat data such as habitat type, distribution and extent would be recorded. The appropriate survey method is expected to consist of basic creek surveys conducted by a two-person team in tandem. Basic creek surveys are designed to evaluate selected reaches of a creek. Final survey boundaries would be established at the conclusion of the initial VES and would be used in the site habitat assessment and subsequent VESs.

During the site habitat assessment phase, which is conducted immediately following the initial VES, information collected would include riparian vegetation, aquatic and terrestrial cover, substrate, water quality, aquatic habitat, and upland habitat.

Visual encounter surveys would be conducted according to the approach provided in the Licensee's above-referenced document. The VES would include aquatic habitats that can be adequately surveyed within approximately 2 hours. The VES would be conducted in tandem by a two-person team. Surveys would begin along the bank. Adjacent aquatic habitat would then be searched and finally suitable aquatic habitat would be searched. All observations would be recorded on VES data sheets.

Products of Study: Survey results will be reported in the Exhibit E of the FERC license application.

Study Schedule: Surveys will be conducted in 2003.

Study 20

Valley Elderberry Longhorn Beetle Survey
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Valley Elderberry Longhorn Beetle Surveys

Objective of Study: To provide a map showing potential habitat for valley elderberry longhorn beetle (VELB) in the project area by mapping the location of elderberry shrubs in the Project Area.

Study Methods: Elderberry surveys will be conducted in conjunction with the vegetation community mapping and special-status plant species surveys. The locations of any elderberry shrubs detected will be mapped. Any evidence of VELB use of elderberry stems in the Project Area will be noted.

Products of Study: Survey results will be reported in the Exhibit E of the FERC license application.

Study Schedule: Surveys are scheduled for March or April, May, and August 2003.

Study 21

Historic Building and Structures Study
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Historic Building and Structures Study

Objective of the Study: Inventory of historic buildings and structures within the Project Area, and National Register of Historic Places (NRHP) evaluation.

Study Methods: The Historic Buildings and Structures Study will include conducting background research at the Northeast Information Center, Chico, the Chico County Historical Society, and the Licensee's Archival Record Center for previous studies on recorded historic buildings and structures within the APE. Field surveys will be conducted to evaluate and record, as necessary (on Department of Parks and Recreation (DPR) inventory forms), the two powerhouses, the two penstocks, and all related structures and historic water conveyance systems currently known to exist in the Project area.

Products of Study: A report detailing history of the facilities and a recommendation of the facilities' eligibility to the NRHP will be included in the Exhibit E for the FERC license application. Appropriate DPR forms will be submitted to the SHPO for review.

Study Schedule: Research will be undertaken in 2003 and completed in 2003.

Study 22

Archaeological Field Surveys
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Archaeological Field Surveys

Objective of Study: The field survey will locate and record historic resources within Project Area of Potential Effect.

Study Methods: The information received from the Northeast Information Center in Chico will be utilized to develop a detailed study plan for field surveys of the APE. Following a detailed review of the results of the literature search, a field assessment will be conducted to identify cultural resources within the APE. Resources identified as adjacent to the APE will be field checked to verify size and distance from the APE. Survey methodology will follow standard methods in accordance with the Secretary of Interior's Standards for Identification [48 FR 44720-44721] and the Federal regulations found at 36 CFR 800.4(b) 1. Field surveys will be dependent on accessibility and terrain. When cultural resources are discovered within the APE, further investigation will be conducted to determine if the resource is eligible for listing on the NRHP. As indicated in Section 4.6, evaluations are needed because NRHP eligibility assessments have not been completed for the nine unrecorded sites nor for sites that may be discovered during the field survey. Assessment is required to document site(s) integrity and significance with regard to the criteria set forth at 36 CFR 60.4. Project archaeologists will prepare a brief prehistoric context for the study area and then use available information to determine which sites are eligible for listing on the NRHP. Appropriate DPR forms will be submitted to SHPO for review.

Products from Study: Results of archaeological survey and description of all Project-related impacts will be included in the Exhibit E of the FERC license application.

Study Schedule: Field survey and research will be conducted and the report completed in 2003.

Study 23

Traditional Cultural Properties Inventory
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Traditional Cultural Properties Inventory

Objective of Study: Identify all Traditional Cultural Properties within the Project APE. Gather ethnographic information. Examine Project-related impacts.

Study Methods: Native American tribes with concerns about the project are expected to include the Pit River Tribe of California and the Redding Rancheria tribe. Representatives from both of these tribes will be consulted. Ethnographic and ethnohistoric literature will be researched to prepare a context for the study area of traditional Native American land and resource use. One meeting with representatives from each individual tribe will be arranged to facilitate discussions of their concerns about Project effects on Traditional Cultural Properties and resources (such as fish, plants, and wildlife), and their recommendations for mitigation measures. Tribal concerns about confidentiality may preclude a site-specific inventory of Traditional Cultural Properties.

Products from Study: Results of the Traditional Cultural Properties Study will be included in the Exhibit E of the FERC license application.

Study Schedule: Research will be undertaken and the report completed in 2003.

Study 24

Regional Recreation Assessment
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Regional Recreation Assessment

Objective of Study: To assess the regional recreational opportunities in the Project Area.

Study Methodology: The recreation resources and uses associated with the Project region will be described (Study 24 and 25, Appendix C). This description will include: (1) the study area boundaries, (2) an estimate of the current level of use of recreational resources and projection future levels, and (3) any additional facilities that are currently being planned for the area. Current recreation goals and objectives for the Project Area as outlined by local, state and federal agencies will be summarized. Agencies will be consulted to ascertain their current management objectives and to identify areas of mutual compatibility and potential areas of conflict.

To the extent possible, the origin and destination of users in the Project Area will be documented. Projection of future demand for recreation resources in the Project Areas will be based on a review of Shasta County General Plan. Recreation specialists will conduct site visits to the Project Area to verify and supplement the recreation information and ground-truth the study map.

To develop a recreation profile, agencies will be consulted to ascertain their current management objectives and recreation goals and objectives for the Project Area. Areas of mutual compatibility and potential areas of conflict will be identified.

The existing recreational facilities and opportunities within the regional vicinity of the Project Area will be identified using the methodology described above. A map will be developed showing the regional recreational resources in the study area. A reconnaissance level assessment of the future demand for recreation resources in the study area will be made using existing information, such as the California Department of Recreation's State Comprehensive Outdoor Recreation Plan, planning documents developed by the Latour State Forest, and Lassen National Forest, and consultation with agency representatives. Agencies will also be consulted to identify future recreation goals for the Project Area and region that will then be presented in the Application. The regional resources identified as part of this task will be used to provide a context for the recreational resources within the Project Area.

Products of Study: Results of the assessment will be included in the Exhibit E of the FERC license application.

Study Schedule: The assessment will be initiated in the spring of 2003.

Study 25

Project Area Recreation Survey
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Project Area Recreation Survey

Objective of Study: To identify number of visitors, trip origin, and the relative frequency to which the Project's resources and facilities are utilized.

Study Methods: To develop a more specific picture of recreation use on the Project's resources and facilities, a reconnaissance-level recreation survey will be conducted. The purpose of the recreation survey will be to identify number of visitors, trip origin, and the relative frequency to which the Project's resources and facilities are utilized. During the summer of 2003, a study team will conduct the surveys. Because access to the majority of the Project's facilities is restricted, the survey will be limited to the only recreation area accessible to the public, Kilarc Forebay where picnicking and fishing takes place.

The team will be provided with a Recreation Survey Form based on similar forms used by the USFS. The form records the number of people observed at the forebay, the time of day, date, number of vehicles, types of recreational activities observed, and weather and general water levels. Where possible, the surveyor will contact observed subjects to determine the trip origin, and if they are fishing, the target species of fish and other creel census data will be collected. The proposed schedule for the recreation use survey is:

- Twice weekly during weekdays once per month
- One weekend per month
- All holiday weekends between Memorial Day and Labor Day

In addition, similar Recreation Survey Forms will be left in visible locations, such as a kiosk, requesting that recreationalists fill them out and mail them to ENTRIX (address and postage will be part of the Recreation Survey Form).

Products of Study: Results of the survey will be included in the Exhibit E of the FERC license application.

Study Schedule: The assessment will be initiated in the spring of 2003.

Study 26

Land Management Review
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Land Management Review

Objective of Study: The land management review will assess the Project's consistency with current land ownership and easements, existing and planned land and water uses, and relevant government regulations and comprehensive plans.

Study Methods: Relevant federal, state, and local comprehensive plans, policies, and regulations; land ownership; the Licensee's easements, and public and private land and water uses will be evaluated for consistency between Project-related comprehensive plans and land and water uses. Management of the region's recreation and other land and water uses will be evaluated for best implementation to maintain or enhance the Project Area's recreational and aesthetic values. Existing land uses will be mapped based on site visits, consultation with resource users and county planners, and a review of aerial photographs.

Products of Study: The results of the Land Management Review will be included in the Exhibit E of the FERC license application, and will be used to evaluate additional needs for enhancing public access to Project lands and water.

Study Schedule: The assessment will be initiated in the spring of 2003.

Study 27

Land Management Inventory
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Land Management Inventory

Objective of Study: To produce a set of maps depicting land use, land ownership, local zoning, topography (slopes), hazards, and the Licensee's easements.

Study Methods: The land management inventory will be compiled for use in Exhibit E. Land management information for the Project area will be input into a Geographic Information System (GIS) and will be used to support primarily the land management and aesthetics studies for relicensing. Land management attributes including ownership, local zoning, slope, hazards, land use, and easements will be mapped on a base including hydrology, roads, contours, public land survey, recreation facilities, hydroelectric facilities, cities, and the project boundary. Land management information will be mapped, in general, at a scale of 1:24,000. The specific scale and geographic extent presented for each resource, however, will ultimately depend on the distribution of each resource and the requirements of the resource information.

Products of Study: A set of maps to be included in the Exhibit E of the FERC license application.

Study Schedule: The assessment will be initiated in the spring of 2003.

Study 28

Aesthetic Resources Study
KILARC-COW CREEK PROJECT
FERC 606

Study Plan Title: Aesthetic Resources Study

Objective of Study: The aesthetic resource study will assess the aesthetic resources available within the Project Area and examine the aesthetic contrast between Project features and the area's scenery.

Study Methods: The Project Area's visual resources (primarily land form and vegetation) will be characterized by a field assessment from representative public viewpoints, a review of USFS regional visual resource reports, and an examination of topographic maps and aerial photographs of the region. Key Observation Points (KOPs) at which Project features can be identified, mapped, and compared to the area's aesthetic resources. The physical contrast and visibility of Project features will be assessed. In addition, Project operations will be evaluated for effects on visual resources.

Products of Study: An assessment of the physical contrast of Project features to the area's landscape and vegetation, as well as the visibility of Project features and the number of viewers will be prepared and included in the Exhibit E for the FERC license application.

Study Schedule: The assessment will be initiated in spring of 2003.