DOE/EIS-0456

CUSHMAN HYDROELECTRIC PROJECT

MASON COUNTY, WASHINGTON

(FERC PROJECT NO. 460)

FINAL ENVIRONMENTAL IMPACT STATEMENT

(FERC/EIS-0095F, ADOPTED AS DOE/EIS-0456)

US Department of Energy

OCTOBER 2010

Lead Agency: U.S. Department of Energy (DOE)

Title: *Final Environmental Impact Statement (FEIS) for the Cushman Hydroelectric Project, Mason County, Washington (Adopted)*

Contact: For additional copies or more information on this final environmental impact statement (EIS), please contact:

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Proposed Action: DOE is proposing to provide cost-shared, American Recovery and Reinvestment Act of 2009 (Recovery Act; Public Law 111-5, 123 Stat. 115) funding for a project proposed by the City of Tacoma, Department of Public Utilities, Light Division. DOE funds would support improvements to the existing 131 megawatt (MW) Cushman Hydroelectric Project, namely the design and construction of a new North Fork Skokomish Powerhouse (Powerhouse) and associated infrastructure, which would include an integral fish collection facility for fish handling and sorting, and equipment for electrical interconnection. The Powerhouse would produce about 23,500 MW hours of energy. The associated fish transport system would allow anadromous (river spawning) fish that are swimming upstream and smolts swimming downstream to be trapped using a safe, passive-capture system, sorted, and transported past the dam.

The Cushman Hydroelectric Project has been the subject of a lengthy Federal Energy Regulatory Commission (FERC) licensing proceeding and related judicial and administrative challenges. In 1996, FERC issued a FEIS evaluating the environmental impacts from the new Powerhouse and the fish collecting and transporting facility. In its July 15, 2010, *Order on Remand and On Offer of Settlement, Amending License, Authorizing New Powerhouse and Lifting Stay* (2010 Order), FERC stated its conclusion that a supplemental NEPA document would not be required for FERC's relicensing of the Cushman Hydroelectric Project. FERC determined that the improvements to the Cushman Hydroelectric Project, which are embodied in a proposed settlement agreement among the City of Tacoma, the Skokomish Tribe, and other parties, are within the range of alternatives examined in the FEIS prepared for relicensing the Cushman Project. FERC considered an alternative in the FEIS to add a powerhouse at the base of Cushman Dam No. 2 similar to the Powerhouse. DOE has independently evaluated FERC's 1996 FEIS and had determined that it satisfies DOE's NEPA procedures. DOE's proposed action is to provide funding for components of the same project that FERC licensed on July 15th, 2010. Accordingly, DOE has adopted the FERC 1996 EIS and the 2010 Order as a DOE Final EIS.

Public Involvement: DOE did not participate as a cooperating agency in the preparation of the 1996 FEIS; therefore, DOE is re-circulating the 1996 FEIS and 2010 Order and filing them with the Environmental Protection Agency (EPA). DOE's Final EIS is available on the DOE NEPA web site (nepa.energy.gov/) and at the following public library:

Hoodsport Timberline Library
North 40 Schoolhouse Hill Road
Hoodsport, WA 98548-0847

DOE will issue a Record of Decision no sooner than 30 days after EPA publishes a Notice of Availability of this Final EIS in the *Federal Register*.

Filed: 12-2-1996

FEDERAL ENERGY REGULATORY COMMISSION

CEII

OFFICE OF HYDROPOWER LICENSING

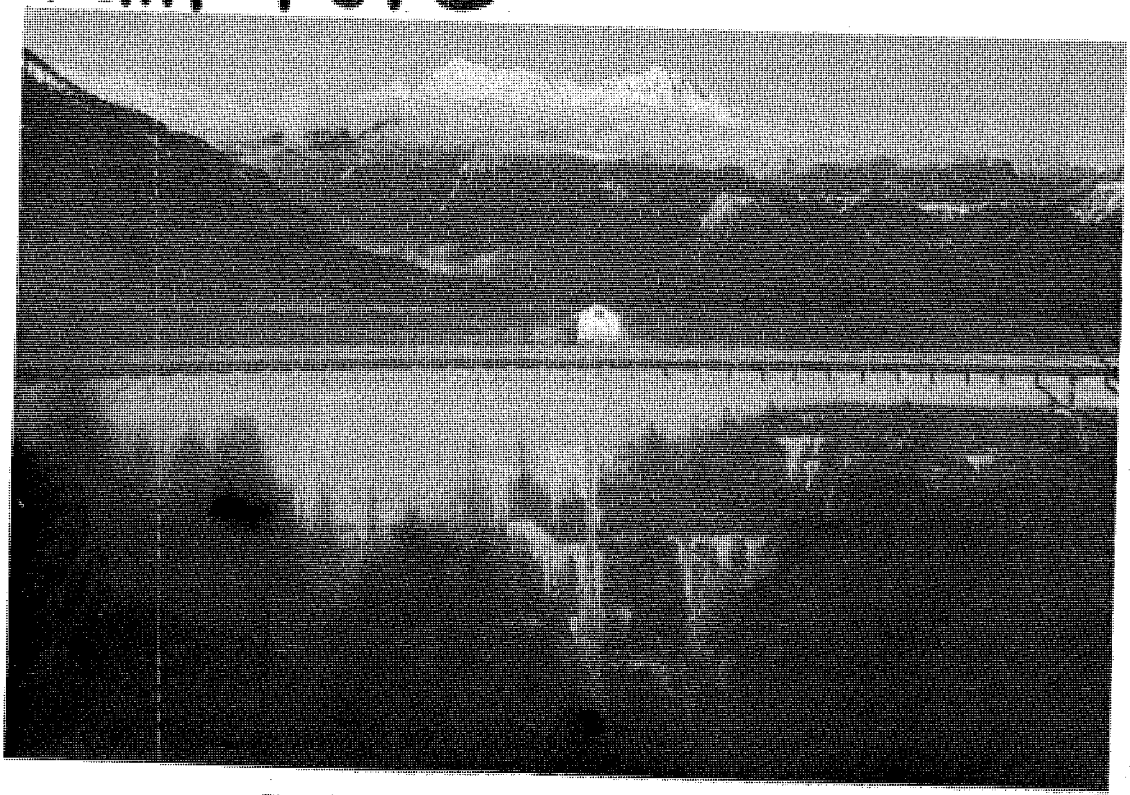
November 1996

FERC/EIS-0095F

FINAL ENVIRONMENTAL IMPACT STATEMENT

Part 1 of 3

CEII



Cushman Hydroelectric Project
(FERC Project No. 460), Washington

888 First Street, N.E., Washington, D.C. 20426

FERC/EIS-0095F

FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF HYDROPOWER LICENSING

FINAL ENVIRONMENTAL IMPACT STATEMENT

CUSHMAN HYDROELECTRIC PROJECT
(FERC PROJECT NO. 460)

Applicant: Tacoma Public Utilities
Tacoma, Washington

Additional copies of the EIS are available from:

Public Reference and Files Maintenance Branch
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

November 1996

COVER SHEET

a. Title: The Cushman Hydroelectric Project (FERC Project No. 460)

b. Environmental Impact Statement

c. Lead Agency: Federal Energy Regulatory Commission

d. Abstract:

Tacoma Public Utilities filed an application for a new license (relicense) for the Cushman Hydroelectric Project located on the North Fork Skokomish River on the Olympic Peninsula in Washington.

The primary environmental issues include instream flows in the North Fork Skokomish River, aggradation in the mainstem Skokomish River, and restoration of anadromous fish.

The staff's recommendation is to relicense the project with a reduction in out-of-basin water diversion and other resource enhancement measures.

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f. Transmittal: This Environmental Impact Statement prepared by the Commission's staff in connection with an application filed by the Tacoma Public Utilities for Project No. 460 is being made available to the public on or about November 30, 1996, as required by the National Environmental Policy Act of 1969 and the Commission's Regulations Implementing the National Environmental Policy Act (18 CFR Part 380).

FOREWORD

The Federal Energy Regulatory Commission (Commission), pursuant to the Federal Power Act (FPA)[1] and the U.S. Department of Energy (DOE) Organization Act[2], is authorized to issue licenses for up to 50 years for the construction and operation of nonfederal hydroelectric developments subject to its jurisdiction, on the necessary conditions:

> [T]hat the project adopted. . . shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water power development, for the adequate protection, mitigation and enhancement of fish and wildlife (including related spawning grounds and habitat), and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other purposes referred to in section 4(e)...[3]

The Commission may require such other conditions not inconsistent with the provisions of the FPA as may be found necessary to provide for the various public interests to be served by the project.[4] Compliance with such conditions during the license period is required. Section 385.206 (1995) of the Commission's Rules of Practice and Procedure allows any person objecting to a licensee's compliance or noncompliance with such conditions to file a complaint noting the basis for such objection for the Commission's consideration.[5]

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1 16 U.S.C. Sec. 791(a)-825(r), as amended by the Electric Consumers Protection Act of 1986, Public Law 102-486 (1992).

2 Public Law 95-91, 91 Stat. 556 (1977).

3 16 U.S.C. Sec. 803(a).

4 16 U.S.C. Sec. 803(j).

5 18 CFR Sec. 385.206 (1995).

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ACRONYMS AND ABBREVIATIONS

AAHU — average annual habitat unit
ACS — Aquatic Conservation Strategy
AIR — Additional Information Request
aMW — average megawatt
APE — area of potential effects
BIA — Bureau of Indian Affairs
BLM — Bureau of Land Management
BOD — biological oxygen demand
BPA — Bonneville Power Administration
CCC — Civilian Conservation Corps
CFR — Code of Federal Regulations
cfs — cubic feet per second
Corps — Department of the Army, Corps of Engineers
CPUE — catch per unit effort model
CSPE — Columbia Storage Power Exchange
CZMP — Coastal Zone Management Program
CY/D — cubic yards per decade
dbh — diameter breast height
DEIS — Draft Environmental Impact Statement
DO — dissolved oxygen
DOE — Department of Energy
DOI — Department of the Interior
EA — environmental assessment
EIS — Environmental Impact Statement
ESCP — erosion and sediment control plan
ESD — Washington State Employment Security Department
EPA — U.S. Environmental Protection Agency
FEMA — Federal Emergency Management Agency
FPA — Federal Power Act
FS — U.S. Forest Service
FWS — U.S. Fish and Wildlife Service
GIS — Geographical Information System
GWh — gigawatt-hour
HEP — habitat evaluation procedure
HSI — habitat suitability index
HU — habitat unit
ICOR — Interagency Committee for Outdoor Recreation
IFC — Instream Flow Committee
IFIM — Instream Flow Incremental Methodology
IPP — independent power producers
JRP — Joint Resource Parties
kV — kilovolt
kW — kilowatt
kWh — kilowatt-hour
LCDC — Lake Cushman Development Corporation
LCSP — Lake Cushman State Park
LSR — late successional reserve

mainstem — mainstem Skokomish River
mg/l — milligrams per liter
MHW — mean high (tide) water
MIF — minimum instream flow
MLLW — mean lower low (tide) water
MW — megawatt
MWh — megawatt-hour
NEPA — National Environmental Policy Act
NMFS — National Marine Fisheries Service
North Fork — North Fork Skokomish River
NPPC — Northwest Power Planning Council
NPS — National Park Service
OFM — Washington State Office of Financial Management
ONF — Olympic National Forest
ONP — Olympic National Park
P.L. — Public Law
PA — programmatic agreement
PMF — probable maximum flood
PNCA — Pacific Northwest Coordination Agreement
Power Plan — Northwest Conservation and Electric Power Plan
ppt — parts per thousand
PUD — public utilities district
RCW — revised codes of Washington
RFHV — relative fish habitat values
RM — river mile
ROW — right-of-way
RR — Riparian Reserve
RWHV — relative wildlife habitat values
SCORP — Statewide Comprehensive Outdoor Recreation Plan
SD1 — Scoping Document 1
SD2 — Scoping Document 2
Shelton CSYU — Shelton Cooperative Sustained Yield Unit
SHPO — State Historic Preservation Officer
SMP — Shoreline Master Program
Tacoma — Tacoma Public Utilities
TCP — traditional cultural property
the Tribe — Skokomish Indian Tribe
USGS — U.S. Geological Survey
WAPA — Western Area Power Administration
WDF — Washington Department of Fisheries
WDFW — Washington Department of Fish and Wildlife
WDNR — Washington Department of Natural Resources
WDOE — Washington Department of Ecology
WDW — Washington Department of Wildlife
WSPRC — Washington State Parks and Recreation Commission

EXECUTIVE SUMMARY

In this Environmental Impact Statement (EIS), we evaluate the environmental impacts of, and alternatives to, the proposed relicensing of the Cushman Hydroelectric Project (FERC Project No. 460) on the North Fork Skokomish River (North Fork) in Mason County, Washington.

The Skokomish River drains about 240 square miles of the southeastern portion of the Olympic Peninsula into Hood Canal. About half of the Skokomish watershed (118 square miles) is drained by the North Fork. The Cushman Hydroelectric Project (Cushman Project) captures the runoff from about 99 square miles of the North Fork watershed.

Owned and operated by Tacoma Public Utilities (Tacoma), the Cushman Project consists of two dams and impoundments on the North Fork with associated power tunnels and penstocks, powerhouses, and a transmission system. The Cushman Project provides both load-following and peaking service to Tacoma's customers.

Constructed in 1925 and 1926, Dam No. 1 is a 260-foot-high concrete arch dam that impounds Lake Cushman, a 9.6-mile-long storage reservoir with a surface area of 4,058 acres and a storage capacity of 372,000 acre-feet at full pool (elevation 738 feet). During severe floods, Lake Cushman may be operated up to elevation 742 feet. The power intake is located upstream of the dam and connects to a single 17-foot-diameter, 540-foot-long power tunnel that leads to two 10-foot-diameter, 150-foot-long penstocks. Powerhouse No. 1, located on the left bank approximately 600 feet downstream from the dam, has a generating capacity of about 50 megawatts (MW) and a hydraulic capacity of about 2,940 cubic feet per second (cfs). A switchyard abuts the powerhouse, and two transmission lines extend approximately 5 miles to Powerhouse No. 2.

Located about 2 miles downstream from Dam No. 1, Dam No. 2 was constructed in 1929 and 1930 and consists of a 230-foot-high concrete arch dam that impounds Lake Kokanee. Considerably smaller than Lake Cushman, Lake Kokanee has a surface area of about 100 acres and a storage capacity of 8,000 acre-feet at full pool (elevation 480 feet). At normal full pool water levels, Lake Kokanee backs up to the Powerhouse No. 1 tailwater. Water is diverted at the dam into a tunnel that extends 2.5 miles to a steel surge tank and three steel penstocks connected to Powerhouse No. 2, which is situated on the shoreline of Hood Canal. Powerhouse No. 2 has a total installed capacity of 81 MW and a hydraulic capacity of 2,700 cfs. A third generator, installed in 1952, increased capacity from 54 MW to the current 81 MW. A switchyard adjacent to the powerhouse is the tie-in point for the Dam No. 1 transmission lines. From this switchyard, two transmission lines extend 26.8 miles to connect with Tacoma's integrated transmission system on the Kitsap Peninsula.

Between Dam No. 1 and Dam No. 2, Tacoma maintained a small diversion structure on McTaggert Creek to divert water from upper McTaggert Creek through Deer Meadow and into Lake Kokanee to enhance power production at Powerhouse No. 2. The diversion structure has not diverted water since 1991 when the creek shifted out of its main channel upstream of the diversion structure. The creek currently flows directly into Deer Meadow, bypassing the diversion.

The project is currently operated to provide a continuous 30-cfs discharge to the North Fork downstream from Dam No. 2. Lake Cushman is operated to minimize spills, thus providing storage for fall and winter floods.

Under normal operating conditions, Lake Cushman is kept full during the summer, at the normal maximum level of 738 feet, and power production at both powerhouses is minimal and generally limited to nights and weekends. The reservoir is gradually drawn down from about August 16 through November 30 to enhance power production by minimizing spills during subsequent high-flow periods. This water management strategy also provides storage space for flood control. By early winter the lake reaches its lowest elevation (about elevation 712 feet), and during the winter months, the project provides both peaking and load-following capability. Beginning on or about March 1, project outflow is decreased and Powerhouse No. 1 is only operated on an as needed basis to provide a continuous release of 30 cfs at Dam No. 2. By late spring, Lake Cushman's level is gradually returned to 738 feet.

Lake Kokanee operation typically follows inflows from Lake Cushman and rarely fluctuates more than 3 feet per year.

Based on our review of the license application, agency consultation, and written and oral comments received from the intervenors for this project, we identified resource objectives of importance to this relicensing proceeding, some of which may conflict with each other. The principal objectives are:

- maintaining production of non-polluting, renewable electrical energy;
- preserving the project's lake environments for recreational and residential uses;
- restoring wild, self-sustaining runs of anadromous fish in the North Fork and mainstem Skokomish River (mainstem), and enhancing recreational, commercial, and subsistence fisheries based on the basin's anadromous fish;
- maintaining and enhancing the project's flood protection benefits;
- enhancing wildlife habitat and protecting wildlife populations;
- improving sediment transport and ceasing and reversing channel aggradation in the Skokomish River; and
- protecting cultural resources.

In this EIS we analyze Tacoma's Proposal and four alternatives.

Tacoma's Proposal

Tacoma proposes to replace the turbine runners at Powerhouse No. 2 within the next 5 years. Tacoma expects that this action would improve efficiency by at least 4 percent over existing turbine performance, bringing powerhouse capacity to 84 MW. Tacoma also proposes to install a new 1.3-MW powerhouse (Powerhouse No. 3) at the base of Dam No. 2 to capture the hydropower potential of its proposed minimum instream flow (MIF).[1] Tacoma would continue to operate the reservoirs in the same manner as they are currently operated.

Tacoma proposes major environmental enhancements for the Cushman Project, including: increased instream flows in the North Fork downstream from Dam No. 2, removal of the McTaggert Creek diversion structure, removal of resident fish passage barriers in project reservoir tributaries, resident fish stocking in project reservoirs, fish habitat enhancement in the North Fork downstream from Dam No. 2, and enhancement and management of 3,599 acres of land for wildlife.

In addition to Tacoma's proposed environmental enhancements, Congress has authorized Tacoma and the National Park Service (NPS) to execute a proposed land exchange to remove lands within Olympic National Park (ONP) from the area occupied by Lake Cushman (Public Law [P.L.] 102-436). The exchange will go forward when all conditions of the law are met to the satisfaction of the Secretary of the Interior, whether or not the project is licensed. Tacoma is also negotiating a land exchange with the U.S. Forest Service (FS) to prevent Lake Cushman from occupying Olympic National Forest (ONF) lands. These land exchanges could also occur under any of the alternatives.

Alternative 1 (No Action)

Under Alternative 1, no action, the project would continue to operate as it does today, under existing operating conditions and constraints including the 30-cfs release required by the project's section 401 water quality certificate. We used this alternative to establish a baseline for comparing the environmental effects of each action alternative.

Alternative 2

Alternative 2 is adapted from resource agencies' and the Skokomish Indian Tribe's (the Tribe's) recommended alternatives to Tacoma's Proposal. Under this alternative, a new powerhouse (Powerhouse No. 3) with a generating capacity of 16 MW would be constructed at the base of Dam No. 2, and the project would operate with full river flows. This alternative would set aside 15,742 acres of land for wildlife and would provide additional environmental enhancements, including removing the dikes on Nalley Ranch, and additional recreation improvements. The primary operational change would be the cessation of diversion from the North Fork and the return of near full flows to the North Fork downstream from Dam No. 2 except as required to reduce downstream flooding.

Alternative 3

Tacoma's Proposal and Alternative 2 present contrasting views on the appropriate level of environmental enhancements and the importance of hydropower production at the Cushman Project. We identified the objectives inherent in these two alternatives and developed Alternative 3 to achieve, to the extent practicable, important elements of each objective. This alternative includes: an instream flow schedule designed to balance the competing demands on North Fork water, a new 3-MW powerhouse (Powerhouse No. 3) constructed in the deep canyon at the base of Dam No. 2, a

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[1] In its comments on the DEIS, Tacoma requests that the Commission authorize, but not require, construction of this new facility (letter from Tacoma to the Commission, March 29, 1996).

staff-formulated wildlife habitat enhancement plan to protect and enhance a total of 5,981 acres of land, fish passage, removal of the Nalley Ranch dikes, and additional recreation improvements.

Alternative 4 (Decommissioning)

To fully analyze all reasonable alternatives to licensing the project, we also considered Alternative 4, decommissioning the project. In decommissioning, the Commission could require the removal of all existing project facilities if necessary to ensure the suitable protection of public interests. We analyzed decommissioning with and without dam removal in this EIS.

The following table presents a comparison of the operating characteristics of Tacoma's Proposal and the four project alternatives.

Table ES-1. Comparison of Tacoma's Proposal to project alternatives.[1]

	Tacoma's Proposal	Alternative 1 (No action)	Alternative 2	Alternative 3 (Staff Recomm.)	Alternative 4 (Decomm.)
Total annual cost [2] ($1,000)	$4,639.0	$1,920.0	$20,665.0	$8,900.0	$7,635.0[3]
Average annual power generation (GWh)[4]	332	343	203	309	0
Annual energy loss (MWh)[5]	11,000	0	140,000	50,000	343,000
Capacity of new Powerhouse No. 3 (MW)	1.3	N/A	16	3	N/A
Average flow below Dam No. 2	100 cfs	30 cfs	782 cfs	240 cfs	784 cfs

1 Source: the staff.
2 Includes levelized cost, O&M cost, and the annual value of generation and capacity loss.
3 Assumes decommissioning with facilities in place.
4 gigawatt-hour
5 megawatt-hour

In addition to Tacoma's Proposal and Alternatives 2, 3, and 4, we also evaluated the consequences of maintaining Lake Cushman's water surface elevation at or below 725 feet. This option has been considered as an add-on to Tacoma's Proposal and Alternatives 2, 3, and 4.

Our recommendations are driven by the direction provided by the Federal Power Act (FPA) as amended. FPA Sections 4(e) and 10(a)(1) require the Commission to give equal consideration to all uses of the waterway on which the project is located. In reviewing the project, we considered the waterway's recreation, fish and wildlife, and other nondevelopmental values equally with its electrical energy and other developmental values. We developed our conclusions in section 4 and present a concise list of recommendations in section 6.6.2.

Based on our independent analysis as presented in this EIS, we recommend that the Commission adopt Alternative 3 in licensing this project. This staff-developed alternative combines elements of Tacoma's Proposal with recommendations from resource agencies and the Tribe, and would provide significant environmental benefits with minimal loss in power generation.

Environmental benefits under Alternative 3 would include measures to reduce flooding, enhance recreation experiences, and improve fish and wildlife habitat. Our proposed increased flows to the North Fork coupled with hatchery stocking of anadromous fish would provide major long-term benefits to fisheries by greatly enhancing habitat, providing salmon passage over the lower falls, and increasing anadromous fish production and species diversity. Removing dikes at Nalley Ranch would expose about 285 acres of land to tidal flows and, by increasing habitat and forage availability, would ultimately benefit shellfish, flounder, herons, egrets, and seals. Under our wildlife habitat plan, 9,999 acres of land and water, including elk winter range and migration corridors, wetlands and riparian areas, mature and old growth forests, and habitats used by threatened and endangered species would be protected from human encroachments, and enhanced through changes in vegetation (i.e., changes in timber cutting practices and restoration of native plants.) Our proposal would provide the greatest amount of recreation improvements and opportunities, including significantly greater barrier-free opportunities. Increases in tourism, which are likely to occur as a result of the recreation enhancements in this alternative, should provide long-term socioeconomic benefits to the local economy. Increases in anadromous fish populations that should result from the proposed fish habitat enhancement would benefit the commercial and sport fishery. The staff concludes that Alternative 3 would be best adapted to comprehensive plans for improving and developing the Skokomish River and would provide the best balance between hydropower uses and other environmental benefits.

1.0 PURPOSE AND NEED FOR ACTION

1.1 Purpose of the Action

The Federal Energy Regulatory Commission (Commission) is considering whether, and if so under what conditions, to issue a new license for the Cushman Hydroelectric Project No. 460 in western Washington State (figure 1-1).

The Commission, pursuant to the Federal Power Act (FPA)[1] and the U.S. Department of Energy (DOE) Organization Act,[2] is authorized to issue licenses up to 50 years for the construction and operation of nonfederal hydropower developments subject to its jurisdiction, on the necessary conditions:

> That the project adopted. . . shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water power development, for the adequate protection, mitigation and enhancement of fish and wildlife (including related spawning grounds and habitat), and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other purposes referred to in section 4(e)...[3]

This Environmental Impact Statement (EIS) was prepared pursuant to the National Environmental Policy Act (NEPA) and Commission regulations to describe and evaluate the potentially significant environmental effects of the proposed relicensing of the Cushman Hydroelectric Project (Cushman Project), and alternatives to the proposed action.

The project consists of two dams and associated power generation facilities located on the North Fork Skokomish River (North Fork) and on Hood Canal in the northwest portion of Washington State. The project is owned and operated by Tacoma Public Utilities (Tacoma) to produce power with consideration for flood protection, fish and wildlife resources, and recreation. In this DEIS, we, the Commission's staff (the staff), analyzed the environmental effects of various alternatives for relicensing or decommissioning the Cushman Project.

1.2 History of the Proceedings

The original license for the Cushman Project was a minor part license issued June 3, 1924, to the city of Tacoma. The minor part license expired after a 50-year term in 1974, and the project has been operating under annual licenses since that time.

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1 16 U.S.C. Sec. 791(a)-825(r), as amended by the Electric Consumers Protection Act of 1986, Public Law (P.L.) 102-486 (1992).

2 P.L. 95-91, 91 Stat. 556 (1977).

3 16 U.S.C. Sec. 803(a).

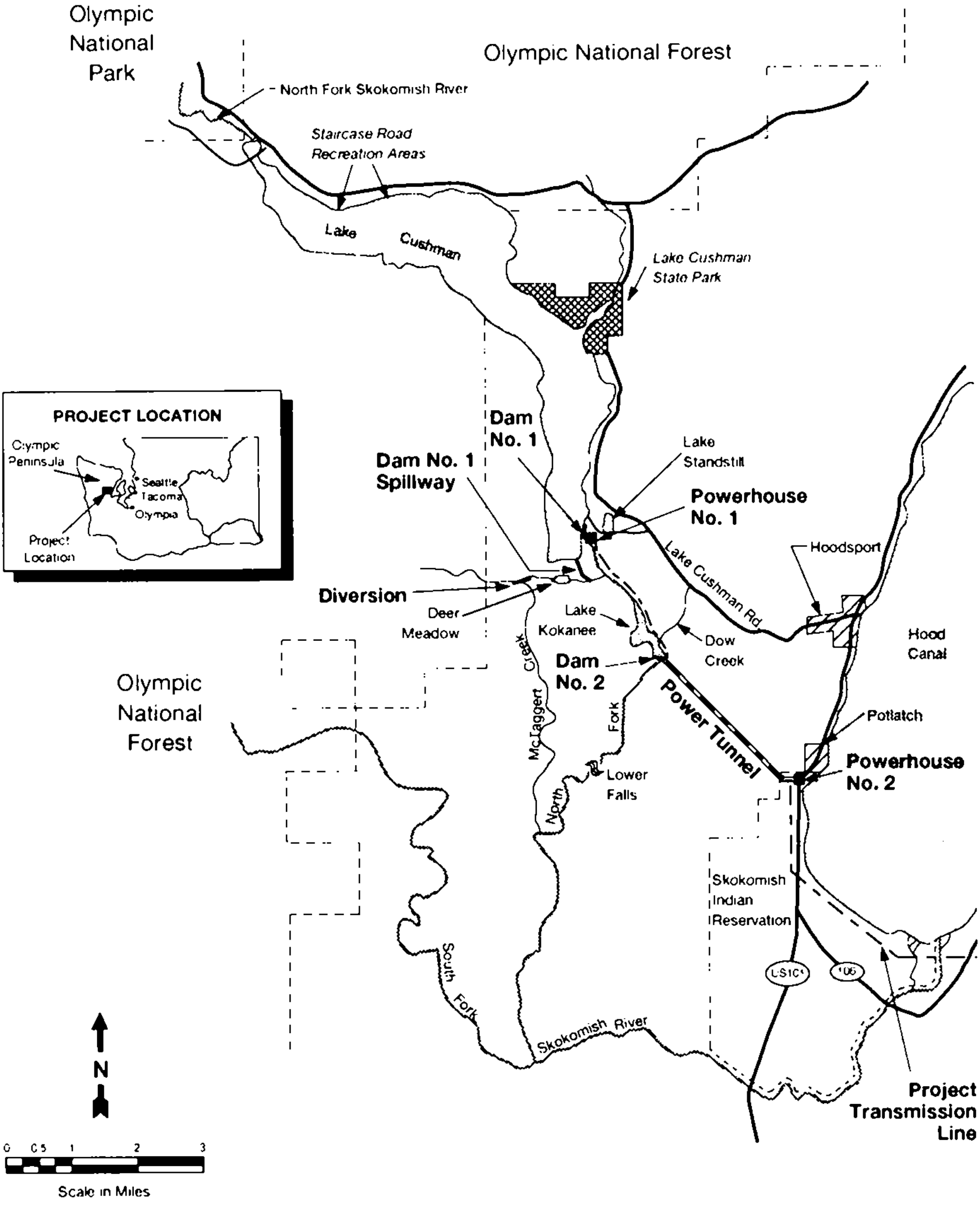

Figure 1-1. Cushman Project area map. (Source: the staff.)

Tacoma submitted an application to relicense the Cushman Project on November 5, 1974. Public notice of the filing was given on March 26, 1975. The application was revised and supplemented by Tacoma on December 17, 1976. Subsequent filings by Tacoma in 1977 included Exhibit R, Recreation Report; Exhibit S, Fish and Wildlife Resources; and Exhibit W, Environmental Statement on the proposed relicensing.

The application was forwarded for agency review on May 4, 1977. From July 1977 through September 1977, comments were received from the U.S. Department of the Interior (DOI); the U.S. Forest Service (FS); the National Marine Fisheries Service (NMFS); the Department of the Army, Corps of Engineers (Corps); the Washington Department of Parks and Recreation; Washington Department of Fisheries (WDF); and the Washington Department of Wildlife (WDW)[4]. Tacoma filed a response to agency letters of comment in January 1978.

Because of concerns that the existing developments could not pass the probable maximum flood (PMF), the Commission issued a letter on May 13, 1982, directing Tacoma to submit a plan and schedule for remedial measures to ensure the dams' safety. Tacoma submitted plans to upgrade the Dam No. 1 spillway structure by adding new radial gate structures. Construction of the new spillway facilities at Dam No. 1 did not commence until 1989. From 1983 through 1991 it was necessary for Tacoma to maintain Lake Cushman at lower-than-normal water levels to ensure the project's ability to pass potential flood waters. In November 1989, Lake Cushman was drawn down to its lowest level (elevation 650 feet[5]) since the reservoir was originally filled to minimize the potential for spilling while the spillway was being improved.

Tacoma applied to the Washington Department of Ecology (WDOE) for a Section 401 water quality certificate on June 27, 1984. On April 30, 1985, WDOE granted certification conditioned upon the release of specified minimum flows. Tacoma appealed that certification, however. During 1986 and 1987, Tacoma and WDOE worked out an interim agreement over the issue of water releases into the North Fork below Dam No. 2 pending relicensing. The agreement centered on a water release schedule consisting of a minimum flow of 30 cubic feet per second (cfs) below Dam No. 2. The revised water quality certificate was issued on December 30, 1987, and interim instream releases of 30 cfs have been maintained since July 1988.

On July 22, 1988, the Commission requested that Tacoma prepare responses to 23 questions. Tacoma submitted responses to the 23 items on June 29, 1990. On January 30, 1991, the Commission notified Tacoma that responses were deficient for four of the 23 items requested and requested additional information for 17 new items. The Commission subsequently withdrew two of the four deficient items, and Tacoma subsequently prepared responses to the remaining deficiencies and 17 new additional information items in July 1991. In March 1992, the Commission made two additional information requests (AIRs). Tacoma responded in May 1992.

On February 22, 1992, the Tribe filed a petition seeking a Commission declaration that this is an original license proceeding rather than a new license or relicensing proceeding, and that the

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4 In 1994, the Washington Department of Fisheries (WDF) and the Washington Department of Wildlife (WDW) merged to form the Washington Department of Fish and Wildlife (WDFW).

5 Elevations refer to Cushman datum unless otherwise stated. Cushman datum is approximately 3.2 feet above mean sea level.

original project encompassed only 8.8 acres of FS land. On May 4, 1994, the Commission issued an order finding that this is a proceeding on an application for a subsequent license (i.e., a relicense) and established the baseline, for the purpose of this environmental review, as existing conditions. Subsequent to the May 4, 1994 order, several requests for rehearing were filed. The state and conservation group petitioners were composed of the following agencies and organizations: WDFW, WDOE, Washington State Parks and Recreation Commission (WSPRC), American Rivers, Federation of Fly Fishers, Friends of the Earth, Trout Unlimited, The Mountaineers, Olympic Park Associates, Washington Trout, and Rivers Council of Washington. The U.S. Environmental Protection Agency (EPA) filed a motion seeking late intervention on March 23, 1994, and joined DOI and the Department of Commerce in their request for rehearing. On June 22, 1995, the Commission issued an order granting EPA intervention in the proceedings and denying rehearing.

On May 28, 1992, the Joint Resource Parties (JRP), including NMFS, DOI, FWS, the National Park Service (NPS), the Bureau of Indian Affairs (BIA), WDF, WDW, and the Skokomish Indian Tribe (the Tribe), filed a motion with the Commission that would require Tacoma to perform four additional studies on hydraulics and hydrology of the Skokomish River and Estuary. The Tribe also filed separate motions on May 26 and June 23, 1992, which included requests for studies listed in the JRP motion and added several other study requests.

On December 10, 1992, the staff conducted two scoping meetings in Washington State. As a follow up to scoping and the additional study requests, on April 8, 1993, the Commission requested that Tacoma undertake studies and prepare responses to 29 items ranging from information on the project transmission line characteristics to aggradation in the mainstem Skokomish River (mainstem). Tacoma submitted responses to the AIRs on August 5 and September 15, 1993. On November 3, 1993, the Commission requested further information and analysis from Tacoma on the wildlife Habitat Evaluation Procedures (HEP). Tacoma filed its response on January 17, 1994.

During the 1980's, it was determined that portions of upper Lake Cushman occupy lands within Olympic National Park (ONP) during late spring and summer, when the lake reaches its maximum level of elevation 738 feet. In 1990, the Bureau of Land Management (BLM) undertook a public land survey that led to the conclusion that lands within the project boundary (defined as the elevation 742-foot contour) occupy approximately 20 acres of ONP. In order to remove the overlap of project lands with lands of ONP, a land exchange was proposed in 1992. This transaction would entail Tacoma purchasing 45 acres of state lands that are within the Soleduck and Quileute areas of ONP and exchanging those lands for 30 acres of ONP land at the head of Lake Cushman.

On October 23, 1992, President Bush signed Public Law (P.L.) 102-436, which would allow the Secretary of the Interior to authorize the land exchange and modify the ONP boundary to remove project lands from the park. The NPS issued a draft environmental assessment (EA) for the proposed exchange on October 20, 1992. The comment period on the NPS draft EA closed on March 18, 1993. A new EA was issued on July 8, 1994, which concluded that it was beyond the EA's scope to analyze the effects of lowering Lake Cushman as an alternative to the proposed land exchange.

During spring of 1993, ONP officials requested that the Commission include land exchange issues in the Cushman DEIS. On June 23, 1993, the Commission sent a letter to NPS asking for clarification on the extent and types of analysis that would satisfy NPS NEPA requirements. On January 25, 1994, DOI responded to the Commission's inquiry. On January 27, 1994, the Commission held a technical conference on the relicensing of the Cushman Project, which included discussion on the status of the proposed land exchange. At that meeting, representatives of DOI indicated that NPS would expect the Commission to fold the results of NPS's analysis into the DEIS on the Cushman Project.

NMFS, the Tribe, the Washington Department of Fish and Wildlife (WDFW), DOI, and the U.S. Fish and Wildlife Service (FWS) submitted preliminary terms and conditions for the Cushman Project during October 1994. Among the recommendations common to all of the agencies is the minimization of out-of-basin diversion.

On July 22, 1994, the Commission, Tacoma, the Advisory Council on Historic Preservation, the Washington State Office of Archaeology and Historic Preservation, NPS, the Tribe, and BIA signed a Programmatic Agreement (PA) addressing the identification and management of cultural resources affected by the project.

On November 30, 1995, the Commission issued the Draft Environmental Impact Statement (DEIS) for public review and comment. Subsequently, the Commission held three public meetings, on January 31, 1996, and February 1, 1996, to receive public comments on the DEIS, and meetings with fish and wildlife agencies to resolve section 10(j) issues on April 22 and 23, 1996.

On April 12, 1996, the Tribe filed a petition requesting that the Commission reverse the staff's December 22, 1995, approval of Tacoma's Cultural Resource Summary Report and requesting referral of certain issues to the Advisory Council on Historic Preservation for possible resolution. In an August 5, 1996, Order, the Commission granted the Tribe's petition in part. After receiving the Advisory Council's recommendations, the Commission will determine what action may be appropriate concerning the PA.

1.3 Scope of the Environmental Impact Statement

After reviewing the application, including responses to AIRs and submittals by intervenors, the Commission staff determined that issuing a new license for the Cushman Project would constitute a major federal action that could significantly affect the quality of the human environment. Accordingly, the Director issued a notice on November 2, 1992, indicating the Commission staff's intent to prepare a DEIS that would evaluate the probable impacts of Tacoma's Proposal for the Cushman Project and alternative courses of action.

We initiated the process by preparing and issuing Scoping Document 1 (SD1) to intervenors and interested parties on November 3, 1992. We held scoping meetings and a site visit on December 9 and 10, 1992. Based on comments and filings received as a result of scoping, we prepared an AIR and Scoping Document 2 (SD2). SD2 was submitted to all parties on April 1, 1993.

Based on the series of filings submitted by intervenors subsequent to scoping, we reconsidered the alternatives listed in SD2. An updated SD2 was then provided to all parties on February 14, 1994, which updated our planned handling of the alternative analysis in the DEIS. As a result of the scoping process, we identified the following principal objectives, some of which may conflict with each other:

- maintaining production of non-polluting, renewable electrical energy;
- preserving the project's lake environments for recreational and residential uses;
- restoring wild, self-sustaining runs of anadromous fish in the North Fork and mainstem, and enhancing recreational, commercial, and subsistence fisheries based on the Skokomish River Basin's anadromous fish;
- maintaining and enhancing the project's flood protection benefits;
- enhancing wildlife habitat and protecting wildlife populations;
- improving sediment transport and ceasing and reversing channel aggradation in the Skokomish River; and
- protecting cultural resources.

In this DEIS, we examine these objectives with consideration for cumulative impacts, consistency with comprehensive plans, and the need for power and conservation. We also evaluate alternative enhancement measures as identified through the scoping process.

1.4 Need for Power

If licensed, as proposed by Tacoma, the Cushman Project would generate about [332] gigawatt-hours (GWh) annually.

Pacific Northwest growth forecasts indicate future increased demand (NPPC, 1996). Although a portion of this demand requirement will be met through demand side management conservation techniques, the vast majority will originate from the development of additional generation resources or regional power purchases. Possible alternatives to consider in meeting future requirements include developing one or more of the following resources:

- gas- or oil-fired turbine;
- hydropower;
- cogeneration;
- waste-to-energy;
- wind;
- solar;
- coal-fired; or
- efficiency improvement technologies.

Socioeconomic, cultural, recreation, flood control, irrigation, and fish protection measures along with other nonpower issues continue to place restrictions on regional hydro resources in the Pacific Northwest. Diminishing regional surpluses have reduced capacity in the overall electric power market and the opportunity to enter into traditional, cost-effective long-term power contracts has also diminished.

Hydropower generally provides the consumer with a balance of reliable low-cost energy and low environmental impact. We address the continued use of hydropower generation as a viable resource to assist in meeting the region's long-term power requirements.

1.4.1 Service Area Trends

Tacoma serves approximately 130,500 customers, including 119,000 residential, 10,000 commercial, and 1,500 industrial users within its 180-square-mile service area. This territory includes the 48 square miles within the Tacoma city limits.

Continuing population growth in the Tacoma service area will affect electric load growth, and Tacoma's load forecast (figure 1-2) depicts 20 years of projected annual load growth. Tacoma's load forecast predicts an annual average growth rate of 0.62 percent or about 4.1 average megawatts (aMW) per year of new energy demand over the next 20 years.

The Pacific Northwest Region, of which Tacoma is a part, is experiencing load growth and changing energy use patterns. To accommodate future uncertainties in planning, a range of possible load growth scenarios are considered. Annual growth currently ranges from 2.7 percent for the high economic growth scenario to -0.02 percent (load reduction) under the low-growth scenario. Planning for future resource developments reflects the range of these load forecasts. Under the medium economic growth forecast of 1.3 percent per year, approximately 280 MW of capacity will be required annually.

1.4.2 Tacoma Power System

Tacoma relies on three general sources to satisfy power requirements: power generated by Tacoma-owned and operated facilities; power conserved by customers; and power purchased from other producers, primarily the Bonneville Power Administration (BPA). Generation from Tacoma-owned hydropower facilities accounts for approximately 2,837,000 megawatt-hours (MWh), or 34 percent of Tacoma's customers' total energy needs. The cost of power from these projects is approximately 7 mills per kilowatt-hour (mills/kWh). In addition, Tacoma owns an 8 percent undivided interest in the Centralia Steam Plant, which accounts for approximately 10 percent of Tacoma's energy supply. The Centralia Steam Plant produces power for about 28 mills/kWh (Tacoma, 1991a). We summarized Tacoma's resources in table 1-1.

The Cushman Project accounts for 131 MW, or about 15 percent, of Tacoma's total owned resource of 868 MW. Annually, this project provides Tacoma with about 343 GWh, or about 4 percent of its total energy requirements. The Cushman Project operates in a manner to provide both load-following and peaking service to Tacoma's electricity customers.

Tacoma provides conservation programs for its customers in both the residential and commercial-industrial sectors. Through 1988, Tacoma captured approximately 10 MW in load

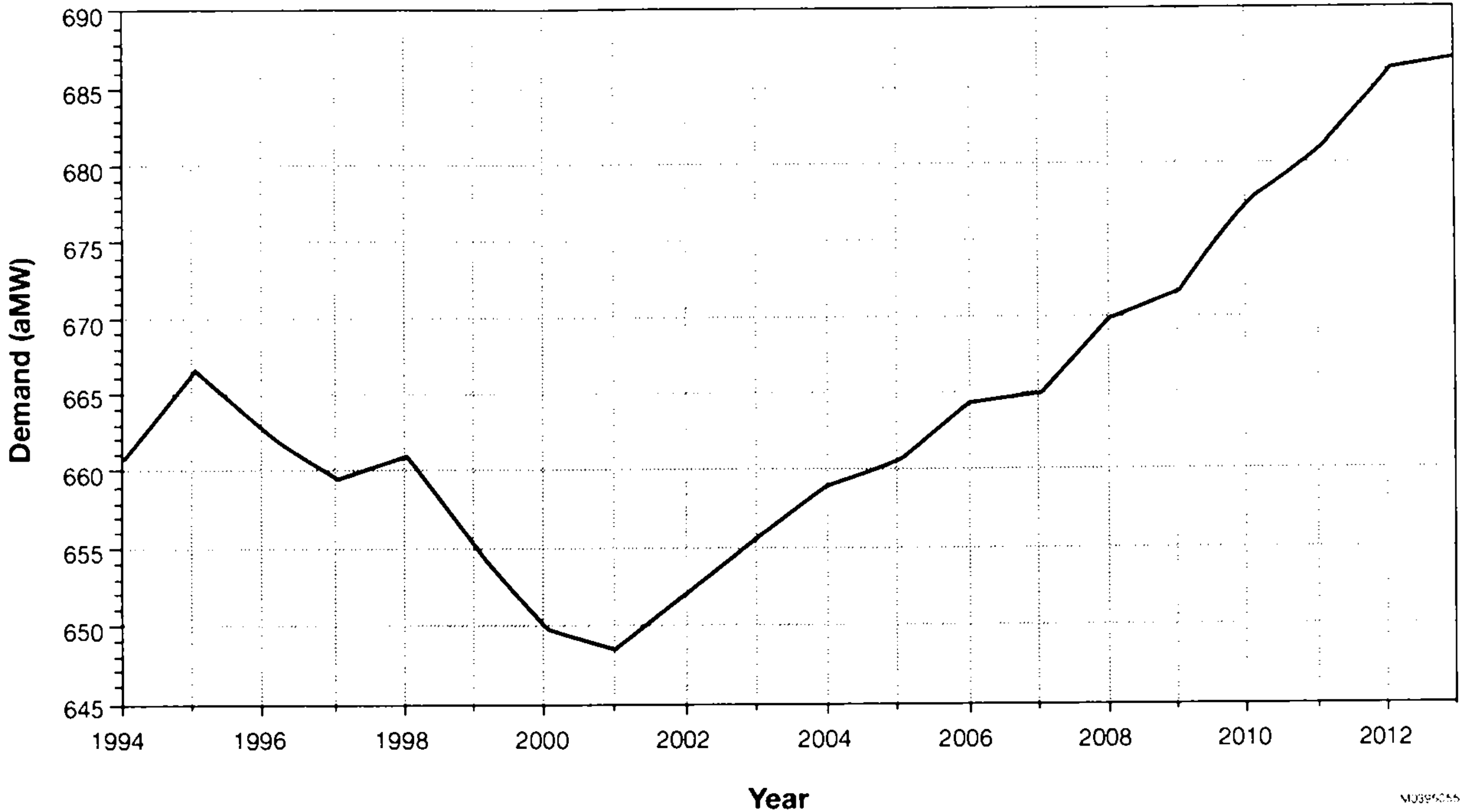

Figure 1-2. Tacoma's load forecast. (Source: Tacoma, 1992a.)

Table 1-1. Tacoma's owned resources.[1]

Plant name	Capacity (MW)
Cushman Powerhouse No. 1	50.0
Cushman Powerhouse No. 2	81.0
Alder	50.0
La Grande	64.0
Mayfield	162.0
Mossyrock	300.0
Centralia	105.0
Steam Plant No. 2	50.0
Wynoochee Project	12.9
Total	868.0

[1] Source: Tacoma, 1994b.

reduction through conservation programs, and more conservation-based load reduction is expected through 2001.

Tacoma purchases 42 percent of its total power from BPA, 6 percent from the Columbia Storage Power Exchange (CSPE), 5 percent from Grant County Public Utility District's (PUD) Priest Rapids Hydroelectric Project, and 3 percent from five small hydropower projects owned by three Columbia Basin project irrigation districts.

Tacoma's current contract with BPA was signed in 1982 and will expire in 2001. Under the contract terms, Tacoma pays BPA a demand charge of $3.46 per kilowatt (kW) and an energy charge of 18.4 mills/kWh during the winter (September through March) and 14.4 mills/kWh during the summer (April through August). This is equivalent to about 21.5 mills/kWh for power purchased at a 100 percent load factor throughout the year.

Tacoma's current contract with Grant County PUD No. 2 allows Tacoma to purchase 12.5 percent of the output of the Priest Rapids Project, or about 72 MW of firm peaking capacity and 359 million kWh of energy annually. The contract is scheduled to expire in 2004. Upon expiration, Tacoma will retain the right of first refusal to continue to purchase 8 percent of the output, which is then more than the actual and prospective needs of Grant County PUD. Power from Priest Rapids is relatively low in cost, approximately 5 mills/kWh. Costs of major refurbishments and fish and wildlife improvements to this project could double costs over the next 5 to 10 years.

Storage projects constructed fairly recently in Canada have augmented stream flows on the Columbia River, which in turn have generated additional power at American hydropower plants. The CSPE, a nonprofit organization, was formed to purchase the Canadian portion of this additional power. The total Canadian Entitlement purchased by CSPE varies annually and declines gradually until the contract ends in 2003. The current contract allows Tacoma to purchase 12.5 percent of the power available from the Canadian Entitlement, currently costing about 4 mills/kWh. The costs are expected to remain low. The governments of Canada and British Columbia have indicated that they will retain the CSPE power following expiration of the agreement.

Tacoma also contracts with the Columbia Basin project irrigation districts to purchase power from five small hydropower projects on irrigation canals in eastern Washington. Under the contract, Tacoma receives half of the projects' output through the year 2025. Tacoma's portion of the average annual generation of these projects is approximately 228,000 MWh. The current cost of this power is approximately 43 mills/kWh. Tacoma has contracted with the Western Area Power Administration (WAPA) to sell WAPA 356 million kWh of energy each year through 2004. The output from the Columbia Basin projects, with additional purchases, supplies this energy during the irrigation season. Tacoma nonfirm power provides the contracted amount during the non-irrigation season.

Hydropower resources owned by Tacoma and resources from other purchases are a critical component of Tacoma's energy mix. These resources have allowed Tacoma to maintain low rates for its customers. If Tacoma did not receive a new license for the Cushman Project, lost energy would have to be replaced by purchasing additional power, probably from the West Coast market or from BPA. The project also serves local power distribution systems and improves system reliability.

The Cushman Project assists Tacoma in maintaining sufficient capacity to meet load and reserve capacity requirements. To provide an adequate level of system reliability, Tacoma is required by the Northwest Power Pool to have the additional capacity necessary to supply requirements for load variations and errors in load forecasting, and to replace generating capacity losses caused by scheduled and forced outages of its own or some other system's generating and transmission equipment. The Operating Reserve Obligation is equal to 5 percent of the utility's on-line generation from hydropower resources, plus 7 percent of its on-line generation from thermal resources, and must be fully available within 10 minutes. If a license is not received for the Cushman Project, this capacity would have to be purchased or replaced by new facility construction.

The cost of replacement power from BPA would be approximately four times greater than the cost of current Tacoma-owned generation, based on existing BPA rates. Tacoma's contract with BPA obligates BPA to meet Tacoma's load requirements, as well as those of many other regional utilities. Even so, BPA's ability to meet this obligation depends on a number of factors and the ability of BPA to indefinitely replace possible lost generation must be questioned.

An alternative to replace lost power from the project would be construction of, or participation in, additional thermal generation. Replacement of the project with a comparably sized thermal project may be economical. Based on a natural gas-fueled combined-cycle plant, replacement power costs would be approximately 21 mills/kWh.

Falling natural gas prices, the opening of transmission access, and the availability of substantial excess generating capacity in California and the Southwest have combined to create an active West Coast market for electric power. The availability of relatively low-cost power in this market makes it an attractive option to meet the Northwest's demand growth. The West Coast market is likely to have substantial supplies of electricity costing about 20 mills/kWh (NPPC, 1996).

Replacing lost generation with federal power could increase annual costs. Such an increase would be especially noticeable to the large number of residential customers who rely on electric heat. Of additional concern is the portion of Tacoma's employment and industrial base that is sensitive to power costs. Pacific Northwest manufacturers depend on readily available, low-priced power to remain competitive. Cost increases that exceed national trends adversely affect the financial health of these power-dependent industries.

Much attention has been devoted to the increasingly "open" market within the electric utility industry. Resources can be acquired by purchasing capacity and energy from other utilities, as well as from independent power producers (IPP). Opportunities to purchase power from IPPs are expected to become more prevalent either through direct negotiation or through bidding processes, as well as through greater access to transmission.

Though all new sources of electricity have associated uncertainties, the cost and availability of new power purchases tend to be the least definable alternatives. Tacoma's evaluation criteria regarding new power purchases are essentially the same as for other resources. They must be cost-effective, obtained with acceptable environmental impacts, and consistent with the Pacific Northwest Electric Power Planning and Conservation Act of 1980.

1.4.3 Regional Power System

In addition to coordination with Tacoma's resources, the Cushman Project is also coordinated with other regional hydropower resources through the Pacific Northwest Coordination Agreement (PNCA). The PNCA provides for coordinated planning and operation of all major hydropower projects to maximize energy production from the system, to assure that hydropower energy is available during low streamflow conditions and to coordinate reservoir operation. Through coordinated use of reservoirs, the PNCA allows utilities to shape energy over time to meet seasonal load needs.

Hydropower is the predominant electrical power source in the Pacific Northwest. The available power generating capacity is limited by natural restrictions, such as varying precipitation, and by government-imposed restrictions, such as minimum instream flows (MIFs) and fish protection measures. Thus, for power planning purposes, forecasting is focused on energy production that can be consistently delivered from year to year. Forecasting is based on the amount of energy that is usually produced (firm energy), not the amount of generation that might be obtained in any given year caused by an unusual natural event, such as above-average rainfall (nonfirm energy).

NPPC determines the need for additional resources by measuring the rate of load growth, system load characteristics, the age and condition of existing resources, and other system reliability criteria. Pursuant to the Pacific Northwest Electric Power Planning and Conservation Act of 1980, NPPC adopted the Northwest Conservation and Electric Power Plan (Power Plan) in 1983. The 1996 Power Plan includes a 20-year demand forecast and estimates resources available to meet future requirements.

The Power Plan recognizes that the future is uncertain and that it is not possible to accurately forecast electrical energy needs. To address this uncertainty, NPPC, in a joint effort with BPA, developed a range of high, medium-high, medium-low, and low electrical load growth scenarios (NPPC, 1996). NPPC considers demand levels between the medium-low and medium-high forecasts to be most likely and equally probable. Conversely, levels outside the low and high forecast are considered to be of low probability and are therefore not considered in the resource planning process. According to NPPC, there exists a 76 percent probability that future demand will be equal to or above the medium-low forecast, and a 19 percent probability that future demand will be equal to or above the medium-high forecast.

Forecasts of regional firm sales of electrical energy depict growth from 19,987 aMW in 1994 to between 19,457 and 35,498 aMW by 2015 (table 1-2). The medium forecast is 26,533 aMW in 2015, representing an average annual growth rate of 1.3 percent.

Table 1-2. Regional forecasts of firm sales of electricity (aMW). [1]

Growth	Actual 1994	Forecasts 2005	Forecasts 2015	Growth Rate 1994 - 2015
High	19,987	27,803	35,498	2.7%
Medium-High	19,987	24,919	29,776	1.9%
Medium	19,987	23,330	26,533	1.3%
Medium-Low	19,987	21,600	23,460	0.7%
Low	19,987	19,155	19,457	(0.1)%

[1] Source: NPPC, 1996.

The need for additional resources is determined by subtracting existing resources (adjusted for any known additions or reductions) from the range of future electricity demands. Currently, adequate resources exist to meet load requirements. Under the low-load forecast, existing resources will be able to meet demand requirements over the 20-year planning horizon. The Power Plan concludes that in the more likely medium-high and medium-low scenarios, there is an 83 percent probability that the region would need to develop new resources by the year 2005.

1.4.4 Environmental Considerations

Because of the vast hydro resources available in the Pacific Northwest, fossil fuel generation is secondary and accounts for only about 20 percent of the region's firm capacity. Furthermore, using hydropower in lieu of fossil fuel based generation reduces atmospheric emissions and avoids other adverse environmental effects associated with fossil fuels.

Burning fossil fuel causes acid rain, generates "greenhouse" gases, and may deplete the ozone layer. On a per-megawatt (MW) basis, among all electric generating resources, coal-fired power plants emit the largest amounts of nitrous oxides and sulfur dioxide, the precursors of acid rain. With the exception of biomass-fired power plants, coal combustion emits more carbon dioxide per unit of energy produced than any other resource. The potentially adverse effects of fossil fuel generation make it less desirable in a region with renewable hydropower resources.

It is easier to reduce regional environmental effects from natural gas-fired and oil-fired generators than it is for coal-fired power plants. Natural gas burns much cleaner than coal or distillate fuel oil. Distillate fuel oil burns cleaner than coal. The use of combustion turbines fueled with natural gas or oil, however, raises environmental concerns regarding fuel-source exploration, development, and transportation.

Non-utility considerations that affect the existing power system must also be considered. These considerations include:

- Columbia River hydropower system operating limitations to protect salmon;
- potential reductions in existing hydropower potential associated with the relicensing of 70 of the region's 155 hydropower projects between 1990 and 2010;
- potential derating of nuclear plants because approved sites for spent fuel disposal are limited;
- possible Clean Air Act limitations on coal-fired generation;
- potential legislation limiting "greenhouse gas" emissions; and
- other environmental concerns.

1.4.5 Conclusion

We conclude that Tacoma has a need for power in both the short and long term, and that the Cushman Project helps to meet part of this need. The power from the project would be useful in meeting part of the need for power projected by both Tacoma and the Northwest Power Planning Council.

2.0 PROPOSED ACTION AND PRINCIPAL ALTERNATIVES

In this section, we describe existing Cushman Project facilities and operations, Tacoma's Proposal, and four project alternatives that we evaluated in this FEIS. The project alternatives are:

- Alternative 1, no action, which is continuation of current project operations;
- Alternative 2, which is a combination of Tacoma's Proposal with recommended operations and enhancement measures from Joint Resource Parties (JRP) (fish and wildlife agencies) and the Tribe, and the staff;
- Alternative 3, the staff-recommended alternative, which is a combination of Tacoma's Proposal with staff-developed alternative operations and enhancement measures; and
- Alternative 4, decommissioning the project.

Table 2-1 provides a summary comparison of Tacoma's Proposal and the four project alternatives.

Within Tacoma's Proposal and Alternatives 2 and 3, we evaluated the consequences of maintaining Lake Cushman's water surface elevation at or below 725 feet at all times and of providing fish passage facilities that would allow anadromous fish access to habitat within and upstream of project reservoirs. We considered lowering Lake Cushman because this action would avoid reservoir inundation of ONP lands if a proposed land exchange between Tacoma and NPS is not executed. We considered fish passage because DOI has requested a reservation of authority to prescribe fishways under Section 18 of the FPA.

2.1 Project Description

The Cushman Project consists of two dams and impoundments on the North Fork (figure 1-1) with associated power tunnels and penstocks, powerhouses, and a 26.8-mile transmission system.

The Dam No. 1 development was constructed in 1925 and 1926 and consists of a 260-foot-high concrete arch dam that impounds Lake Cushman and a 9.6-mile-long storage reservoir with a 4,058-acre surface area and a 372,000-acre-foot storage capacity at full pool (elevation 738 feet). During severe floods, Lake Cushman may be operated up to elevation 742 feet. Table 2-2 presents the stage-area and stage-storage relationships for Lake Cushman. A spillway with two radial gates is offset from the dam structure on the right side. The power intake is upstream of the dam and connects to a single, 17-foot-diameter, 540-foot-long power tunnel that leads to two, 10-foot-diameter, 150-foot-long penstocks. Powerhouse No. 1, on the left bank approximately 600 feet downstream from the dam, consists of two identical single runner, vertical shaft Francis turbines with a hydraulic capacity of 2,940 cfs. The installed generating capacity of the two units is about 50 MW. A switchyard abuts the powerhouse on the left bank, and two 115-kilovolt (kV) transmission lines extend approximately 5 miles to the Dam No. 2 development.

Dam No. 2, approximately 2 miles downstream from Dam No. 1, was built in 1929 and 1930 and consists of a 230-foot-high concrete arch dam impounding Lake Kokanee. Tacoma added

Table 2-1. Comparison of Tacoma's Proposal with project alternatives.[1]

		Tacoma's Proposal	Alternative 1 (No action)	Alternative 2	Alternative 3	Alternative 4 (Decommissioning)
Operations						
Lake Cushman:	full pool elevation (ft)	738	738	738	738	322 (dam removed)
	draw-down elevation (ft)	712	712	723	712	
Lake Kokanee:	normal pool elevation (ft)	478	478	478	478	0
Powerhouse No. 1 capacity (MW)		50	50	50	50	0
Powerhouse No. 2 capacity (MW)		84	81	84	84	0
Powerhouse No. 3 capacity (MW)		1.3	N/A	16	3	N/A
Flow below Dam No. 2 (cfs)		100	30	[2]	240-400	783[3]
Average annual power generation (GWh)		332	343	203	309	0
Environmental Enhancement Measures						
1. Remove McTaggert Creek diversion structure		yes	N/A	yes	yes	N/A
2. Release flows for silt removal		300 cfs/ 3 days/3 years	N/A	782 cfs	400 cfs/ every Nov.	N/A
3. Release flows for downstream fish migration		20 cfs/11 days	N/A	782 cfs	N/A	N/A
4. Modify fish passage in Big and Dow Creeks		yes	N/A	yes	yes	N/A
5. Enhance fish habitat in lower North Fork		yes	N/A	yes	yes	N/A
6. Remove North Fork lower falls to facilitate fish passage		yes	N/A	no	no	N/A
7. Stock fish in Lakes Cushman and Kokanee		yes	N/A	yes	yes	N/A
8. Dredge mainstem channel/restore side-channels		no	N/A	yes	yes	N/A
9. Remove dikes on Nalley Ranch/restore estuarine conditions/tidal shellfish enhancement		no	N/A	yes	yes	N/A
10. Renovate/support George Adams Hatchery and construct/support a new hatchery		yes/support GA Hatchery only	yes/support GA Hatchery only	yes	no	N/A
11. Acquire conservation easement to Richert Farm for wildlife preservation		no	N/A	yes	yes	N/A

	Tacoma's Proposal	Alternative 1 (No action)	Alternative 2	Alternative 3	Alternative 4 (Decommissioning)
12. Improve recreational sites/facilities:		N/A			N/A
Big Creek Campground	yes		yes	yes	
LCSP	yes		yes	yes	
Hood Canal Recreation Park	yes		yes	yes	
Staircase Road recreational area	yes		yes	yes	
Mt. Rose trailhead	yes		yes	yes	
Dry Creek trail	yes		yes	yes	
Southern Lake Cushman public boating access	no		yes	yes	
Lake Cushman Resort acquisition	no		no	yes	
Public access at Lake Kokanee	no		yes	yes	
Lake Cushman viewpoint	yes		yes	yes	
Bear Gulch access	no		no	yes	
13. Protect/enhance terrestrial resources on enhancement parcels (acres):		N/A			N/A
Transmission line ROW	508		508	508	
Westside	193		193	193	
LCSP	335		0	0	
Dow Mountain	225		225	225	
Lake Standstill	55		0	0	
Deer Meadow	440		440	440	
Potlatch	187		0	0	
Northern Lower North Fork	1,469		1,328	1,328	
Southern Lower North Fork	0		2,156	2,156	
Purdy Creek	190		290	190	
Nalley Ranch	0		880	880	
Belfair Wetlands	0		323	0	
Lilliwaup Swamp	0		9,348	0	
Total Land Enhancements	3,602		15,781	5,920	

[1] Source: the staff.

[2] Releases based on inflows and reservoir rule curve (table 2-4). Expected flow after 5 years would be 2,900 cfs, with an average flow of 782 cfs and an interim flow of 240 cfs.

[3] 783 cfs if decommissioned with dam in place; 784 cfs if dam removed.

N/A = not applicable

Table 2-2. Stage-area and stage-storage data for Lake Cushman.[1]

Stage (feet)	Surface Area (acres)	Volume (acre-feet)	Stage (feet)	Surface Area (acres)	Volume (acre-feet)	Stage (feet)	Surface Area (acres)	Volume (acre-feet)
690	3,150	200,709	708	3,438	259,731	726	3,800	324,842
691	3,160	203,864	709	3,454	263,177	727	3,819	328,651
692	3,170	207,029	710	3,486	266,647	728	3,839	332,480
693	3,180	210,204	711	3,504	270,142	729	3,858	336,329
694	3,190	213,389	712	3,521	273,654	730	3,891	340,203
695	3,200	216,584	713	3,539	277,184	731	3,912	344,105
696	3,210	219,789	714	3,556	280,732	732	3,933	348,027
697	3,220	223,004	715	3,574	284,297	733	3,954	351,970
698	3,230	226,229	716	3,592	287,880	734	3,975	355,934
699	3,240	229,464	717	3,609	291,480	735	3,996	359,919
700	3,310	232,739	718	3,627	295,098	736	4,016	363,925
701	3,326	236,057	719	3,644	298,734	737	4,037	367,952
702	3,342	239,391	720	3,682	302,397	738	4,058	372,000
703	3,358	242,741	721	3,702	306,089	739	4,079	376,069
704	3,374	246,107	722	3,721	309,800	740	4,093	380,155
705	3,390	249,489	723	3,741	313,531	741	4,113	384,258
706	3,406	252,887	724	3,760	317,282	742	4,133	388,381
707	3,422	256,301	725	3,780	321,052			

[1] Source: Tacoma, 1995a, modified by the staff.

a third turbine generator in 1952, increasing capacity of Powerhouse No. 2 from 54 MW to 81 MW. Prior to 1991, between Dam No. 1 and Dam No. 2, Tacoma maintained a small diversion structure on McTaggert Creek that diverted flows from upper McTaggert Creek through Deer Meadow and into Lake Kokanee. The diversion structure, consisting of an earthen dike with a diversion opening on the left bank leading to a culvert under FS Road No. 2340, was originally designed to continuously bypass at least 2 cfs. The diversion dike is penetrated by an 8-inch-diameter pipe to provide a bypass flow into McTaggert Creek. The bypass intake structure is a wooden box with a steel rod trashrack. The diversion structure has not diverted water since May 1991, when the creek "shifted" out of its main channel upstream of the diversion structure. McTaggert Creek currently flows directly into Deer Meadow, bypassing the diversion site (letter from TPU to the Commission, March 29, 1996).

Lake Kokanee, which is much smaller than Lake Cushman, has a surface area of about 100 acres and a gross storage capacity of 8,000 acre-feet. At full pool (elevation 480 feet), Lake Kokanee backs up to the Powerhouse No. 1 tailwater. A gated spillway structure abuts the dam on the right side. The power intake is on the left abutment. The power intake leads to a 17-foot-diameter pressure tunnel that extends 2.5 miles to a steel surge tank and three 12-foot-diameter, 1,350-foot-long steel penstocks. The penstocks connect to Powerhouse No. 2 situated on the shoreline of Hood Canal.

Powerhouse No. 2 contains three turbine-generator units with a total installed capacity of 81 MW and a maximum hydraulic capacity of approximately 2,700 cfs. The third turbine-generator unit was installed in 1952 and increased the capacity from 54 MW to 81 MW. A switchyard adjacent to the powerhouse is the tie-in point for the Dam No. 1 transmission lines. From this switchyard, two 115-kV transmission lines extend southward from Powerhouse No. 2, along Hood Canal, eastward across the Skokomish Estuary, to and across North Bay, and then tie into Tacoma's integrated transmission system at the Vaughn Tap, just east of Allyn on the Kitsap Peninsula. From the Vaughn Tap, a transmission line that is part of Tacoma's integrated system continues an additional 15.2 miles east and southeast, crossing Henderson Bay and The Narrows before ending at the Pearl Street substation in Tacoma. The transmission line right-of-way (ROW) is typically 100 feet wide and covers a total area of approximately 508 acres over the entire 42-mile length.

The proposed project boundary for relicensing the Cushman Project encompasses all of the project works, including the entire 42-mile length of transmission line and ROW from the project to Tacoma. The project boundary around most of Lake Cushman has been defined as the 742-foot contour, which is 4 feet above the normal maximum operating level. Lands within the 742-foot contour include approximately 14 acres of FS land administered by the Olympic National Forest (ONF), and about 20 acres of NPS land that is part of a 30-acre parcel proposed for a land exchange between Tacoma and NPS (section 1.2).

2.2 Project Operation

The Cushman Project is operated to produce electrical power. Project operations are designed to provide load-following and meet peak-demand period needs. As part of the PNCA, project operations are coordinated with the operations of other utilities to meet regional firm capacity needs. The project reservoirs are also used extensively for recreation and to provide incidental flood control benefits.

The estimated mean annual flow of the North Fork at Dam No. 2 is approximately 784 cfs for the period of record October 1967 through September 1989. Lake Cushman's usable storage capacity is 372,000 acre-feet. By storing water in Lake Cushman and diverting it to the powerhouses when needed, the project provides firm capacity, peaking power, and flood attenuation.

Lake Cushman is operated according to reservoir operating criteria that form a rule curve (table 2-3). Operations are designed to ensure that Dam No. 1 can safely pass the probable maximum flood (PMF) at all times. PMF passage is provided by a combination of storage and spillway capacity. Rule curve maxima may be exceeded for short periods to reduce downstream flooding.

Table 2-3. Lake Cushman rule curve, in feet.[1]

Month	Minimum	Typical	Maximum
January	690	716	729
February	690	717	729
March	700	721	734
April	710	729	736
May	710	732	738
June	720	738	738
July	720	738	738
August	720	738	738
September	710	727	733
October	710	717	727
November	700	712	724
December	700	714	726

[1] Source: Tacoma, 1993a.

Under normal operating conditions, Lake Cushman is kept full most of the summer at the normal maximum level of 738 feet. The reservoir is gradually drawn down from about August 16 through November 30 to enhance power production by minimizing spills during subsequent high-flow periods. This water management strategy also provides storage space for flood control. During this late summer and fall period, both powerhouses are generally operated 24 hours a day. By late November the lake reaches its lowest elevation (typically about elevation 712 feet). During the winter months, the project provides both peaking and load-following capability, which is important to the regional power supply grid. Beginning on or about March 1, project outflow is decreased and the reservoir is allowed to refill. During this period, Powerhouse No. 2 is often shut down and Powerhouse No. 1 is only operated on an as-needed basis to provide a continuous release of 30 cfs at Dam No. 2. By late spring, Lake Cushman's level is gradually brought up to elevation 738 feet. During the summer months, power production at both powerhouses is minimal, as Lake Cushman is kept as full as possible to maintain recreation and aesthetic values. Generation at this time is generally limited to nights and weekends to provide load-following.

From 1983 to 1991, Lake Cushman lake levels were held lower than normal to ensure that the project could pass the PMF until a new spillway was constructed. With the new spillway modifications that accommodate PMF flows, lake draw-downs have returned to pre-1983 levels (table 2-3).

Lake Kokanee operation typically follows inflows from Lake Cushman and rarely fluctuates more than 3 feet per year. Normal water surface elevation of Lake Kokanee is maintained at between 475 and 478 feet.

Prior to July 1988, all discharge from Lake Kokanee was routed through the power tunnel and penstocks to Powerhouse No. 2. During that period, seepage and tributaries provided water to the North Fork channel below Dam No. 2. Since 1988, the project has been operated to pass 30 cfs down the North Fork below Dam No. 2.

2.3 Tacoma's Proposal

2.3.1 Project Facilities and Operation

2.3.1.1 Replace Powerhouse No. 2 Turbine Runners

Tacoma plans to replace the turbine runners at Powerhouse No. 2 within the next 5 years. Tacoma expects that this action would improve efficiency by at least 4 percent over existing turbine performance, bringing powerhouse capacity to 84 MW. This modification would increase hydraulic capacity to about 3,000 cfs.

2.3.1.2 New Powerhouse at the Base of Dam No. 2 (Powerhouse No. 3)

Tacoma proposes to construct a new 1.3-MW powerhouse in the deep canyon at the base of Dam No. 2 (figure 2-1) and to release a 100-cfs MIF below Dam No. 2 (section 2.3.2)[1]. The powerhouse would consist of one small turbine that would utilize the 160 feet of static head to harness power from the 100-cfs flow releases. The intake structure would be located at an elevation that would provide near-optimal water temperatures for downstream fisheries. The flow line to the new powerhouse would be designed to accommodate at least the minimum flow of 100 cfs, and a bypass valve in the powerhouse would pass necessary flows during a turbine shut-down period.

A new 2,600-foot-long transmission line would connect the new powerhouse to the existing transmission lines from Powerhouse No. 1.

We refer to this proposed new powerhouse as Powerhouse No. 3 throughout this DEIS. Other alternatives considered in this FEIS include different sizes and configurations for this powerhouse; we use the Powerhouse No. 3 designation for each of these alternatives.

2.3.1.3 Reservoir Operations

Tacoma would operate the project reservoirs in the same mode as they are operated today. Between Memorial Day and Labor Day, Lake Cushman would be maintained near the full pool elevation of 738 feet. During the fall, Lake Cushman would be drawn down to reach its lowest level, typically 712 feet, by the end of November (table 2-3). Reservoir levels at Lake Kokanee would continue to fluctuate only slightly between elevations 475 and 478 feet.

2.3.2 Environmental Measures

Tacoma proposes the following environmental enhancements.

- Remove the existing McTaggert Creek diversion structure and re-establish the original stream channel to enhance fishery resources in McTaggert Creek.

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[1] In its comments on the DEIS, Tacoma requests that the Commission authorize but not require construction of this facility (letter from Tacoma to the Commission, March 29, 1996).

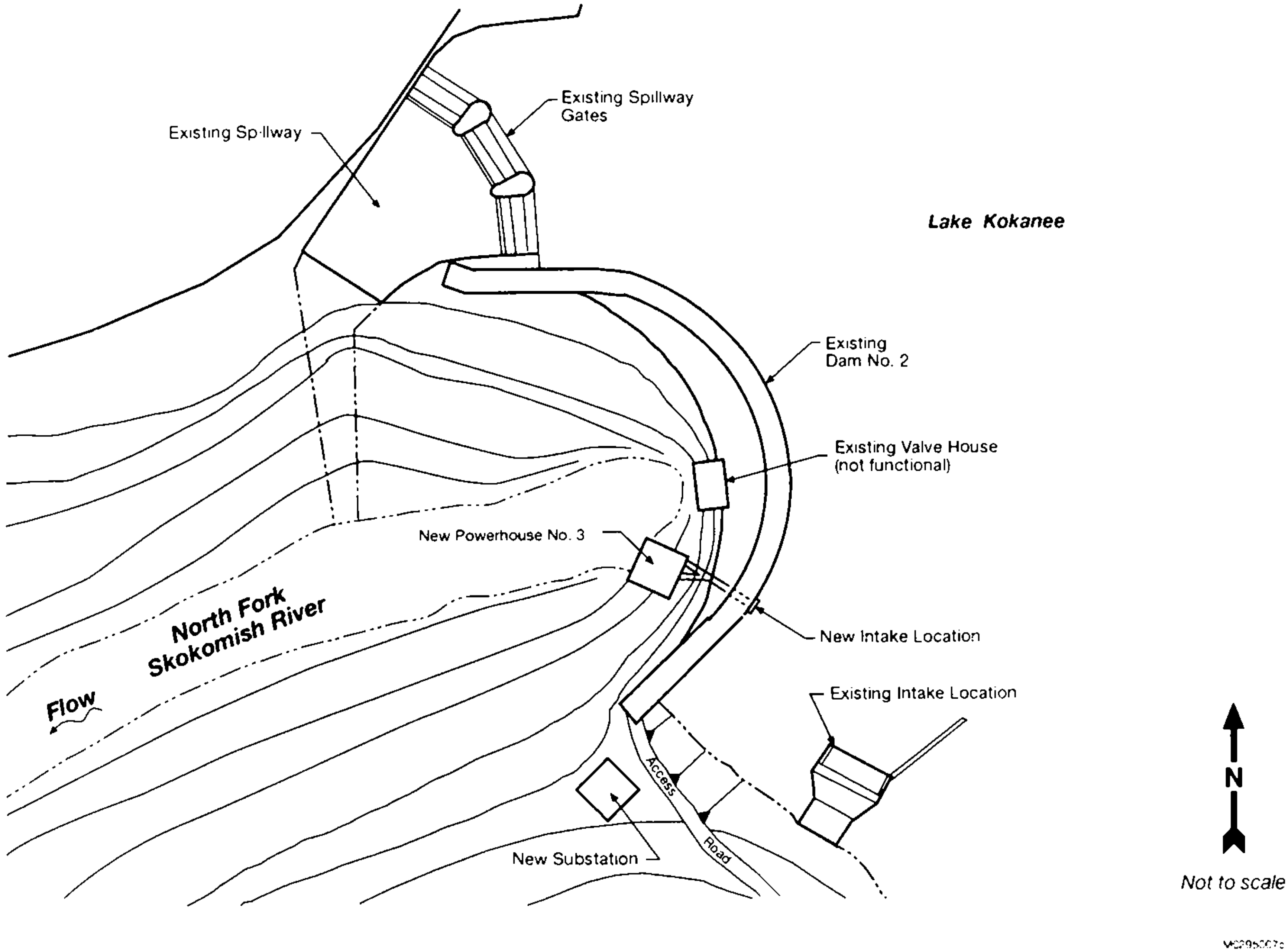

Figure 2-1. Configuration of 100-cfs Powerhouse No. 3 under Tacoma's Proposal. (Source: Tacoma, 1993a.)

- Increase MIF below Dam No. 2 to 100 cfs year-round to enhance fish habitat in the lower North Fork.

- Release an additional 20 cfs to the North Fork for a total of 11 days (6 days in the spring and 5 days in the fall) to stimulate downstream migration of anadromous fish.

- Release a total of 300 cfs to the North Fork for 3 days in November every 3 years to remove accumulated silts from pools in the lower North Fork.

- Modify fish passage restrictions in Big Creek and Dow Creek.

- Enhance fish habitat in the lower North Fork below Dam No. 2.

- Fund a fish stocking program for Lake Cushman and Lake Kokanee.

- Protect and enhance native plant and wildlife habitats on a total of 7,617 acres of land and water (3,599 acres of land only) including the transmission line ROW, reservoirs, and Westside, Lake Cushman State Park (LCSP), Dow Mountain, Lake Standstill, Deer Meadow, Potlatch, Northern Lower North Fork, and Purdy Creek parcels (figure 2-2).

- Improve facilities at Big Creek Campground, LCSP, and Hood Canal Recreation Park to increase recreation opportunities.
- Convert the informal Staircase Road recreation sites into developed day-use only areas.

- Improve the Mt. Rose trailhead, and relocate the Dry Creek Trailhead to bypass the existing portion of the trail that is close to residences.

2.3.3 Land Exchange

In addition to the above enhancements, to remove lands within ONP from the area occupied by Lake Cushman, Congress has authorized Tacoma and NPS to execute a proposed land exchange. Tacoma would acquire two parcels, totaling 45 acres, of Washington Department of Natural Resources (WDNR) land and exchange them for about 30 acres of ONP land that are partially inundated at the head of Lake Cushman when the lake is at elevation 738 (Tacoma's proposed maximum operation level). The exchange will go forward when all conditions of the law are met to the satisfaction of the Secretary of the Interior, whether or not the project is licensed.

Because we do not know if and when the proposed land exchange will actually take place, we considered the project's effects, with and without the exchange, in section 4.

2.4 Alternative 1 (No Action)

We used the no-action alternative to establish a baseline for comparing the environmental effects of each alternative. Under Alternative 1, the project would continue to operate under the terms and conditions of the existing license. No changes would be made to existing project facilities or operations. The project would continue to release 30 cfs to the lower North Fork as required by the project's Section 401 water quality certificate.

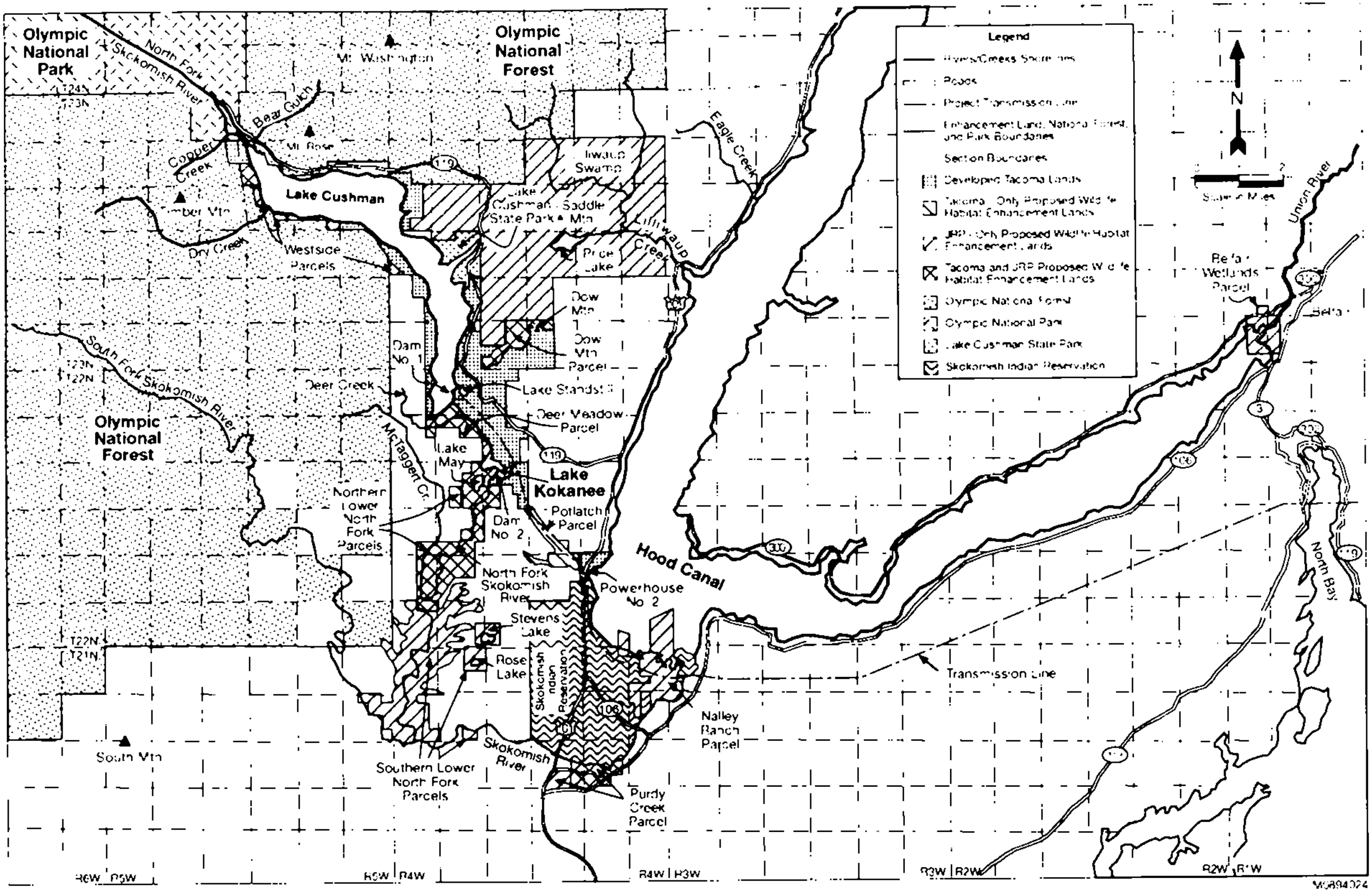

Figure 2-2. Location of proposed on-site and off-site wildlife habitat enhancement lands for the Cushman Project. (Source: the staff.)

2.5 Alternative 2

This alternative is adapted from the JRP's and the Tribe's recommended alternatives to Tacoma's Proposal. Under this alternative, we assumed that Powerhouse No. 2 would be used infrequently to provide minor flood control benefits.

2.5.1 Project Facilities and Operation

2.5.1.1 New Powerhouse at the Base of Dam No. 2 (Powerhouse No. 3)

To reduce the loss of power generation caused by minimizing out-of-basin diversion under Alternative 2, a new powerhouse (Powerhouse No. 3) would be constructed in the deep canyon at the base of Dam No. 2 (figure 2-3). The powerhouse would be constructed in an underground cavern hydraulically connected to the existing diversion tunnel. A single vertical shaft Kaplan turbine with a generating capacity of 16 MW and a hydraulic capacity of 1,300 cfs would be installed in the powerhouse.

Approximately 200 feet of new access road would be constructed along the left bank downstream from the dam and connected to the existing road. An area approximately 70 feet by 120 feet would be cleared for access shaft excavation, laydown of construction equipment and materials, and a new substation. A new transmission line approximately 2,600 feet long would connect the existing lines from Powerhouse No. 1 to a new substation. To make room for the new substation, one residence would be removed.

2.5.1.2 Reservoir Operations

Under Alternative 2, Tacoma would maintain Lake Cushman's water level at or above 723 feet at all times to enhance reservoir fisheries. All other aspects of reservoir management would remain as they are today to preserve the project's power production and downstream flood control benefits. Releases to the lower North Fork would be based on inflows and the reservoir rule curve (table 2-4). This is not a run-of-river operation but is designed to minimize out-of-basin diversion while preserving the flood control, hydropower, and recreation benefits provided by the reservoirs.

2.5.2 Environmental Measures

Alternative 2 would include the following environmental enhancements in addition to those proposed by Tacoma (section 2.3.2).

- Cease out-of-basin diversion except to the extent necessary to provide downstream flood protection.
- Provide fish habitat enhancements for the North Fork based on the design flow of 2,900 cfs (full flow).
- Renovate and support the George Adams Hatchery on Purdy Creek to sustain anadromous fish harvests, and construct and support a new hatchery to be operated by the Tribe.

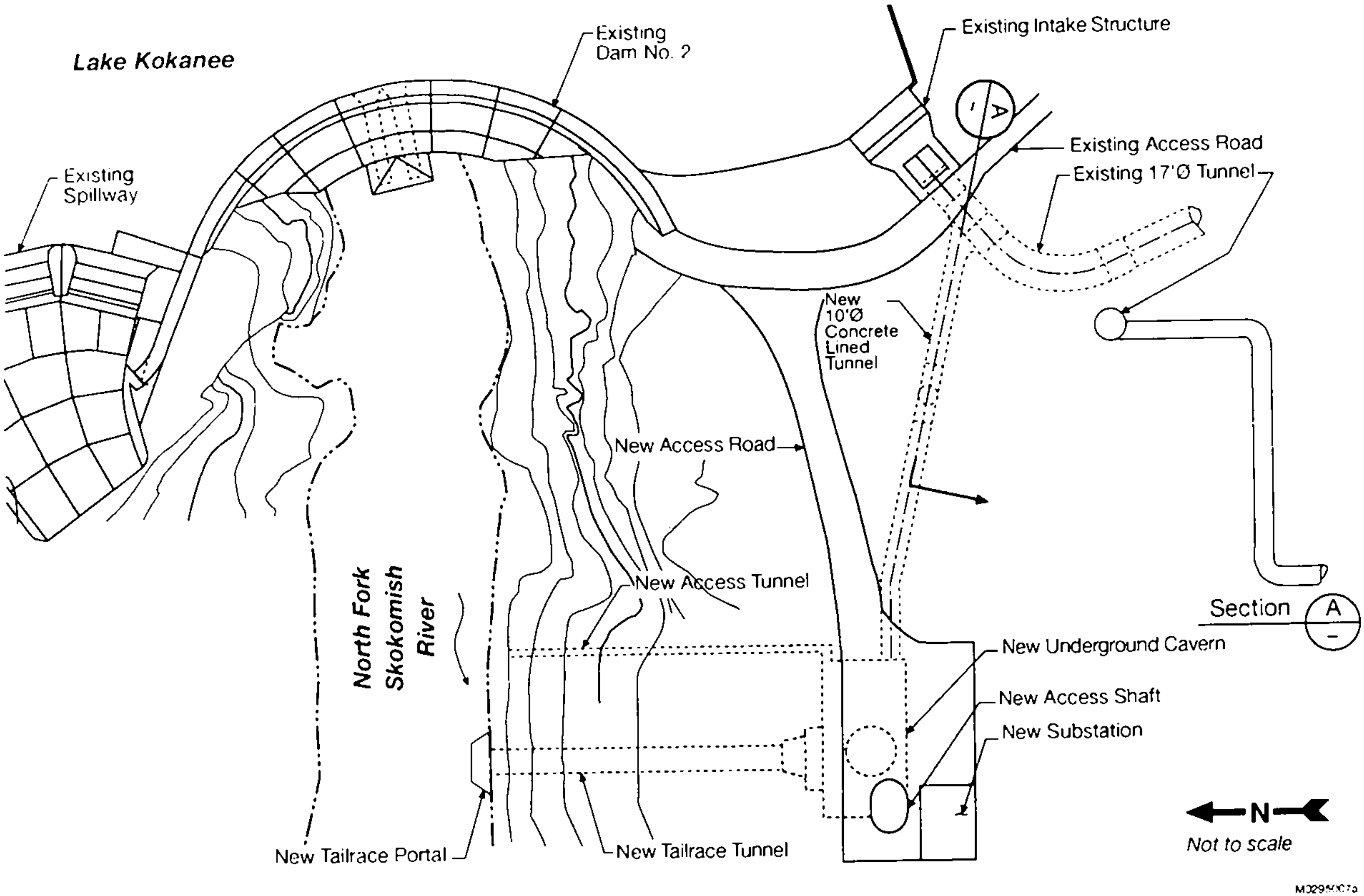

Figure 2-3. Configuration of 1,300-cfs Powerhouse No. 3 under Alternative 2. (Source: Tacoma, 1993b.)

Table 2-4. Lake Cushman rule curve under Alternatives 2 and 3, in feet.[1]

Month	Minimum	Typical	Maximum
January	723	724	729
February	723	724	729
March	723	724	734
April	723	729	736
May	723	732	738
June	723	738	738
July	723	738	738
August	723	738	738
September	723	727	733
October	723	724	727
November	723	724	724
December	723	724	726

1 Source: the staff.

- Develop and implement an estuary production and tidal shellfish enhancement plan to increase eelgrass beds, beach graveling and clam seeding, Pacific oyster populations, and provide crustacean monitoring.

- Improve the mainstem's in-channel conveyance capacity by dredging and by restoring side-channels.

- Remove dikes and restore estuarine conditions to 285 acres of land on the Nalley Ranch parcel at the Skokomish River mouth (appendix D).

- Protect and enhance native plant and wildlife habitats on a total of 19,689 acres of land and water (15,742 acres of land) including the transmission line ROW, reservoirs, and Westside, Dow Mountain, Deer Meadow, Northern Lower North Fork, Southern Lower North Fork, Purdy Creek, Nalley Ranch, Belfair Wetlands, and Lilliwaup Swamp parcels (figure 2-2).

- Acquire lands near Dam No. 1 to provide public boating access to the southern portion of Lake Cushman, and acquire additional lands adjacent to the project reservoirs to develop recreation facilities.

- Provide recreation enhancements at existing recreation sites.

2.6 Alternative 3

Tacoma's Proposal and Alternative 2 differ on the appropriate level of environmental enhancements and the importance of hydropower production at the Cushman Project. We identified the objectives inherent in these two alternatives and developed a staff alternative to achieve, to the extent practicable, important elements of each objective. This staff-recommended alternative was designed to provide substantial environmental enhancements while maintaining high levels of hydropower generation.

2.6.1 Project Facilities and Operation

2.6.1.1 New Powerhouse at the Base of Dam No. 2

To minimize the loss of hydropower potential caused by our proposed MIFs, a new powerhouse (Powerhouse No. 3) would be constructed in the deep canyon at the base of Dam No. 2 (figure 2-4). The powerhouse would be aboveground, approximately 200 feet downstream from Dam No. 2, and would be hydraulically connected to the existing intake and diversion tunnel. A single, 3-MW, vertical shaft Kaplan turbine with a 240-cfs hydraulic capacity would be installed in the powerhouse.

Construction access would be provided by a cableway across the gorge. A new switchyard and transmission substation would be located atop the left abutment, off the left end of the dam, and adjacent to the existing access road. A new transmission line approximately 2,600 feet long would connect the existing lines from Powerhouse No. 1 to the new substation.

2.6.1.2 Reservoir Operations

Tacoma would operate the project reservoirs as it does today (table 2-3) to preserve the project's power production and downstream flood control benefits.

2.6.2 Environmental Measures

Alternative 3 includes the following environmental enhancements in addition to those proposed by Tacoma (section 2.3.2).

- Provide 240 cfs MIF to the lower North Fork (or inflow, whichever is less) with 400 cfs flows in November.
- Participate in projects to enhance the mainstem's conveyance capacity.
- Develop an anadromous fish stocking plan to increase anadromous production and diversity in the lower North Fork.
- Remove dikes and restore estuarine conditions to 285 acres of land on the Nalley Ranch parcel at the Skokomish River mouth.
- Protect and enhance native plant and wildlife habitat on a total of 9,999 acres of land and water (5,981 acres of land only) including the transmission line ROW, reservoirs, and Westside, Dow Mountain, Deer Meadow, Northern Lower North Fork, Southern Lower North Fork, Purdy Creek, and Nalley Ranch parcels (figure 2-2).
- Acquire Lake Cushman Resort and manage it as a public park.
- Provide an additional boat launch facility on Lake Cushman for public use.
- Provide for boat mooring at LCSP.

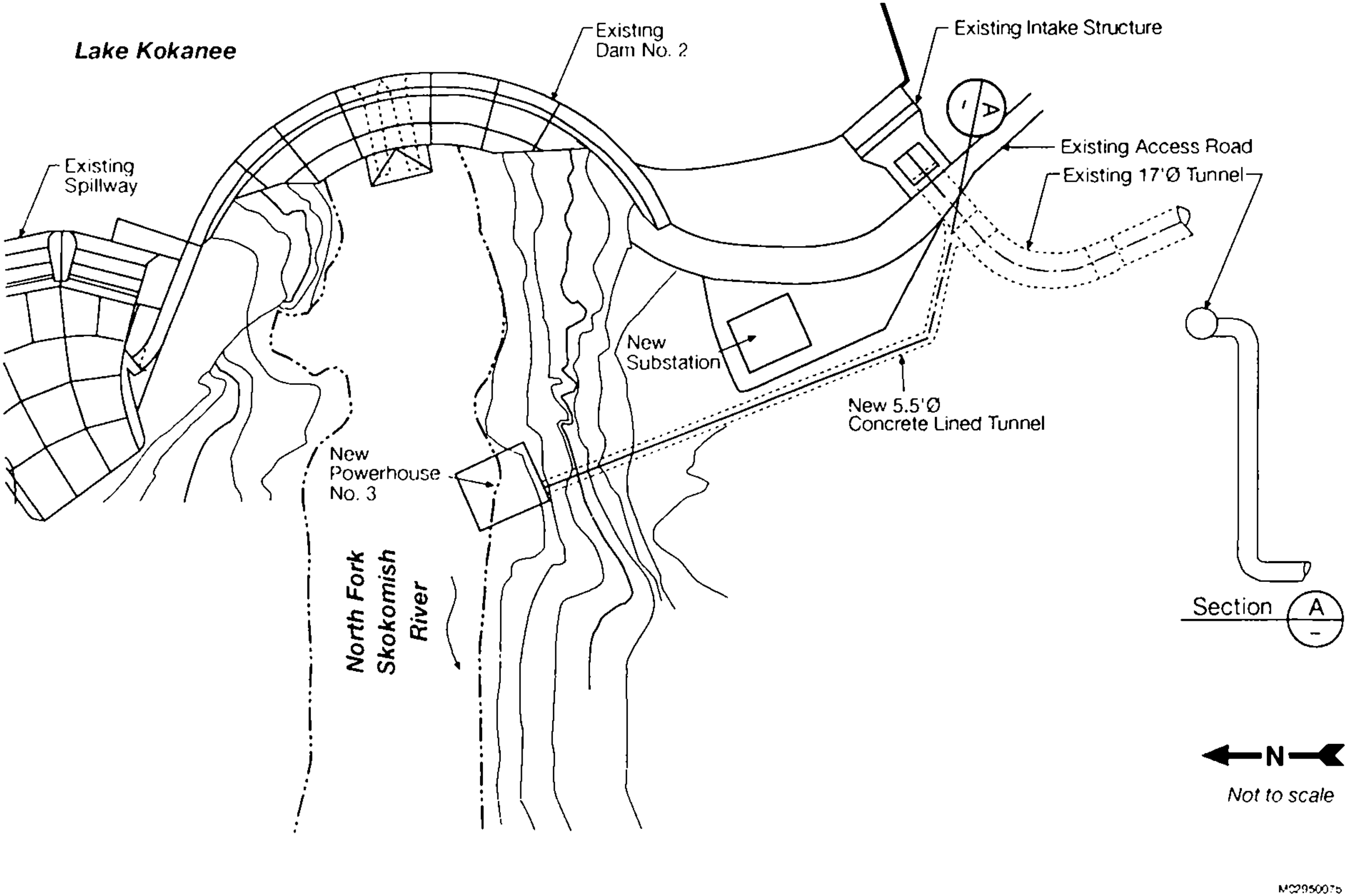

Figure 2-4. Configuration of 240-cfs Powerhouse No. 3 under Alternative 3. (Source: the staff.)

- Develop and manage a 50-unit campground near the Big Creek inlet on Lake Cushman.
- Provide recreation enhancements at existing recreation sites.

2.7 Alternative 4 (Decommissioning)

In addition to the agency and staff alternatives (Alternatives 2 and 3) to Tacoma's Proposal, we analyzed this decommissioning scenario both with and without dam removal.

2.7.1 Decommissioning with Dam Removal

Removal of Dams No. 1 and No. 2 would require draining each reservoir, re-establishing stable river channels, removing the material from project facilities and disposing of it, and rehabilitating the reservoir areas. An offsite area would be required for construction rubble and sediment disposal. If this alternative were selected, a detailed project removal plan would be required. The general process and estimated quantities involved in project removal are briefly described in the following section.

2.7.1.1 Dam No. 1

Lake Cushman would be initially lowered by controlled releases through the spillway. Once below the spillway invert at elevation 692 feet, the reservoir would be lowered through the powerhouse units and the low level outlet valve at the dam.

After the reservoir level is sufficiently lowered, the existing structures would be removed and the material disposed of. Removal of Dam No. 1 would include the concrete arch dam, concrete gravity wing walls at both abutments, and the earth section with concrete core wall at the left abutment. The intake tower on the upstream side of the dam and the spillway to the right of the dam would also be removed. The existing Powerhouse No. 1 in the canyon just downstream from the dam would be removed to re-establish natural flow conditions in the river channel. The electrical output lines from the powerhouse, substation, access tramway, and approximately 5 miles of transmission lines connecting to Powerhouse No. 2 would also be removed.

The dam and other concrete structures would be removed in a controlled manner using drill and blast techniques and/or diamond wire saw cutting. Construction access would include a cableway across the gorge. The removed material would be transported off the project site by truck for disposal. Some coffer damming and pumping would likely be required for removal of the lower dam portion in the stream channel. The concrete volume to be removed from the dam, spillway, and powerhouse would be approximately 75,000 cubic yards. Additionally, approximately 22,000 cubic yards of earthfill material would be removed from the left abutment embankment section. These quantities do not include equipment and material to be removed from the intake tower, powerhouse, substation, tramway, and conductors and structures of the transmission lines.

Rehabilitation would include consideration of sediment deposition on the reservoir floor. As necessary, sediments near the dam area would be removed and disposed of off-site. Otherwise, sediments in the reservoir area would be stabilized to reduce future downstream erosion. If sediments would be classified as hazardous under EPA guidelines, special procedures could be required that could significantly increase costs.

After Lake Cushman is lowered, demolition and removal work and rehabilitation of the area would take up to 24 months and employ approximately 25 to 50 workers.

2.7.1.2 Dam No. 2

Removal of Dam No. 2 facilities would probably be done prior to removal of Dam No. 1 so that Lake Cushman could be used to store larger inflow volumes while work proceeded downstream. Activities would be similar to those described above for Dam No. 1.

Removal of Dam No. 2 facilities would include the concrete arch dam, spillway, intake structure, and left abutment retaining wall. The powerhouse, substation, surge tank, and penstocks would be removed.

Removal methods would be similar to those for Dam No. 1. Decommissioning the flowline tunnel would include plugging each end with approximately 170 total cubic yards of concrete. The concrete volume to be removed from the dam, spillway, intake, and powerhouse would be approximately 75,000 cubic yards. These quantities do not include equipment and material to be removed from the surge tank, penstocks, powerhouse, substation, and conductors and structures of the transmission line.

After Lake Kokanee is lowered, demolition and removal work and rehabilitation of the area would take up to 24 months and employ approximately 25 to 50 workers.

2.7.2 Decommissioning without Dam Removal

Under this scenario, the project would be retired with all facilities left in place. Although the reservoir would continue to fluctuate on a seasonal basis for dam safety and flood control, power production would cease. All water entering Lake Cushman would be released to the lower North Fork, except during floods when up to 2,900 cfs could be diverted to Hood Canal.

2.8 Lowered Lake Cushman Water Level Option

For Tacoma's Proposal and for Alternatives 2 and 3, we considered an operating plan for Lake Cushman that would maintain Lake Cushman's water level at or below 725 feet. Because the proposed land exchange has not yet been executed, we evaluated this option as a measure that would prevent the reservoir from occupying ONP lands. If Lake Cushman's water level were maintained at or below 725 feet, no ONP lands would be inundated by the reservoir (figure 2-5).

Maintaining the lake level at or below 725 feet would only affect the April through September operations because the reservoir is normally drawn down below 725 feet the remainder of the year. We developed a reservoir rule-curve (table 2-5) that would facilitate this option based on a reservoir routing routine. We assumed that severe floods are most likely from September through February and that the spillway gates would be opened once the lake level reached 720 feet. Under these conditions, 65,000 cfs (a 2,500-year flood) could be passed at the project without exceeding a lake level of 725 feet.

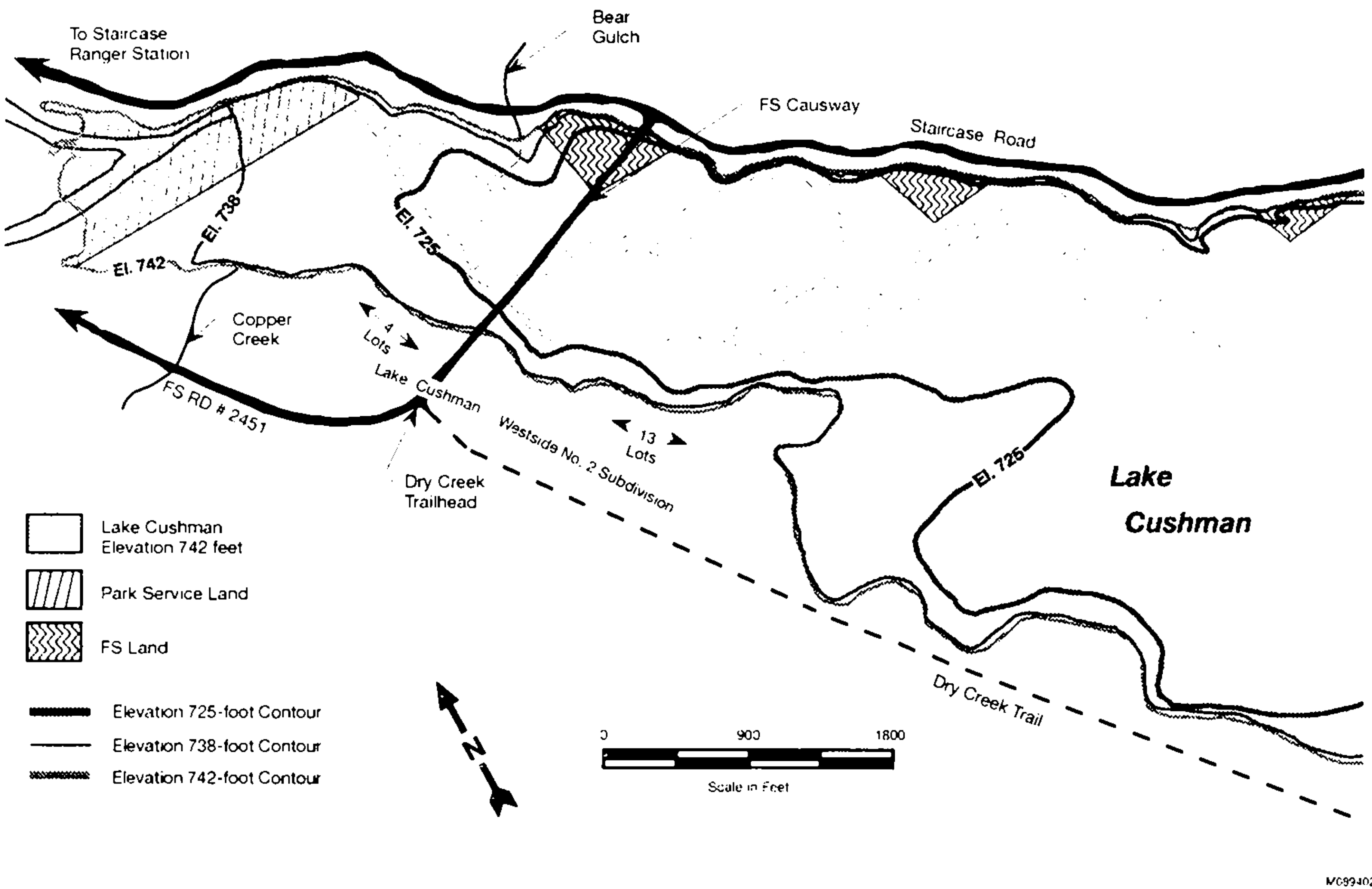

Figure 2-5. Upper Lake Cushman showing approximate elevation contours. (Source: Tacoma, 1990.)

2.9 Fish Passage Option

DOI has requested a reservation of authority to prescribe fishways. On March 29, 1996, DOI informed the Commission that it was prescribing downstream and upstream fishways for the Cushman Project, but did not include a specific fishway prescription. Although the staff initially indicated that it would accept DOI's prescription, we have concluded, based on further analysis, that DOI's purported prescription is untimely and is not sufficiently specific to constitute a valid fishway prescription under Section 18 of the FPA. The Commission will ultimately resolve this issue in its licensing decision. Because DOI has requested a reservation of authority to prescribe upstream and downstream fishways, and therefore may do so at some time during the new license term, we examine the economic and environmental impacts of various fish passage options in appendix C and in section 4.4.7. We also have considered DOI's fish passage measures as recommendations under Section 10(a) of the FPA. We do not adopt these recommendations because the measures' likelihood of biological success is too uncertain and they do not represent the best balance of developmental and non-developmental resources.

To make upper North Fork habitats accessible to anadromous fish, both adult upstream passage to spawning grounds and downstream passage for outmigrating juveniles or smolts would be needed. Providing for both upstream and downstream passage would require new facilities in the river above and below the project.

Based on our analysis (appendix C), a trap-and-haul system is the best way to provide both upstream and downstream passage. We considered the following fish passage enhancements for Tacoma's Proposal and Alternatives 2 and 3:

- construction of a trap-and-haul collection facility on the downstream right bank at the base of Dam No. 2;

- construction of a cableway for fish transport from the collection facility to the top of the left abutment of Dam No. 2; a bucket loading pit would be provided on the left abutment to allow transfer of downstream migrants from the haul truck to a fish bucket for cableway transport to the river below; and

- installation of a "gulper," consisting of barge-mounted louvers moored in Lake Cushman or a fish barge collection system for downstream passage.

2.10 Mandatory Terms and Conditions

Because about 14 acres of FS lands are within the project boundary, FS has the authority to prescribe mandatory conditions on those lands to ensure that the project is consistent with the purposes for which the federal reservation was created (FPA Section 4(e)). FS has provided a list of Olympic National Forest Land Management Plan standards and guidelines for the late-successional reserve management units that apply to the Cushman Project. These standards and guidelines are general and many do not apply to FS lands that are periodically inundated along the Lake Cushman shoreline. To the extent that these standards and guidelines apply to FS lands occupied by the Cushman Project, we identified any inconsistencies between these conditions and the proposed project and alternatives in sections 4 and 6.

Table 2-5. Lake Cushman reservoir levels under the lowered Lake Cushman water level option, in feet.[1]

Month	Minimum	Typical	Maximum
January	690	700	720
February	690	700	720
March	700	708	721
April	710	716	723
May	710	719	725
June	720	725	725
July	720	725	725
August	720	725	725
September	710	714	720
October	710	710	720
November	700	700	720
December	700	700	720

[1] Source: the staff.

3.0 AFFECTED ENVIRONMENT

3.1 Regional Setting

The Cushman Project is located on the southeastern side of the Olympic Peninsula in western Washington. The project is within Mason County and occupies portions of the North Fork and shoreline areas along the southwestern coastline of Hood Canal (figure 1-1).

The Skokomish River Basin covers approximately 240 square miles on the southeastern Olympic Peninsula and drains into southern Hood Canal. Hood Canal is a deep, narrow fiord adjoining Puget Sound (figure 3-1). The North Fork is regulated by the project and drains approximately 118 square miles of the Skokomish River watershed. The South Fork is an unregulated river that drains about 124 square miles of the watershed. Upper drainages of both the North and South Forks are located within ONP; most of the drainage within the park is associated with the North Fork. Most of the Skokomish River Basin is forested, either as a protected ecosystem in ONP, as managed multiple-use forests in ONF, or as industrially managed timber lands.

Except for the lower Skokomish Valley and its adjacent lowland plateaus, the Skokomish River Basin is composed of steep, rugged terrain. The uppermost portions of the basin follow along the Olympic Mountains at elevations of 4,000 to 6,000 feet. In the upper watershed, valley walls are steep with sharp ridge tops and are deeply dissected by numerous small mountain streams. These streams discharge into the three principal tributaries (North Fork, South Fork, and Vance Creek) that flow through deep, narrow valleys and gorges.

The North Fork flows through ONP, then into Lake Cushman, and on through private timber and agricultural lands, while the South Fork flows through roughly 23 miles of ONF and through some private timber lands. This portion of ONF is part of the Shelton Cooperative Sustained Yield Unit (Shelton CSYU), an intensively managed timber production unit that also encompasses adjacent private timber lands owned by Simpson Timber Company. The Cushman Project divides the North Fork into two river reaches (figure 3-2). The North Fork above Lake Cushman is known as the upper North Fork, while the North Fork below Lake Kokanee and Dam No. 2 is known as the lower North Fork. The North and South Forks join to form the mainstem, which flows approximately 9 miles through the Skokomish Valley and then forms a wide fluvial delta at the lower end of Hood Canal. The Skokomish Delta is the largest delta on Hood Canal and is considered to be a very productive and regionally important estuary.

The Skokomish Valley is generally flat, though it does exhibit the undulating topography common to the flood plains of the major Puget Sound Basin lowland rivers. Additionally, remnant side channels that were active prior to settlement are visible throughout the valley. The valley varies in width from 0.5 mile at its upper end to more than 2 miles at the river mouth.

3.2 Geology, Soils, and Channel Morphometry

3.2.1 Geology

The Olympic Peninsula is composed of two major bedrock terrains: peripheral and core rocks. The project area is underlain by peripheral rocks, which form a horseshoe pattern, open on

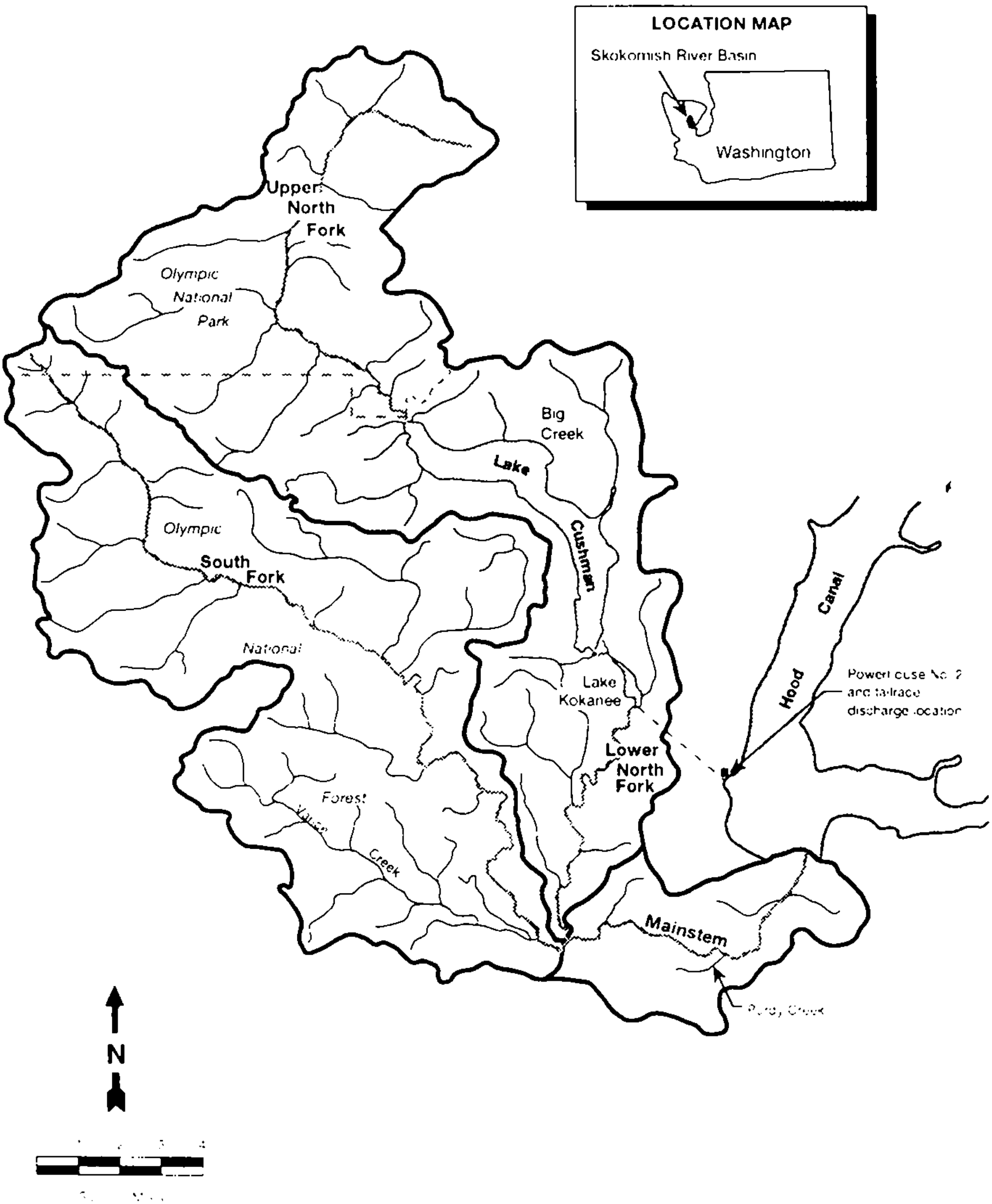

Figure 3-1. Skokomish River watershed map. (Source: the staff.)

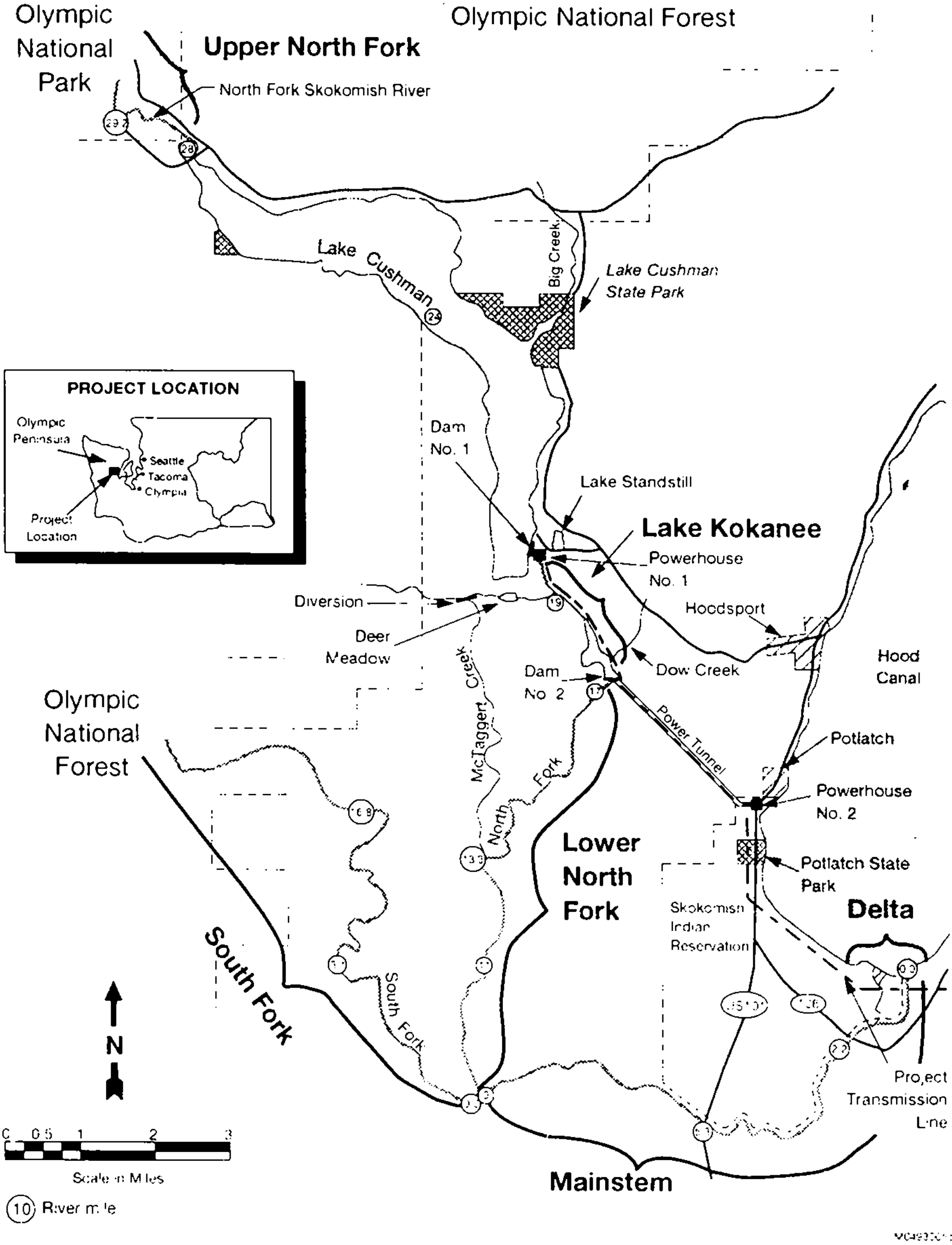

Figure 3-2. Index of Skokomish River reaches and river mile locations. (Source: the staff.)

the west, around the core rocks. The peripheral rocks underlying the project area are part of the Crescent Formation and consist of basalt, pillow basalt, breccia, diabase, gabbro, minor interbedded sedimentary rocks, and red, manganiferous argillite and limestone. The Hurricane Ridge fault separates the peripheral rock from the core rock. Shearing along this fault is evident in the vicinity of Slate Creek, upstream of the project area.

The upper part of the project area, including the reservoir perimeters and dam sites, is underlain by the basalt flows and mudflow breccia of the Crescent Formation. Fine-grained lacustrine sediments, delta alluvial deposits, drift deposited by Olympic alpine glaciers, and colluvium overlay the Crescent basalt.

The lower project facilities, including Powerhouse No. 2, the penstocks, and transmission line, are largely underlain by glacial drift. Thick deposits of till, outwash, and some alluvium accumulated in this area during the geologically recent (circa 13,000 years ago) retreat of the continental ice sheet.

The plateaus adjacent to the Skokomish Valley that rise 400 to 600 feet above the valley floor are composed of layers (lenses) of glacial outwash sands and gravels and interglacial sediments (Canning et al., 1988). These geologic strata are well exposed in the valley's canyon walls and are perhaps best exposed under the BPA power transmission corridor on the north side of the lower Skokomish Valley. In upper portions of the Skokomish Basin, basalt bedrock is exposed in many locations, and in canyon reaches of the North Fork and South Fork, the river has cut down to bedrock.

3.2.2 Soils and Erosion Characteristics

On the steep mountain slopes around Lake Cushman, soils range from very gravelly loam to silty clay loam, with frequent rock outcrops. Soils underlying Powerhouse No. 2, the penstock, the transmission line, and slopes adjacent to Lake Kokanee are primarily cobbly sandy loam, gravelly loam, and gravelly sandy loam. Soils of the Skokomish Valley are deep alluvial soils.

Soils of the Skokomish River Basin are typical of mountainous soils of the Olympic Peninsula's east slope. These soils have a high erosion potential, which is related to slope steepness and high rainfall rates, and are easily disturbed by road building and other earth-moving activities or by devegetation during clearcut logging. Soils on forest slopes are relatively shallow; soils on the plateaus are deeper. In general, upland soils on slopes are well drained, with low to moderate water retention, and high infiltration rates. Because the Skokomish River Basin has unstable soils and steep slopes, land sliding and debris sliding can be expected to contribute sediments to the river system (Canning et al., 1988). These materials, along with natural landslide events, all contribute to river bed aggradation.

An estimated 3.6 times as much sediment yield has occurred in the Shelton CSYU because of erosion from heavily logged areas (Canning et al., 1988). Most of this erosion has occurred in the South Fork Basin; relatively little logging occurs in the North Fork Basin. Additionally, any sediment produced in the upper North Fork Basin would be deposited in Lake Cushman.

3.2.3 Channel Morphometry

The Skokomish River system includes 9.0 miles of mainstem channel, 33.3 miles of North Fork channel, 27.5 miles of South Fork channel, and 270 miles of tributary channels. Tributaries include Vance Creek (11.0 miles) and Purdy, Brown, LeBar, and McTaggert Creeks (Canning et al., 1988). Table 3-1 lists the river mileage locations of prominent features.

3.2.3.1 North Fork

The upper North Fork is characterized by a steep gradient that changes to a moderate gradient about 1 mile above Lake Cushman. The lower North Fork also has a steep gradient for about 4 miles, then the river has a more moderate gradient until it joins with the South Fork.

Since completion of Dam No. 2 in 1930, the flows in the North Fork between Dam No. 2 and McTaggert Creek have been significantly reduced. Prior to dam construction, mean annual flow in the North Fork immediately above McTaggert Creek was about 800 cfs. After Dam No. 2 was in place, flows in the upper reach of the lower North Fork averaged less than 10 cfs. These flows represented seepage from the dam and tributary and groundwater inflow. Starting in July 1988, Tacoma began releasing 30 cfs below Dam No. 2.

The grain size of sediments lining the channel downstream from the dams has changed as a result of both hydrologic and geologic conditions. Prior to construction of the Cushman dams, the river bed was composed primarily of cobbles (2.5 to 10 inches in diameter) with some gravel patches and boulders. Pre-dam hydrologic conditions in the historical channel below Dam No. 2 resulted in a predominantly cobble streambed because natural flows were high enough to move gravel that entered the reach. The source area for gravel and larger particles was historically limited by a natural lake (historic Lake Cushman) that was located at river mile (RM) 24. Gravel from upstream of the lake was deposited at the head of the historic lake, just as gravel is now deposited at the head of existing Lake Cushman.

The present bed below Dam No. 2 is dominated by gravel rather than cobbles. Present river flows below Dam No. 2 are not able to move gravel except under infrequent flood conditions. The source area for gravel below Dam No. 2 is limited to sidewall erosion and tributaries. Sediments from sources such as Big Creek between the site of Dam No. 2 (RM 17.3) and RM 24 were cut off when the dams were built. Gravel accumulation has been much slower between the dam and RM 15.3 because above RM 15.3 the river is contained within a narrow valley of bedrock that does not produce much gravel. Below RM 15.3, the geology of the river valley changes to high banks of erodible glacial deposits that produce large quantities of sand and gravel. Thus, though there is some gravel in the channel between Dam No. 2 (RM 17.3) and RM 15.3, it is not as abundant as downstream from RM 15.3. Below McTaggert Creek, gravel is extremely abundant.

The channel substrates between Dam No. 2 and McTaggert Creek have accumulated fines (sand, silt, clay, or organic detritus) in subsurface pore spaces. More significantly, measurements of silt accumulation in pools indicate as much as 3 feet of silt and organic matter have been deposited.

Table 3-1. River mile locations of prominent riverine features in the Skokomish Basin.[1]

Stream name	Feature	River mile
Skokomish River — mainstem	Mouth	0.0
	US 106 bridge	2.2
	Purdy Creek	4.1
	US 101 highway bridge; gaging station 12061500	5.3
	North Fork-South Fork confluence	9.0
Skokomish River continues as the North Fork	Confluence with South Fork	9.0
	Gaging station 12059500	10.0
	McTaggert Creek	13.3
	Dam No. 2 (Lake Kokanee)	17.3
	Dam No. 1 (Lake Cushman)	19.6
	ONF boundary	24.0
	Lake Cushman inlet	28.0
	Gaging station 12056500 (Staircase Rapids)	29.2
South Fork	Mouth = confluence with North Fork	0.0
	Vance Creek	0.8
	Gaging station 12060500	3.1
	ONF boundary	3.5
	Forest road 2340 bridge	6.8
	Brown Creek	12.8
	LeBar Creek	13.5
	ONP boundary	26.4

[1] Source: Canning et al., 1988.

3.2.3.2 South Fork

The upper South Fork is characterized by a moderate gradient, with extremely steep-sided drainages entering the stream. From about 8 miles to about 3 miles upstream of its confluence with the North Fork, the South Fork has incised and flows through a narrow, steep gorge that is up to 300 feet deep. Below the gorge, the next 3 miles of the South Fork have a low gradient as the river flows through the large, glacially formed Skokomish Valley.

The lower portion of the South Fork receives large quantities of sediment from the upper watershed. In this area and throughout the mainstem, large gravel bars are building, reducing the channel's conveyance capacity (figure 3-3). Consequently, during floods, the stream is forced to erode into banks made of finer or more erodible material. This has produced considerable bank erosion and has diminished the channel capacity sufficiently so that floods are occurring in areas and at frequencies that have not been experienced before.

Aerial photographs of the upper South Fork drainage by Reichmuth (1987) indicate that large quantities of sediment are being released from the heavily logged areas that cover large portions of the South Fork Basin.

3.2.3.3 Mainstem Skokomish River

The mainstem is a low gradient (-0.33 percent slope to +0.27 percent slope) meandering alluvial river. (Positive slope indicates areas where the river bed rises in a downstream direction.) A network of old meanders, creeks (Swift, Hunter, Weaver, and Purdy), and plowed-over sloughs drain into the mainstem. Partially filled sloughs are clearly evident only during low intensity flooding of the valley. Old meanders are also partially filled, which limits their ability to carry floodflows and contributes to locally chronic high water tables and flooding.

Average tidal levels at the tide gauge at Union at the mouth of the Skokomish River and corresponding land-based elevations are shown in table 3-2. Under average conditions, which is mean high (tide) water (MHW), direct tidal influence extends up the Skokomish River to the location where the river bed elevation equals 4.9 feet at RM 3.7 (Canning et al., 1988). Indirect tidal influence occurs above this location, depending on river flow rates.

Table 3-2. Average tidal levels (in feet) at the tide gage at Union at the mouth of the Skokomish River and corresponding land-based elevations.[1]

	Tidal elevation	Land-based elevation (1929 datum)
Mean higher high water	11.8	4.9
Mean high water	10.8	3.9
Mean tide (sea) level	6.9	0.0

[1] Source: Canning et al., 1988.

Over the past century, changes in land use (from undeveloped forests to farming, logging, and road building) in the Skokomish River Basin have increased the amount of sediment while hydropower development has decreased the amount of water supplied to the mainstem.

Figure 3-3. Gravel bars on the mainstem Skokomish River. (Source: Reichmuth, 1987.)

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Mean high water	10.8	3.9
Mean tide (sea) level	6.9	0.0

[1] Source: Canning et al., 1988.

Over the past century, changes in land use (from undeveloped forests to farming, logging, and road building) in the Skokomish River Basin have increased the amount of sediment while hydropower development has decreased the amount of water supplied to the mainstem.

Additionally, channel location and migration patterns in the mainstem have been controlled by diking and filling sloughs. These changes have adversely affected the sediment transport capacity and channel morphometry of the river.

Canning et al. (1988) noted a shift during the past few decades from a meandering pattern towards a braided channel on the mainstem for 2 miles downstream from the South Fork confluence and on the South Fork for 3 miles upstream of the confluence. Braided channels are often associated with rivers that have an excessive supply of sediment and are aggrading. Because Lake Cushman completely interrupts sediment transport to the lower North Fork, and because of low or zero flow conditions downstream from Dam No. 2, the North Fork contributes very little to the mainstem's sediment load.

River bed aggradation is progressively increasing flooding of the Skokomish Valley. As the river bed fills with gravel, the channel capacity is reduced causing more frequent overbank floodflows, stream channel braiding, and riverbank erosion. The US 101 and State Highway 106 levees, acting as dams, also contribute to aggradation of the mainstem.

3.2.3.4 Skokomish Estuary

The Skokomish Estuary is formed where the Skokomish River enters Hood Canal. The river splits into a number of distributary channels that flow through brackish and salt water marshes onto a broad, flat, muddy shelf that drops off steeply into Hood Canal. The shelf was formed by deposition of fine-grained sediments at the mouth of the river. The estuary is further described in section 3.4.5.

3.3 Water Quantity and Quality

3.3.1 Water Quantity

3.3.1.1 Project Hydrology

The Skokomish River originates high on the Olympic Range's eastern slope in ONP (figure 3-1). Skokomish River headwaters annually receive over 200 inches of precipitation. On average, Lake Cushman annually receives over 90 inches of precipitation. Precipitation is highest from October to April, with December generally being the wettest month.

The annual discharge pattern of the North Fork upstream of the project is controlled by Pacific storms in early winter, snowmelt during spring months, and baseflow conditions during the summer. Baseflow conditions are supported by groundwater discharge, glacial melt, and snowmelt from higher elevations. Flows below the project are strongly affected by project operations. The U.S. Geological Survey (USGS) maintains a network of stream gaging stations throughout the Skokomish watershed (figure 3-4). Mean annual surface water runoff from the Skokomish River Basin is about 1,245 cfs, with a runoff rate of 5 cfs per square mile (Canning et al., 1988).

Upper North Fork flow is first stored in Lake Cushman. Lake Cushman's full-pool (738-foot elevation) surface area is about 4,058 acres, mean depth is 115 feet, and hydraulic residence time is 307 days. The lake's water level normally fluctuates about 20 to 50 feet annually, cresting in summer and dropping to low pool in fall or winter (Tacoma, 1990). Lake Cushman

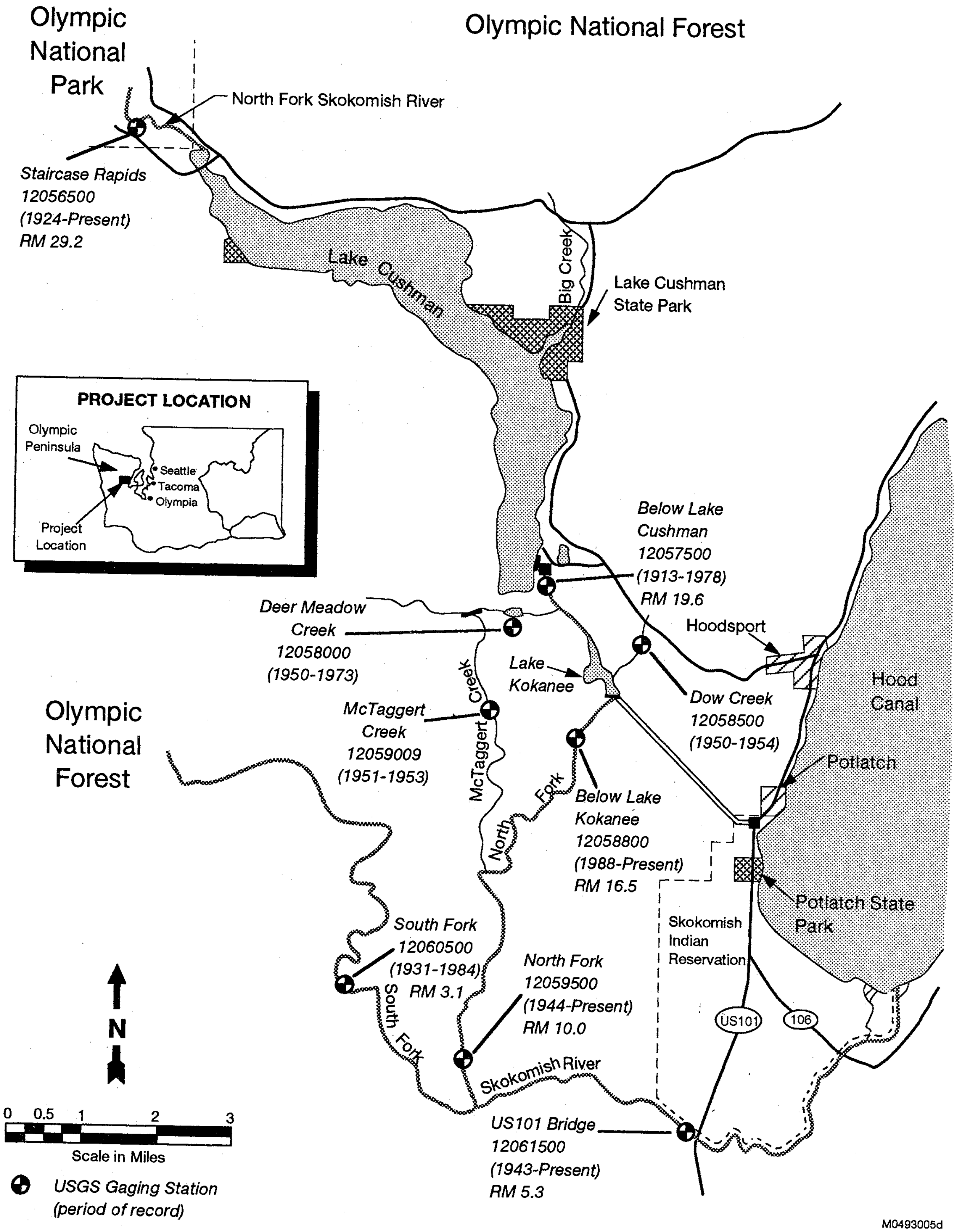

Figure 3-4. Locations of USGS stream gaging stations in the Skokomish River watershed. (Source the staff.)

discharges into Lake Kokanee. Lake Kokanee's surface area is 100 acres and its mean depth is about 80 feet at 480-foot full-pool elevation. The lake rarely fluctuates more than 3 feet per year. At full pool, the lake retains water about 5.4 days (Tacoma, 1990). Since June 1988, a continuous 30-cfs instream flow has been released from about 15 to 20 feet deep in Lake Kokanee to the lower North Fork.

Figure 3-5 presents North Fork flow durations for inflow to Lake Cushman (USGS Station No. 12056500), estimated natural flow (without dams) at the Dam No. 2 site,[1] and discharge upstream of the confluence with the South Fork (USGS Station No. 12059500) for the period of record October 1967 through September 1989 (water years 1968 through 1989).

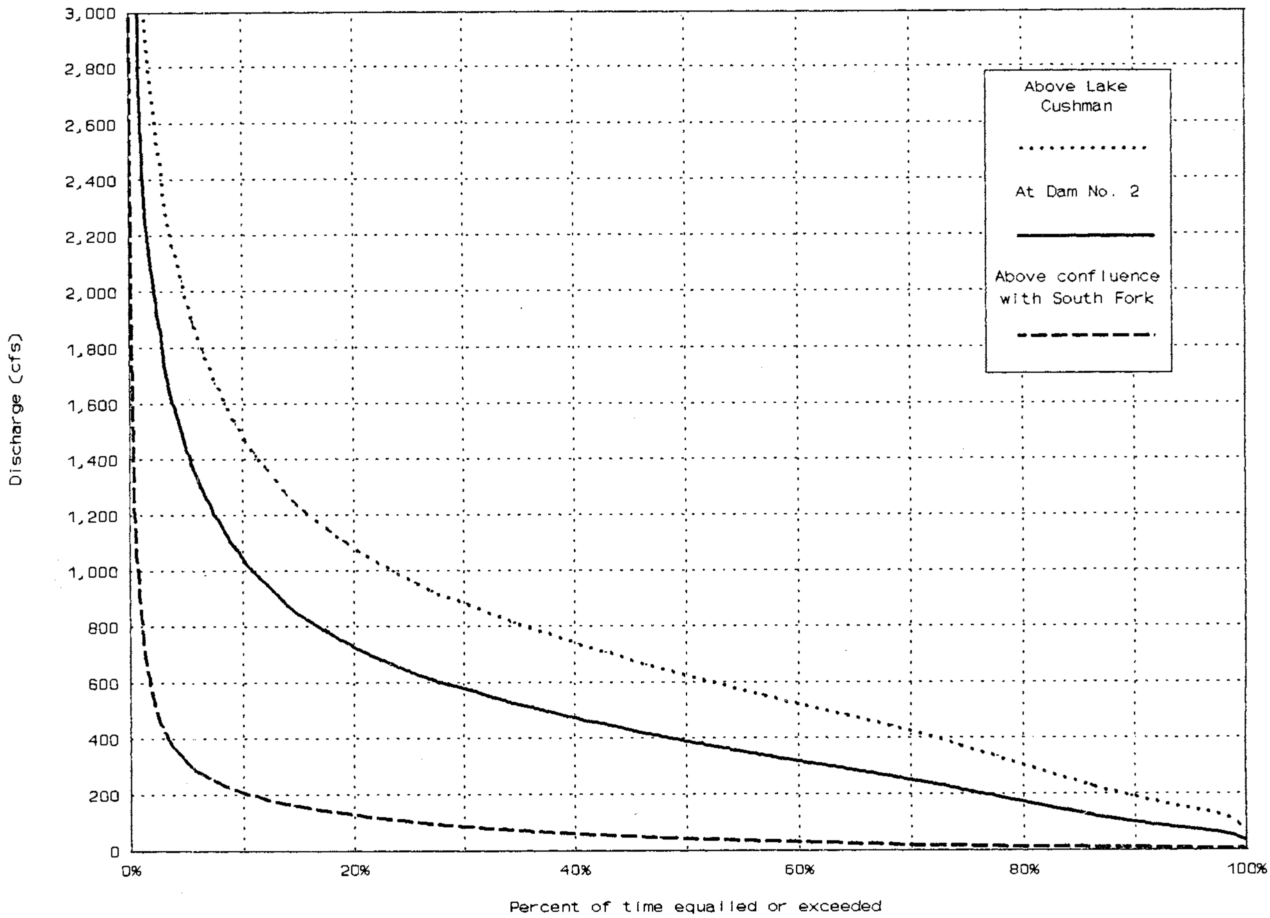

Figure 3-5. North Fork Skokomish River flow duration at three sites from October 1967 through September 1989.

For the 1968 to 1989 period of record, the mean annual discharge of the North Fork upstream of Lake Cushman was approximately 528 cfs. The estimated mean annual discharge at Dam No. 2 under natural flow conditions (no dams) was 784 cfs. The mean annual discharge of the North Fork upstream of the confluence with the South Fork was approximately 98 cfs.

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1 This estimate is based on a regression equation for converting daily flows above Lake Cushman (USGS Station No. 12056500) to natural flows at the Dam No. 2 site provided by Tacoma (1993a).

Prior to 1988, there was no flow in the river downstream from Dam No. 2 except when the dam spilled as a result of floods or project maintenance. Portions of the river above McTaggert Creek were often essentially dry during late summer. Downstream from the confluence with McTaggert Creek, flows in the river were similar to flows in the creek.

Average discharge rates on the mainstem, as measured at the gage at RM 5.3, are highly variable. Mean minimum discharges range from approximately 160 cfs from July through October, to 750 to 1,000 cfs from December through March. Mean monthly discharges range from approximately 300 cfs from July through September to approximately 2,150 cfs from December through February (Canning et al., 1988). The Skokomish River experiences a bimodal peak flow distribution. Its greatest discharges occur from December through January, caused by winter rains, and in late spring, caused by snowmelt. Mean maximum flows in December and January range from 4,500 to 5,500 cfs (Canning et al., 1988).

3.3.1.2 Flooding

Extreme precipitation events have caused peak flows as high as 36,800 cfs (December 19, 1994) on the mainstem. Overbank flows and flooding in the lower Skokomish Valley are known to occur at flows of 4,650 cfs or more. Upstream of the US 101 bridge, the river can contain flows between 8,000 to 9,000 cfs before flooding (Canning et al., 1988). From records of flow obtained since 1943 at the US 101 gage, some flooding is estimated to occur in this reach on a yearly average of 1 day in November, 3 days in December, 3 days in January, 2 days in February, and 1 day in March (Canning et al., 1988). In only 2 water years since 1943 (1946 and 1962) was overbank flooding upstream of the US 101 bridge considered insignificant at the times of peak annual flows (Canning et al., 1988). The highway fill acts as a dam, lessening the flooding of some downstream properties, and contributing to the frequency, severity, and/or duration of flooding of nearby upstream properties (Canning et al., 1988).

Flooding on the Skokomish Indian Reservation lands is common and usually occurs during periods of heavy rainfall in winter. Floodflows are characterized by rapid increases in flows within a few hours, followed by decreases to small flows within 2 or 3 days. Several floodflows occur each year, often in close succession. Because of its low land elevation, flooding on the reservation is more frequent and more severe than in the Skokomish Valley upstream of the reservation boundary.

Table 3-3 shows estimated peak discharges at selected USGS gage stations on the Skokomish River system. Note that even the 1-year recurrence interval flood at the US 101 bridge exceeds the estimated channel capacity (4,650 cfs).

3.3.1.3 Water Rights

Tacoma currently diverts up to about 2,700 cfs from the North Fork for power generation. Downstream agricultural and domestic users also make minor diversions. Tacoma has been required to release 30-cfs MIF from Dam No. 2 to the lower North Fork since 1988. The remaining flow from the upper North Fork and a portion of McTaggert Creek's water is diverted out of the drainage basin for power production. The Cushman Project diverts between 35 and 42 percent of the total annual flow of the Skokomish River system, which is discharged directly into Hood Canal near the town of Potlatch.

Table 3-3. Estimated flood discharge throughout the Skokomish River.[1]

USGS gage number, location	Peak discharge (cfs) based on log-Pearson III analysis (exceedence probability/recurrence interval, years)					
	0.99/1	0.50/2	0.20/5	0.10/10	0.04/25	0.01/100
12056500 Staircase Rapids	2,168	4,041	9,666	12,522	16,745	24,430
12057500 Below Lake Cushman	1,638	8,056	11,162	12,668	14,083	15,483
12059500 North Fork mouth	486	2,185	3,671	4,791	6,340	8,893
12060500 Lower South Fork mouth	4,376	11,685	15,767	18,235	21,118	25,002
12061500 US 101 bridge	6,619	15,579	20,027	22,574	25,430	29,094

1 Source: Williams et al., 1985.

In 1922, Tacoma was granted the right to divert water from the North Fork for power generation by the Washington Supreme Court (Tacoma v. State, 122 Wash. 448 [1922]) and holds six state water right certificates associated with Cushman Project operation (table 3-4). Tacoma's 1922 power generation water rights (1,000 cfs) are based on the mean annual flow of the river. WDOE requires power generation water rights based on peak withdrawal rates, rather than the average. According to WDOE, the maximum hydraulic capacity of the project exceeds Tacoma's existing state water rights. Tacoma, while asserting that the 1922 condemnation of rights associated with North Fork water fully authorizes it to take the entire flow of the river, agreed to file new applications to divert up to 2,500 cfs from the North Fork for power generation at the Cushman Project (applications S-2-27419 and S-2-27420). The Tribe has formally protested the granting of these rights and has requested an Environmental Impact Statement (EIS) to support the state's decision. WDOE has accepted the applications, but has not yet granted a permit or certificate to Tacoma for these additional water rights.

As a result of turbine runner replacement, Tacoma has recently increased the hydraulic capacity at Powerhouse No. 1 and plans to increase the capacity of Powerhouse No. 2 in the future (Tacoma, 1993b). Because of the planned modification of Powerhouse No. 2, Tacoma may apply to utilize an additional 450 cfs of water in the future, increasing its total water rights, under the state's new policy, to 2,950 cfs.

Table 3-4. State of Washington water rights held by the City of Tacoma for the Cushman Project.[1]

Type of water right	WDOE Certificate No.	Project facility	Amount	Existing capacity
Storage	706	Lake Cushman	190,000 acre-feet	453,350 acre-feet
Storage	1528	Lake Kokanee	7,300 acre-feet	8,000 acre-feet
Diversion	656	Powerhouse No. 1 generation	1,000 cfs	2,500 cfs
Diversion	1527	Powerhouse No. 2 generation	1,000 cfs	2,700 cfs
Diversion	5548	McTaggert Creek Diversion	5 cfs	up to 30 cfs
Diversion	1258	Powerhouse No. 2 cooling and domestic	0.5 cfs	Unknown

1 Source: the staff, adapted from Tacoma, 1977.

3.3.2 Water Quality

The entire Skokomish River system is classified by WDOE as Class AA "extraordinary" waters. Table 3-5 lists WDOE water quality standards for Class AA waters. Water quality is similar upstream of and downstream from the project. Except for turbidity and suspended solids, water quality indicators vary little over time and comply with state water quality standards. Turbidity and suspended solids increase, both upstream and downstream, during low flows and high runoff periods.

In 1994, the North Fork from Dam No. 2 to its confluence with the South Fork was included on Washington State's list of water quality-limited waters for having inadequate instream flows for fish habitat and for exceeding temperature standards (WDOE, 1994). Temperature standard violations are based on a 1985 water quality study that indicated elevated temperatures below Dam No. 2 (Kendra, 1985). Reduced water volumes are subject to the warming influence of ambient air temperatures (Wampler, 1980). The 30-cfs instream flow implemented in 1988, however, now mitigates lower North Fork water temperatures, thus meeting state standards.

USGS, WDOE, and Tacoma have collected substantial water quality data in the study area. USGS has several sites with a historic record (table 3-6). A summary of 1989-1991 data was used to describe existing conditions; however, 1990 project data are not representative of normal project operating conditions. Lake Cushman water levels were unusually low during spillway construction between August 1989 and December 1990. Beginning in January 1991, Tacoma assumed more typical operation, and water quality monitoring resumed.

3.3.2.1 Temperature

During 1989, water temperatures at Staircase Ranger Station varied from about 0°C during December to 11°C during mid-summer. Water temperatures during 1989 were comparable to the historic temperature record, although summer and fall temperatures were slightly cooler than most years. Water temperatures upstream of the project comply with state standards.

Table 3-5. Washington State Class AA quality standards for fresh surface water.[1]

Water quality indicator	Class AA standards
Fecal coliform	100 colonies/100 ml[2] geometric mean; <10% of samples >200 colonies
Dissolved oxygen	9.5 mg/l[3]
Total dissolved gas	≥ 110% saturation
Temperature	16°C caused by human activities
	When natural conditions exceed 16°C, no temperatures will be allowed that will increase the receiving water temperature by >0.3°C
	Temperature increases caused by point source activities shall be ≤ t=28/(T+7) where "t" represents the maximum permissible temperature increase measured at a mixing zone boundary and "T" represents the background temperature
	Incremental temperature increases resulting from nonpoint source activities shall not exceed 2.8°C
pH	6.5 to 8.5
Turbidity	≤ 5 NTU[4] over background turbidity

1 Source: WAC, 1992.
2 ml — milliliter
3 mg/l — milligrams per liter
4 NTU — Nephelometric turbidity units

Downstream, Lake Cushman's relatively large surface area and 307-day hydraulic retention time expose water to sunlight, raising reservoir temperatures. Lake Cushman exhibits distinct temperature stratification during summer months (figure 3-6). Water column temperatures range from about 6°C near lake bottom to 18°C on the lake's surface. Mixing begins during fall when surface temperatures cool and deep water temperatures warm. The lake is well-mixed by December, and temperature is about 5°C throughout the water column. Seasonal temperature stratification is a natural process in temperate North American lakes.

Water temperature immediately below Dam No. 1 in the upper end of Lake Kokanee is highly variable, changing as much as 9.0°C in a 2-hour interval. Sudden powerhouse starts release cold water from the 600-foot elevation of Lake Cushman. During powerhouse shut-downs, warmer surface water from Lake Kokanee backflows into the canyon, causing reciprocal rapid temperature increases (Tacoma, 1990). Nevertheless, Lake Kokanee exhibits nearly uniform temperatures throughout the water column most of the year and stratifies only during the summer (figure 3-7). Temperatures range from 5 to 16°C from reservoir bottom to surface. Frequent or high flows from Lake Cushman can affect Lake Kokanee water temperature, disrupting the smaller lake's stratification process. These conditions do not normally occur during typical project operation but were observed during Lake Cushman's extended draw-down procedure during 1989. The highest Lake Kokanee temperature was about 16°C.

Unlike Lake Cushman, Lake Kokanee does not cause rapid temperature fluctuations downstream. Lake Kokanee's mixing characteristics, stable water levels, and continuous 30-cfs minimum release moderate downstream temperatures. Before the 30-cfs minimum flow release

Table 3-6. Skokomish River and North Fork water monitoring sites and data collection periods.[1]

Site	River mile	Record period	USGS station number
Mainstem Skokomish River			
US 101 bridge	5.3	1943-present	12061500
Lower North Fork			
South Fork juncture	9.0		
Gaging station	10.0	1944-present	12059500
McTaggert Creek	13.3		
Upstream of McTaggert Creek	14.1	1989-1991	Harza Station
Downstream from Lake Kokanee	16.5	June 1988-present	12058800
Lake Kokanee			
Dam No. 2	17.3	1974-82	
Lake near dam		1989-1991	12058600
Lake Cushman			
Dam No. 1	19.6	1913-present	12057500
Lake near dam		1974-82 1989-1991	12057000
Lake Cushman inlet	28.0	1913-30 1941-78	
Upper North Fork			
Staircase Rapids	29.2	1924-present	12056500

[1] Source: the staff, adapted from KCM, Inc., 1993.

began, the project increased lower North Fork water temperatures (Wampler, 1980). Now, with 30-cfs instream flow, temperatures in the lower North Fork approach natural seasonal patterns observed upstream of the project at Staircase Ranger Station. Groundwater inflow into the lower North Fork also moderates lower North Fork water temperature upstream of McTaggert Creek. Lower North Fork water temperatures vary during the year from about 4 to 12°C, complying with the state standard (Tacoma, 1990).

Mainstem water temperatures range from 5°C during winter to about 11°C during summer.

3.3.2.2 Dissolved Oxygen

Study area surface waters are typically well-oxygenated and rarely drop below the 9.5 milligrams per liter (mg/l) state standard. Both lakes exhibit seasonal dissolved oxygen (DO) stratification. During 1989, DO concentration in both lakes ranged from about 4 to 14 mg/l and, in the lakes' upper 70 feet, rarely dropped below 9 mg/l. DO concentration is usually less than 8.0 mg/l at depths greater than 100 feet in Lake Kokanee.

Lower North Fork DO concentrations are typically greater than 10.0 mg/l. Dam No. 2 disperses flow down the spillway where DO concentrations equilibrate with the atmosphere. Because of this equilibrating mechanism, water below Dam No. 2 is oxygen-saturated and has little supersaturation potential when flows are less than 100 cfs (Tacoma, 1989).

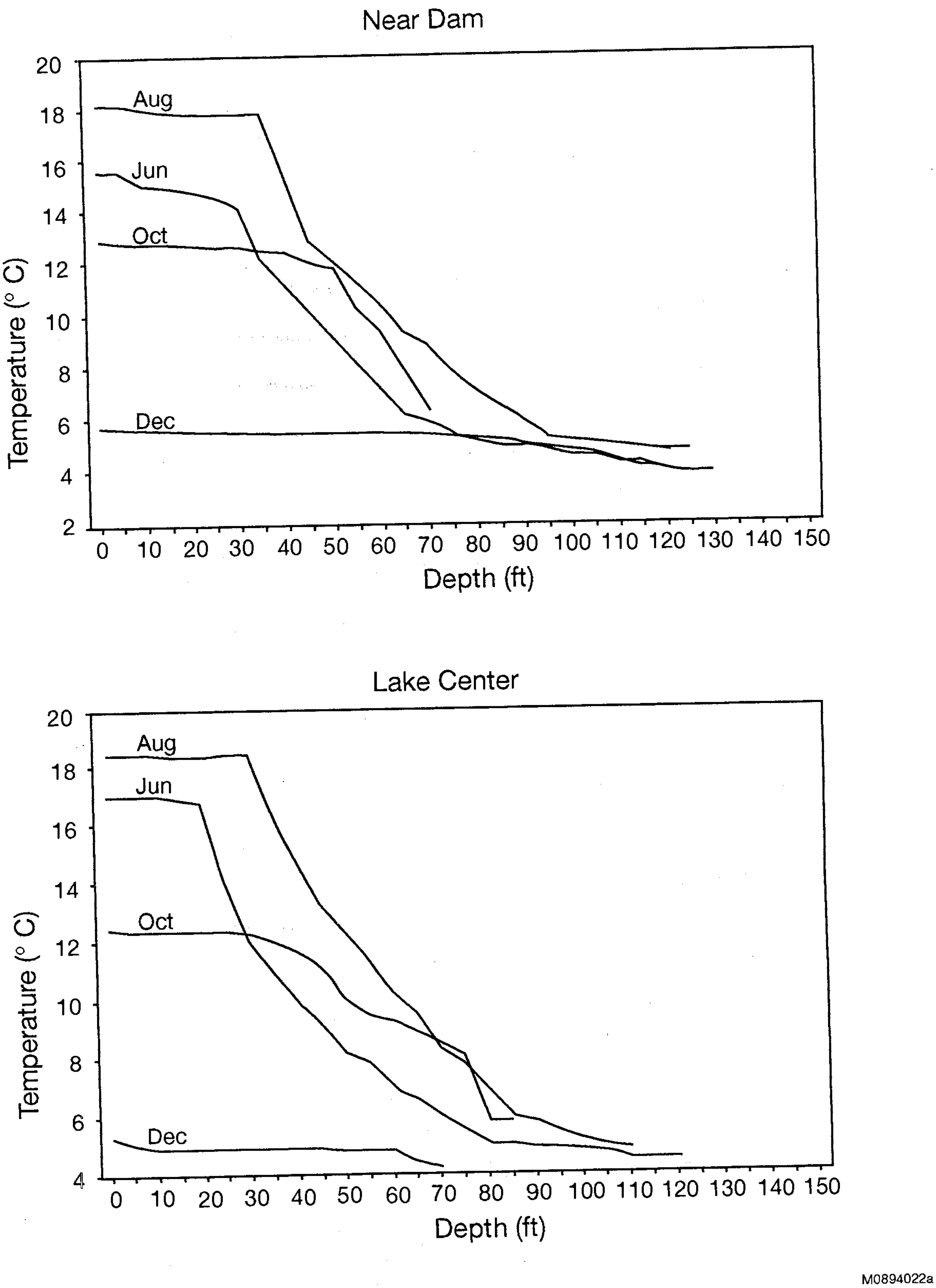

Figure 3-6. Lake Cushman temperature stratification patterns during 1989. (Source: Tacoma, 1990.)

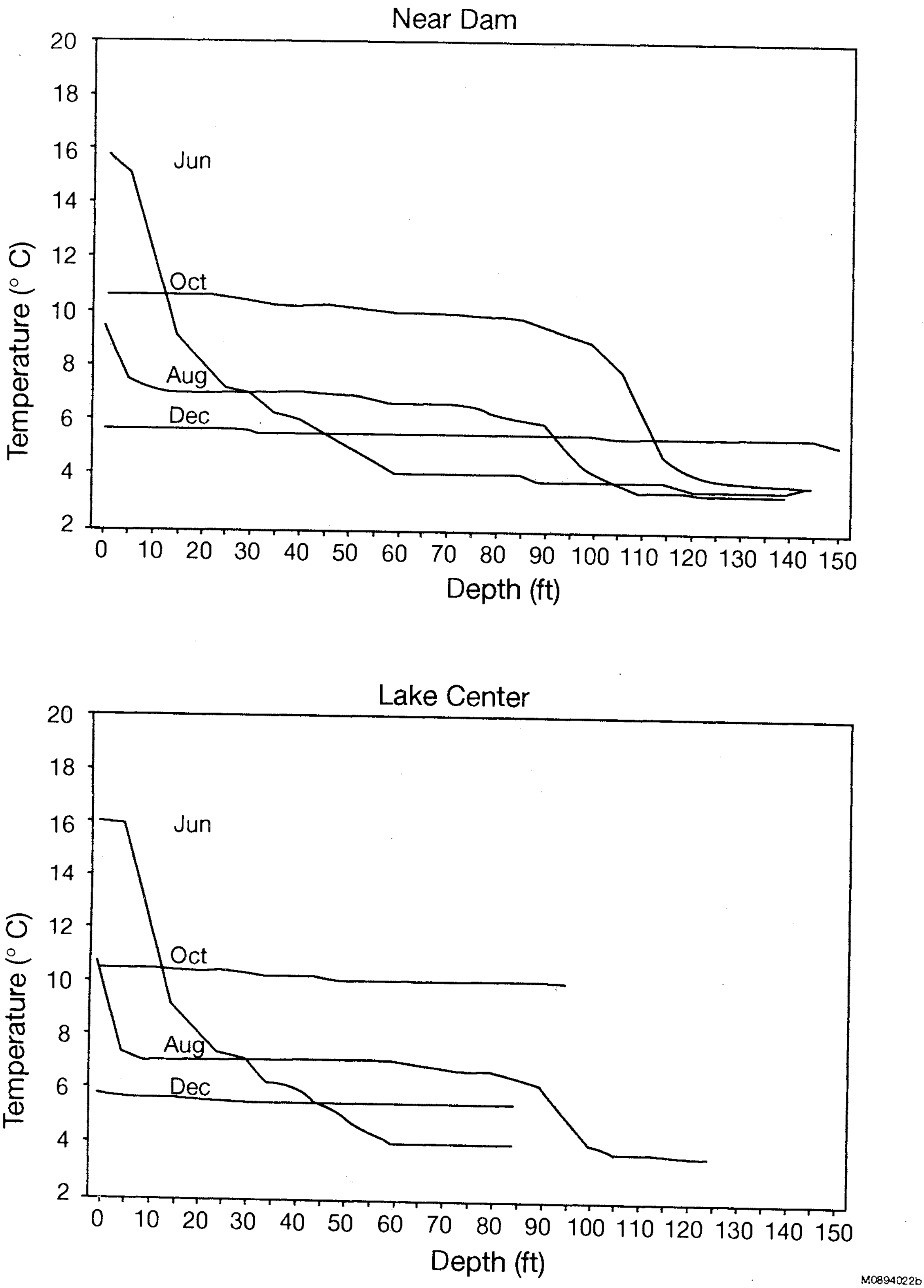

Figure 3-7. Lake Kokanee temperature stratification patterns during 1989. (Source: Tacoma, 1990.)

Mainstem DO concentration is usually 9.6 mg/l or greater and was below the 9.5 mg/l standard only once when a 9.0 mg/l concentration was measured.

3.3.2.3 Other Water Quality Indicators

Mainstem suspended solids concentrations, and thus turbidity, are closely linked with river flow rates. When flows are less than 5,000 cfs, suspended solids concentrations and flow have a linear relationship. Suspended solids increase to about 50 mg/l at 5,000 cfs. When flows are greater than 5,000 cfs, suspended solids become highly variable, ranging up to 369 mg/l at 6,560 cfs (Canning et al., 1988). The South Fork is the source of most mainstem turbidity; the project reservoirs are a sediment sink and rarely spill to the North Fork. The pH values range from 6.7 to 7.8, thus meeting WDOE standards; pH was not correlated to seasonal variation or any other influences (Tacoma, 1992a).

3.4 Aquatic Resources

The Skokomish River's fishery and estuary resources are a substantial component of Hood Canal's important regional fisheries. The river's fisheries are commercially and recreationally valuable and are strongly supported by hatchery production programs.

3.4.1 Anadromous Fish

Eight anadromous salmonids are found in the Skokomish River, including five salmon species (chinook, chum, coho, pink, and sockeye) and three trout species (steelhead, sea-run cutthroat, and Dolly Varden). Anadromous fish runs occur throughout the year in the Skokomish River (figure 3-8). Because the Skokomish watershed is considerably larger than other Hood Canal watersheds, it currently and has historically produced more anadromous fish than the other Hood Canal tributaries. Hatchery-produced fish dominate chinook, chum, coho, and steelhead spawning runs.

There are no reliable records estimating the lower North Fork's pre-project anadromous fish production and interested parties disagree on the historical geographic upstream limit of North Fork anadromous spawning. The Tribe claims that, of all the Hood Canal tributary streams, the Skokomish River historically had the greatest number and variety of anadromous fish (Skokomish Indian Tribe, 1994). According to tribal accounts, anadromous fish used the river during all seasons. Spring-run chinook entered the river during April and were followed by summer steelhead, sockeye, summer/fall chinook, early chum, and pink salmon. Later in the season the river supported large coho, late-normal chum, and winter steelhead runs.

There were substantial sockeye runs before the dams were built (Wampler, 1980; James, 1995; Lichatowich, 1992). Chinook, sockeye, coho, and steelhead adults almost certainly could have passed upstream of the lower falls (RM 15.6) and young sockeye probably reared in the old Lake Cushman, now inundated by the existing Lake Cushman. Chum and pink salmon are not inclined to leap and are usually found in lower-gradient, mainstem reaches of Olympic Peninsula rivers. Due to their propensity for limited sojourns into freshwater, it is doubtful that pink salmon or chum migrated above the lower falls.

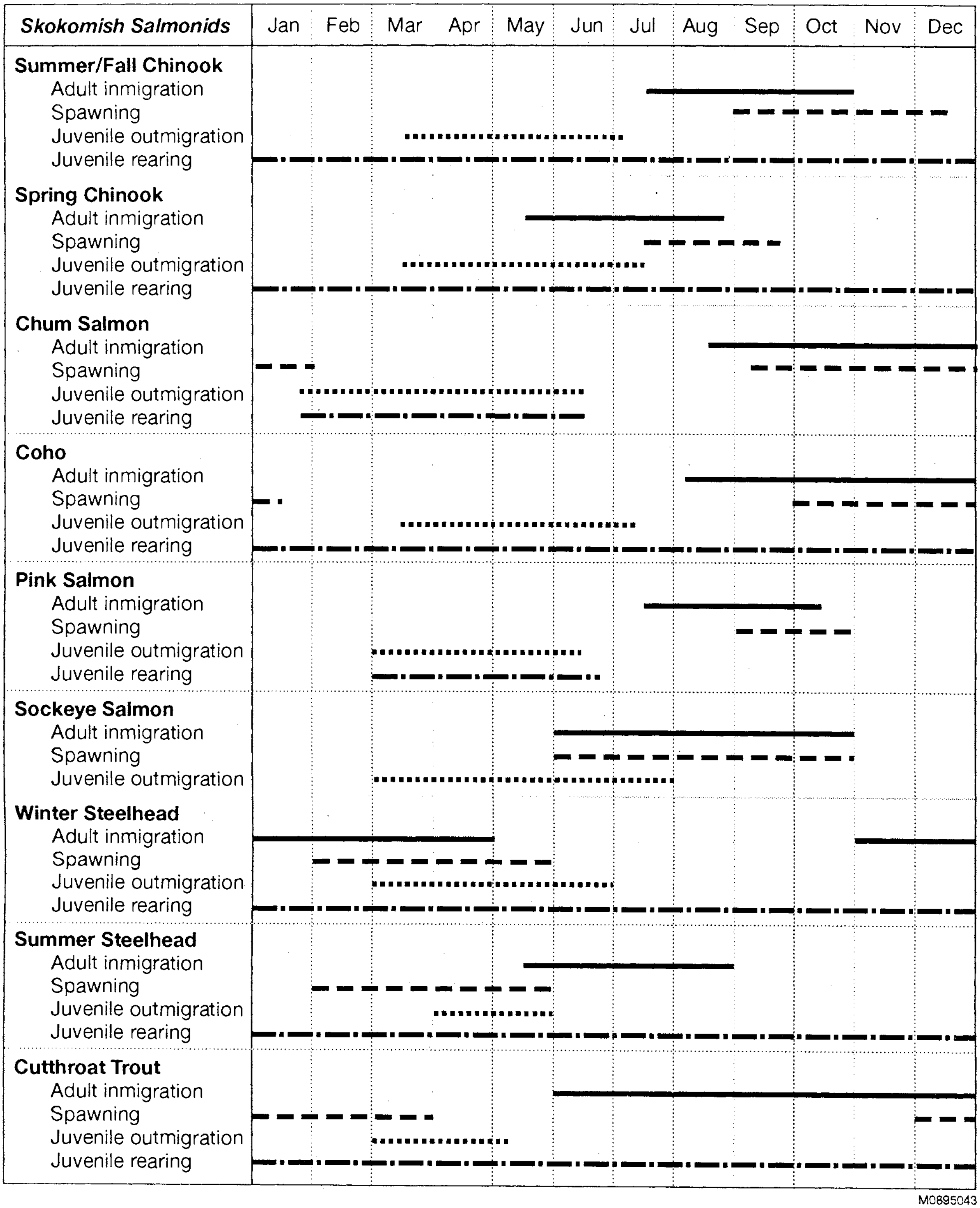

Figure 3-8. In-river life cycle stages of Skokomish salmonids. (Source: the staff, adapted from Williams et al., 1975; KCM, 1993; and Tacoma, 1991.)

WDF (1957) documented anadromous fish population declines in Hood Canal during the early 1920's, before Cushman Project construction. In response to the decline, WDF closed the lower two-thirds of Hood Canal to commercial fishing, after which, the runs increased until the dams were built.

Dam construction eliminated anadromous fish access to upstream spawning and rearing habitat and considerably decreased North Fork and mainstem flow. Chinook runs were dramatically reduced. North Fork spring-run chinook may have been eliminated and fall-run chinook were greatly diminished (WDF, 1957). In the late 1970s, Hood Canal sport catches dropped off dramatically. This decline has been attributed to stream habitat destruction, driftnet fishing on the high seas, increased competition from Indian and non-Indian commercial fisheries in Washington waters, and an exploding fish-eating mammal population in Hood Canal.

In 1926, Dam No. 1 construction blocked anadromous fish passage to habitat upstream of RM 19.6 and in 1930 Dam No. 2 construction blocked fish passage above RM 17.3. By an agreement with the state, signed in 1959, Tacoma mitigated chinook and coho losses by building George Adams Hatchery. Between 1930 and 1988, low summer flows in the lower North Fork also diminished habitat and excessively high winter flows scoured spawning gravels from the stream bottom (Williams et al., 1985). Since 1988, a 30-cfs minimum flow release from Dam No. 2 has improved lower North Fork fish habitat. Tacoma's IFIM analysis indicates that with 30-cfs flow, there are about 20 hectares of total habitat in the lower North Fork (Tacoma, 1993b).

3.4.1.1 Chinook Salmon

The Skokomish River is important to chinook salmon because of their habitat preference for rivers and tributaries; chinook typically spawn and rear in large rivers. The mainstem, South Fork, Vance Creek, and lower North Fork contain suitable chinook spawning habitat.

Low flow in the Lower North Fork limits chinook production (Williams, et al., 1975). Typical lower North Fork spawning populations have ranged from 50 to 150 adults, depending on streamflow. Since 1988, when Tacoma began the 30-cfs minimum flow release from Dam 2, chinook spawning density in the North Fork has increased, as measured by the number of spawning nests (redds) per mile. Before 1988, 10 redds, or about 2.3 per mile, was the highest number counted between RM 9.0 and 13.3 (4.3 miles). In 1989, 10 redds per mile were recorded in the same segment (Tacoma, 1990). The average, however, is still lower than the 15-redds-per-mile density average reported for other Washington coast streams (WDF, 1981).

Although a spring chinook run used the South Fork during the 1950's, the Skokomish spring chinook is now considered nearly extinct (Nehlsen et al., 1991). Tribal managers believe a Skokomish spring chinook stock still exists, however, state technical staff disagree (WDF et al., 1993).

Figure 3-8 shows in-river life cycles of spring and fall chinook salmon. Fall chinook adults enter the Skokomish in August with spawning continuing into December (Mason County, 1993). WDF spawning surveys indicate that most spawning occurs on the North Fork (Mason County, 1993). After hatching and emerging in the spring, juvenile salmon remain in the river for up to 18 months (Lusch, 1985). Chinook stocks in the mainstem, South Fork, and lower North Fork may also use estuarine habitat to rear before entering Hood Canal (section 3.4.6; Levings et al., 1988; Levy and Northcote, 1982).

Fall chinook returns (escapement plus harvest) from 1970 through 1993 trace a cyclical pattern and are typically fewer compared to chum and coho salmon (figure 3-9). (Escapement is the number of adult fish that return to their natal stream after fishery harvest is subtracted. During the last cycle, chinook run sizes increased to a high of about 15,000 fish in 1988 and then declined to roughly 2,000 fish in 1992 and 1993.

3.4.1.2 Chum Salmon

Among Hood Canal's major rivers (Dosewallips, Duckabush, Hamma Hamma, and Skokomish), the Skokomish River supports the largest chum runs. The mainstem, South Fork, Vance Creek, and lower North Fork are important chum production areas (Williams et al., 1975).

Chum are the most abundant anadromous species spawning in the lower North Fork, ascending as far as McTaggert Creek, and in recent years have dominated populations of returning salmon (figure 3-9). Spawning is particularly concentrated in the lower 3.5 miles of the North Fork's main channel. Typical spawning runs in this area are comprised of 4,000 adults (Williams et al., 1975). Figure 3-8 shows the in-river life cycle of chum salmon.

Skokomish chum salmon are composed of three stocks with overlapping occurrence in the river system. The early run chum population has declined in the last 25 years; the stock currently contributes minimally to the Skokomish chum salmon runs. Two normal run stocks are present, early-normal (September and October spawning) and late-normal (November through January spawning). The Skokomish River chum spawning run is almost entirely late-normal stock.

3.4.1.3 Coho Salmon

The Skokomish River provides abundant coho spawning and rearing habitat, and although the lower North Fork typically lacks large wood debris that provides cover from predators, coho salmon are the lower North Fork's second most abundant anadromous species (Tacoma, 1990). Vance Creek on the South Fork and McTaggert Creek on the lower North Fork are important coho-producing streams (Williams et al., 1975). Spawning populations have ranged from 400 to 2,000 fish. Juvenile coho rear in all accessible areas of the North Fork, South Fork, mainstem, and their tributaries and generally remain in the river at least 1 year before migrating to Hood Canal. Figure 3-8 shows the in-river life cycle of coho salmon.

The Hood Canal wild coho stocks are managed as a primary management unit. Because of chronically low escapement, commercial fishing for coho was not permitted in the Hood Canal during the 1992 management period (September 6 through October 31).

3.4.1.4 Pink Salmon

During odd-numbered years, pink salmon are the predominant salmon run in the Dosewallips, Duckabush, and Hamma Hamma Rivers where most Hood Canal pink salmon production occurs. Historically, Skokomish River pink salmon populations have always been lower than other major Hood Canal stream populations. Nehlsen et al. (1991) indicate that loss of adequate freshwater habitat has placed Skokomish River pink salmon at high risk of extinction. Escapement has declined to 100 or fewer fish (Nehlsen et al., 1991).

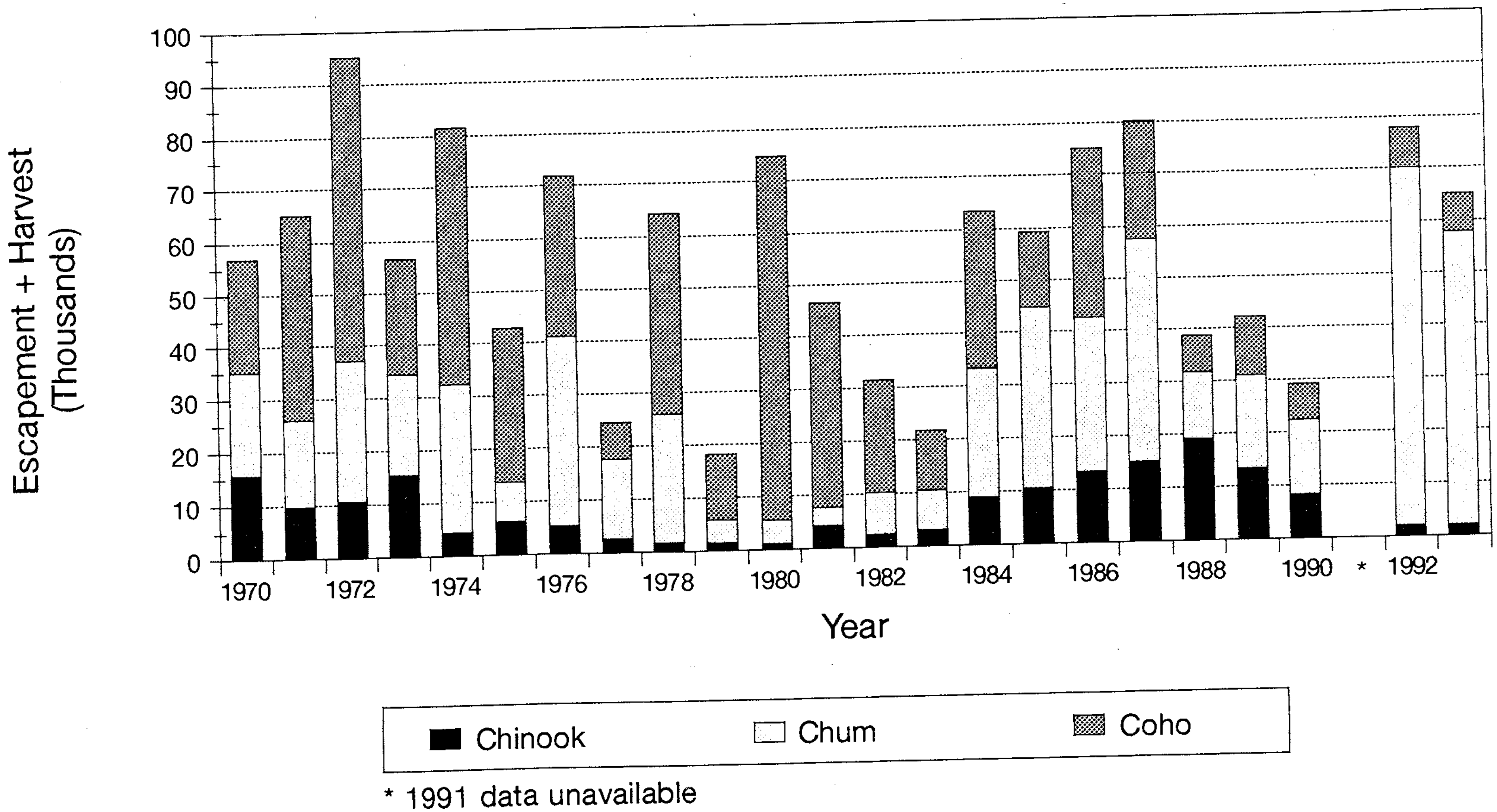

Figure 3-9. Skokomish River chinook, chum, and coho runs from 1970-1993. (Source: the staff, adapted from KCM, Inc., 1993 and WDFW, 1995.)

Pink salmon spawn primarily in the lower mainstem. Williams et al. (1975) indicate that glacial-fed streams appear to be required for pink salmon reproduction and that the quality of estuaries and marine waters of Hood Canal is a major factor in survival. Following incubation and fry emergence from the gravel, the juveniles immediately drift seaward. Downstream movement occurs from mid-February to the first part of June (Williams et al., 1975).

3.4.1.5 Sockeye Salmon

Historically, there were substantial sockeye runs before the Cushman Project dams were built (Wampler, 1980; James, 1995; Lichatowich, 1992). Sockeye require a lake to complete their reproductive cycle and, since construction of the Cushman dams, the requisite lake environment has been unaccessible. As a result, sockeye occur at very low levels in the Skokomish River, although adult sockeye are occasionally caught in migrant traps.

3.4.1.6 Steelhead Trout

The Skokomish River supports both summer and winter steelhead stocks, however, both populations are declining and the winter stock is heavily supported by hatchery production (Mason County, 1993). Steelhead spawn in a wide variety of substrate sizes from fine gravel to medium-sized cobble. Juveniles use moderate gradient runs, riffles, and boulder pocket waters in tributaries and large mainstem rivers (Gibbons et al., 1985). While the lower North Fork contains suitable steelhead spawning habitat, because juvenile steelhead rear in freshwater for up to 2 years, habitat conditions affecting juvenile rearing (including annual flow fluctuations and competition with other resident species) affect steelhead more substantially than other anadromous fish.

Nehlsen et al. (1991) lists Skokomish River winter steelhead as a species of special concern. The 1992 Washington State Salmon and Steelhead Stock Inventory (WDF et al., 1993) lists summer steelhead with unknown status and Skokomish winter steelhead as depressed based on chronically low spawner escapement. Lower North Fork steelhead are primarily winter steelhead with spawning runs occurring from November through April and hatchery fish return peaks from December through January. Figure 3-8 shows in-river life cycles for winter and summer steelhead trout.

3.4.1.7 Sea-Run Cutthroat Trout

The history of Skokomish River sea-run cutthroat trout is not known. Data on natural sea-run cutthroat trout populations in the lower North Fork and its tributaries is limited but indicates that cutthroat are following the regional declining population trend. Lower North Fork and mainstem spawning substrate quality is fair.

Figure 3-8 shows the in-river life cycle of cutthroat trout. Juvenile rearing usually occurs in small tributaries, often in pool habitat similar to that favored by coho. Generally, Puget Sound stocks leave their natal streams earlier (most at age 2) than do fish from coastal areas (age 5). In the marine environment, adults remain within 50 km of their natal stream, and most do not move into deep water.

Hanson (1977) found that when cutthroat and steelhead juveniles were placed in the same habitat, steelhead had the advantage competing for selected habitat. He also noted that in Idaho, researchers found no cutthroat and steelhead trout populations occupying the same area. Phillips et al. (1980) found that when cutthroat, coho, and steelhead juveniles were present together in the Skagit River, cutthroat were least abundant.

3.4.1.8 Dolly Varden

Dolly Varden are widely distributed throughout the Olympic Peninsula and might occur in the Skokomish River. Recent sampling records, however, do not indicate their presence in the Skokomish River.

Dolly Varden need undisturbed, clean, cold, silt-free waters. Activities related to forest management, primarily logging and road building, are considered to be responsible for habitat degradation affecting this species (WDW, 1992). WDF (1992) intends to manage all existing Dolly Varden to ensure their continued existence, enhance their numbers, and preserve their intrinsic genetic and ecosystem value.

3.4.2 Hatchery Production of Anadromous Fish

To determine chinook and coho losses from project construction and operation, WDF reviewed project effects in 1957 and determined that annual hatchery production of 1,500,000 fall chinook fingerlings and 585,000 coho yearlings would fully compensate for chinook and coho losses. To mitigate project effects and to obtain the state's full release from further fisheries mitigation claims against the project, Tacoma agreed to contribute to George Adams Hatchery construction and operation. Tacoma provided the land, 75 percent of construction costs, and financial support for annual hatchery operation and maintenance which is tied to an inflation index (Tacoma, 1990). When originally constructed, the hatchery had a 6.75-million egg hatching capacity and rearing capacity for 2 million chinook fingerlings and 1.3 million coho yearlings. Recent hatchery releases to the Skokomish River are shown in figure 3-10.

Since 1966, hatchery production is believed to have dramatically increased the fall chinook catch. Fall chinook hatchery production began with George Adams hatchery operation in 1961. The hatchery uses Purdy Creek (which flows into the mainstem Skokomish River) as the "natal stream" for fall chinook returns and for the majority of plantings.

3.4.3 Resident Fish

Skokomish River and reservoir resident gamefish include kokanee, rainbow, cutthroat, and bull trout; rainbow and cutthroat trout are the dominant species and have always been present throughout the upper watershed upstream of Staircase Rapids. The bull trout population is restricted to Lake Cushman, its tributaries, and the upper North Fork. Lake Cushman also supports a sparse largemouth bass population. Some cutthroat and kokanee might remain in Lake Kokanee because of natural spawning and/or Cushman dam entrainment.

Land-locked chinook salmon spawn in the upper North Fork. Adult chinook from the Lake Cushman population are increasingly observed during upper North Fork spawning adult surveys. These fish might be remnants from the historic spring or fall chinook stocks or hatchery stocks.

Based on surveys conducted in similar Washington rivers, the Skokomish River likely supports other nongame fish populations, including minnows, dace, peamouth, squawfish, suckers, sticklebacks, sculpins, mountain whitefish, and marine species such as flounder and lamprey.

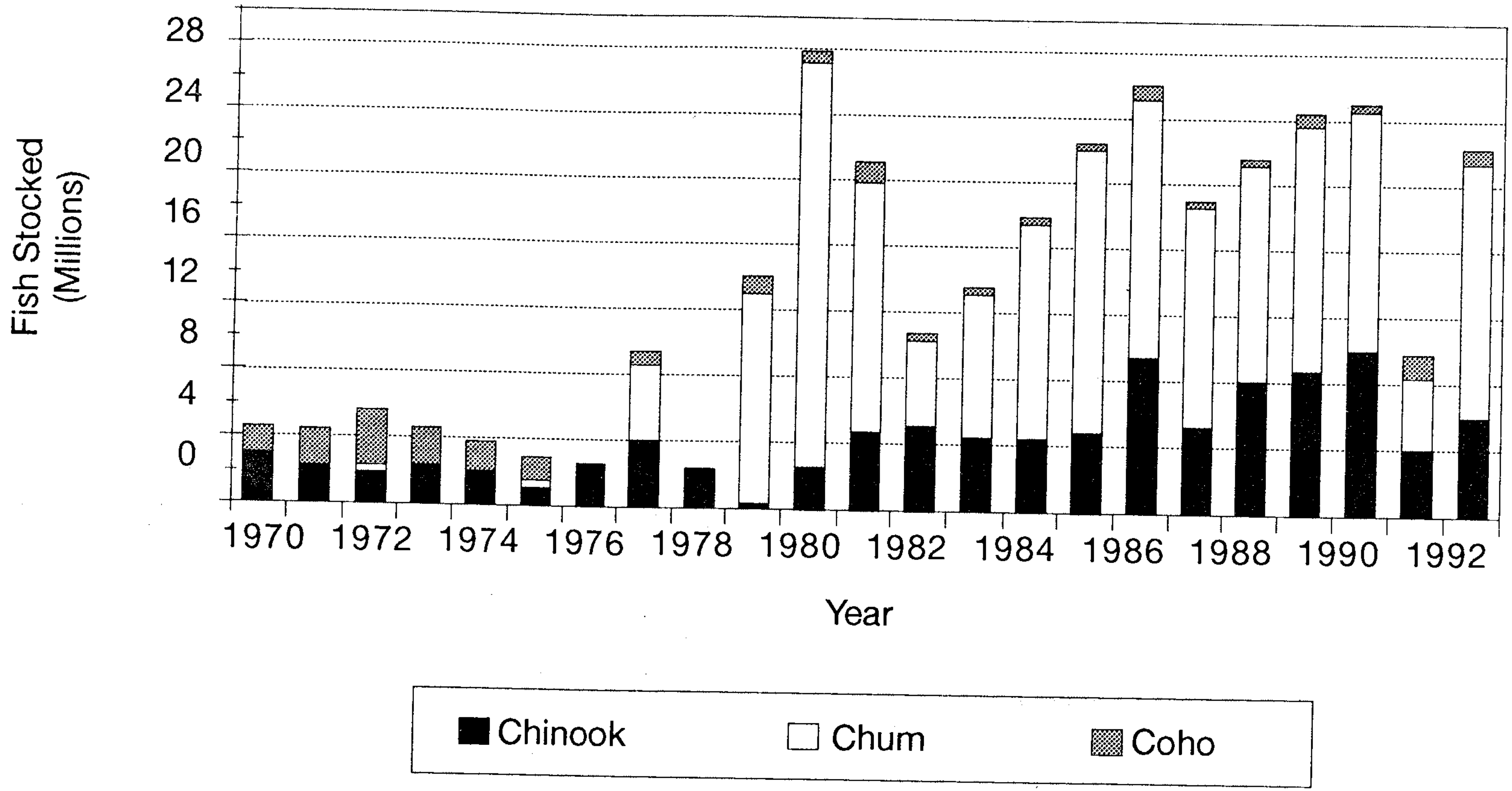

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Figure 3-10. Skokomish River hatchery releases of chinook, chum, and coho salmon. (Source: the staff, adapted from KCM, 1993.)

Staircase Rapids is considered a natural barrier to Lake Cushman's land-locked chinook salmon passage when flows are low. Historically, Staircase Rapids (near RM 29.9) was a formidable barrier and, depending on flow, prevented passage of most anadromous salmonids prior to project construction, thus limiting competition with resident fish. After 1925, project construction isolated the upper North Fork and bull trout and chinook salmon remained in Lake Cushman.

Since the dams were built, resident gamefish have continued to compete with anadromous fish for limited habitat downstream from Dam No. 2. Low instream flows between 1930 and 1988 restricted available habitat and intensified interspecific competition. Since the 30-cfs minimum flow was implemented, more suitable habitat is available. Yet even with a 30-cfs minimum flow, the falls near RM 15.6 restrict anadromous fish passage. Upstream of the falls, therefore, resident rainbow and cutthroat trout have less competition for habitat.

3.4.3.1 Kokanee Salmon

Kokanee are a non-anadromous form of sockeye salmon. Their life history is similar to sockeye salmon except that kokanee migrate from freshwater lakes to tributary streams to complete their life cycles and, therefore, never leave freshwater.

Lake Cushman supports a resident kokanee population that was supplemented by periodic stocking from 1936 through 1983. Kokanee numbers stocked during this period ranged from 40,000 to 3,991,968 (Tacoma, 1990). The magnitude of Lake Cushman natural kokanee production is not known, but a 1989 gill net survey captured adult kokanee, indicating some natural reproductive success (Tacoma, 1990).

Kokanee are generally distributed throughout reservoirs except during mid-summer when they are in deeper waters (Northcote et al., 1964; Echo, 1954). Interspecific competition between kokanee and other resident fish species occurs, but is probably limited because the primary kokanee prey base is not extensively used by other species reported present in Lake Cushman (letter from Willie R. Taylor, Director, U.S. Department of the Interior, Washington, DC, March 29, 1996).

Near-shore areas and the North Fork inlet are the best lake spawning habitats. During November and December, kokanee spawn in shoreline areas with suitable gravel and less than 50 percent slope. Tacoma surveyed the area between 0 and 30 feet deep at minimum pool. Based on gravel and slope criteria, kokanee shoreline spawning habitat is abundant in Lake Cushman at all normal water levels (Tacoma, 1990). Reproductive success partially depends on stable reservoir water levels during spawning and egg incubation. Declining water levels during the critical kokanee reproduction period can expose and desiccate incubating eggs and alevins in these shoreline areas. Typically, Lake Cushman water level elevation drops from about 717 to 712 feet during November, exposing about 88 acres of previously wetted shoreline.

3.4.3.2 Rainbow Trout

Rainbow trout are the principal gamefish found upstream of Staircase Rapids on the upper North Fork. The species is well-adapted to Pacific Northwest stream environments and commonly resides in most watershed areas (lakes, mainstem rivers, and tributaries). A small rainbow trout population also inhabits the lower North Fork.

Lake Kokanee sustains a rainbow trout fishery, supported by catchable-size fish stocking. Natural reproduction in Lake Kokanee, however, is not documented for rainbow trout.

Rainbow trout life history is similar to steelhead. Spawning occurs during spring (April to June) and fry emerge during early to mid-summer depending on temperature (Scott and Crossman, 1973). Reservoir populations might migrate up tributary streams to spawn.

3.4.3.3 Cutthroat Trout

Isolated cutthroat populations might exist in the upper North Fork and its tributaries upstream of Staircase Rapids. Lake Cushman supports a resident cutthroat trout fishery that is supplemented through stocking. Lake Cushman's natural reproduction potential of trout, however, is not known. Tacoma's 1989 electrofishing surveys suggest that lower North Fork resident cutthroat are not abundant. About 8 percent of all yearling trout sampled were cutthroat.

Resident cutthroat trout spawn and fry emerge about the same time as their anadromous counterparts, but they often exhibit very limited movement in the stream. They might spend their entire lives within a few hundred yards of their original spawning area.

Cutthroat trout usually feed on littoral zone benthic invertebrates and surface insects. Frequent and dramatic lake level fluctuations reduce food production and suitable rearing habitat.

Lake Cushman cutthroat trout harvest rates are variable and correlate with stocking rates. Typically, trout catch rates are highest during April and May, then taper off during mid-summer (Tacoma, 1990). Stocked catchable-size cutthroat trout provide a near-shore fishery, lessening resident fish competition.

3.4.3.4 Bull Trout

Lake Cushman supports an endemic bull trout population. Bull trout spawn in the upper North Fork below Staircase Rapids, and until the early 1980's, there was a strong bull trout fishery. Overharvest of vulnerable spawning bull trout in the upper North Fork reduced the population. Since 1982, this population has been protected by closing the river to harvest, and then, during 1986, by closing Lake Cushman to bull trout harvest. Currently, the Lake Cushman bull trout population is the only one in the state known to be increasing (WDW, 1992).

Bull trout spawn in streams, but most growth and maturation occurs in Lake Cushman. They require clean, cold water systems and are susceptible to various forms of habitat degradation, angling pressure on spawning grounds, loss of prey species (juvenile salmon), and interspecific competition with other resident or introduced salmonids. Spawners enter streams during early summer. Spawning activity is concentrated from October through December. Fry are found in shallow, slow backwaters, side channels, and eddies (Shepard et al., 1984).

The Lake Cushman bull trout population is classified as a "no immediate risk population" (WDW, 1992). Nevertheless, bull trout is listed as a Category 1 species found warranted for listing under the federal Endangered Species Act. Species whose populations have declined in abundance in recent years receive this designation and require management to prevent them from becoming threatened. FWS is currently evaluating the bull trout's status in four states, including Washington.

WDF (1992) intends to manage all existing bull trout to ensure their continued existence, enhance their numbers, and preserve their intrinsic genetic and ecosystem value.

3.4.4 Entrainment

Powerhouse No. 1 and No. 2 intakes are not screened. The Powerhouse No. 1 intake is located at a depth of 138 feet in Lake Cushman, which makes substantial entrainment unlikely; because of temperature and DO preferences, fish generally reside in upper, warmer layers of large, deep reservoirs. The Powerhouse No. 2 intake is located at a depth of about 35 feet in Lake Kokanee. Turbine mortality tests during 1960 and 1961 found average mortalities as high as 48 percent of young fish passing through the turbines (Tacoma, 1991c).

3.4.5 Tailrace Attraction and False Attraction

Fish attracted to tailraces can be physically injured in turbines and draft tubes. Adult salmon attracted to tailraces rather than their natal streams (false attraction) can be delayed from their spawning runs, which can diminish reproductive success. Because salmon explore river estuaries to find their home stream by odor, Powerhouse No. 2 outflow into Hood Canal could delay adult fish migrating to the Skokomish River. Fish have been observed in the tailrace, and anglers report that fishing is better during powerhouse operation.

Tacoma (1992a) evaluated tailrace and draft tube velocities to determine fish access and injury potential. The turbine runner assembly at Powerhouse No. 2 is at the same elevation as extreme high tide, which usually occurs in January. During project shut-down, when turbine runners are stationary, fish could contact runners during extreme high tides. At all other tides, fish would have to jump up to 12.5 feet out of the water to contact the stationary runners. During project start-up, the turbine takes less than 1 minute to reach full speed. Tacoma believes that rapidly increasing velocities probably force fish away from runner blades before contact (Tacoma, 1992a). During turbine operation, high peripheral velocities near the turbine runners would prevent fish from reaching moving runners.

Turbulence and differential velocities in the draft tubes and tailrace can also cause fish injury when the turbine starts up. During Tacoma's fish behavior study (1992a) (discussed below), however, only two dead or injured fish were observed during 61 hours of visual coverage across the tailrace from September through December 1991. Draft tube and tailrace underwater investigations during 1989 and 1991 revealed no dead or injured fish.

Tacoma (1992a) evaluated three tailrace barrier designs to prevent fish access to the draft tubes. Two designs cause high velocities and turbulence that might injure fish by inducing them to leap at the rack or try to swim through it. The other design provides overhead cover and might promote tailrace fish holding. Neither design would reduce false attraction to powerhouse discharge.

Tacoma (1992a) also evaluated fish behavior during Powerhouse No. 2 shut-downs. Project shut-downs might be a possible means to reduce tailrace delays. Powerhouse No. 2 normally does not operate during spring refill, which begins about March 1. During summer it operates nights and weekends. Tacoma observed the tailrace during two study periods, from September to December 1991 (to coincide with peak wild coho and chum runs). Tacoma's statistical analysis indicates less fish movement (in or out of the tailrace) on days with powerhouse shut-down. Net movement of fish (toward or away from the powerhouse) does not differ on days with and without powerhouse shut-down. Tacoma did not find a statistically significant difference in movement on days following shut-down.

3.4.6 Skokomish Estuary

Because salinity data used to define estuarine limits under Cowardin et al.'s (1979) wetland classification system are unavailable for the Skokomish River, for the purposes of analysis in this DEIS we defined the Skokomish Estuary's upper boundary as the extreme high tide level at about 15.5 feet above the mean lower low (tide) water (MLLW) level (0 foot). Although the lowest low tide levels are about 3.3 feet below MLLW, we defined the sudden river delta drop-off into Hood Canal at about 5 to 6 feet below MLLW as the estuary's lower boundary (figure 3-11). Vegetation types and their distribution within the estuary are listed in table 3-7.

Table 3-7. Skokomish Estuary vegetation.[1]

Feet above MLLW [2]	Water salinity (ppt) [3]	Dominant vegetation types [4]
≥ 12.1 (MHW) [5]	< 20	redtop, tufted hairgrass
6 to 10	< 20	Lyngbye sedge-red fescue
≥ 12.1	> 20	American Three-square, salt grass, jaumea
8 to 12	> 20	salt grass, seaside arrowgrass, pumea, pickleweed
≤ 6 to 8	≥ 10	eelgrass or mudflats

1 Source: the staff.
2 MLLW is mean lower low (tide) water level (0 feet).
3 ppt is parts per thousand.
4 See appendix E for scientific names.
5 MHW is mean high (tide) water.

Estimates of current and past amounts and distributions of these different habitats within the estuary vary considerably among available reports, because various authors have defined and measured these habitats differently. Based on Yoshinaka and Ellifrit's (1974) distribution map, we estimated that eelgrass beds slightly overlapping marsh areas mixed with mudflats cover about 1,640 acres. Bortelson et al. (1980) estimated that the amount of intertidal area between MLLW and mean high water (MHW, 12.1 feet above MLLW) with low salt marsh, mudflat, and eelgrass decreased by about 10 percent from 1,235 acres to 1,110 acres between 1884 and 1952. Most of these intertidal habitat losses were caused by an estimated 20-foot recession of the Skokomish Delta face (Hutchinson, 1988). Jay (1995) compared 1885 and 1972 bathymetric data and concluded that the Skokomish Delta had shrunk by about 2 to 2.5 percent because the delta face had receded, which combined with shoaling on the inner delta had steepened the delta slope and reduced the area of eelgrass beds between 0.6 foot above and 2.4 feet below MLLW from 514 acres to 427 acres (a 16.7 percent reduction). Tacoma's mapping of the 1885 and 1972 bathymetric data (letter from Paul H. Svoboda, Natural Resources Manager, Tacoma Public Utilities, Tacoma, Washington, October 20, 1994) also indicate some delta steepening, because the contours corresponding to MLLW and about 2 feet below MLLW are clearly closer together on average for 1972 than they were in 1885 (figure 3-11).

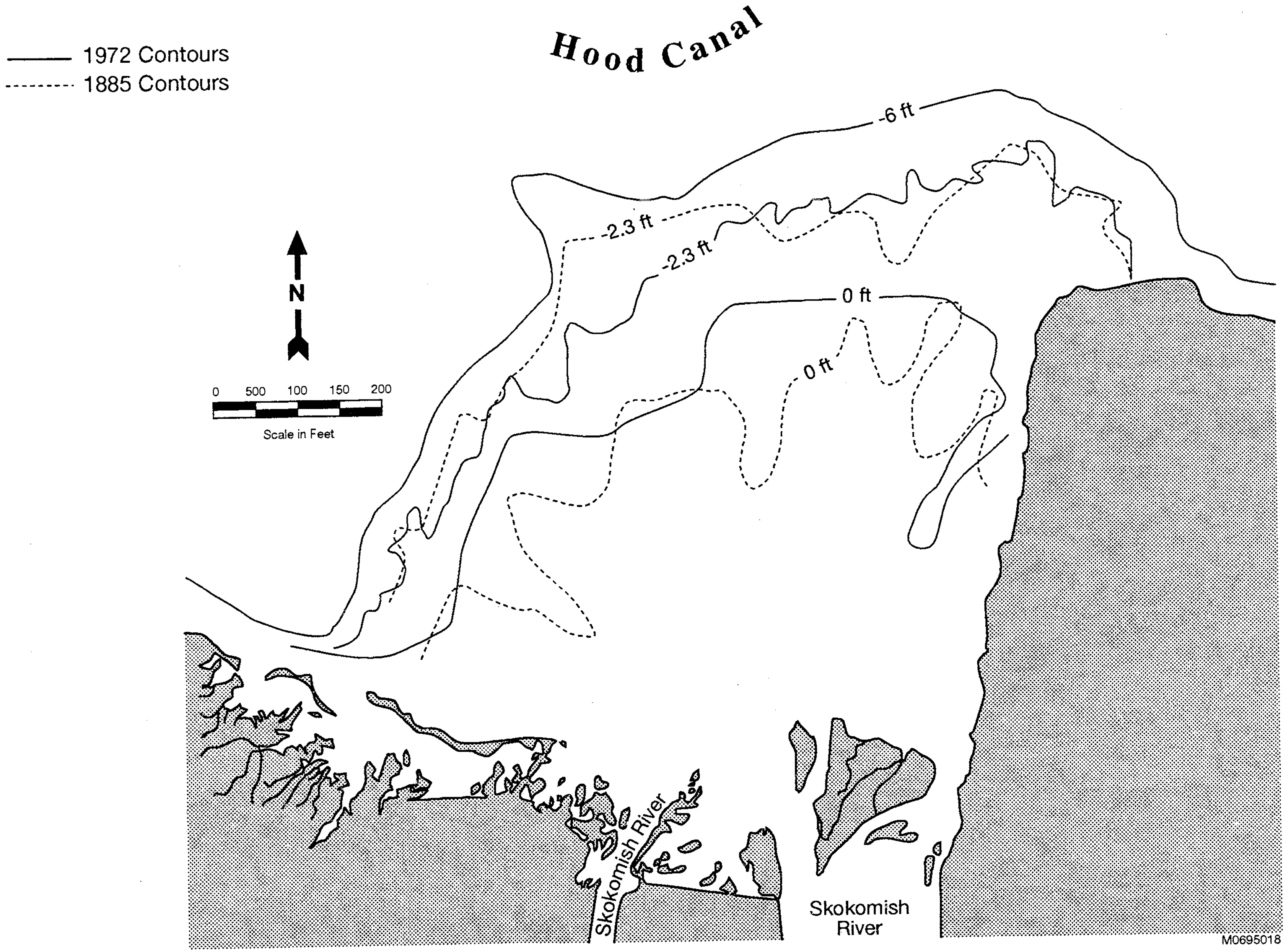

Figure 3-11. Elevation contours of the Skokomish River delta relative to MLLW in 1885 and 1972. (Source: the staff, adapted from Bortelson et al., 1980 and letter from Paul H. Svoboda, Natural Resources Manager, Tacoma Public Utilities, Tacoma, WA, October 20, 1994.)

Measurement and rounding errors could account for some of the observed differences between the 1880's and 1970's, but the consistency of the results supports the finding that the Skokomish Delta has receded on the order of 2 percent with some steepening of the delta slope. Any losses of valuable eelgrass habitats are probably less than characterized by Jay, however, because eelgrass can grow from 6 feet above to 22 feet below MLLW (Phillips, 1984) and is the dominant vegetation from 0 to 8 feet below MLLW in Hood Canal (Yoshinaka and Ellifrit, 1974), and Jay considered only a small portion of the range of depths over which eelgrass grows. For example, if Yoshinaka and Ellifrit's (1974) eelgrass distribution map is correct, then an 87-acre loss as calculated by Jay could represent less than 5 percent of the eelgrass that would have existed before the project.

Although these findings are consistent with the hypothesis that project water diversions have contributed to observed changes in the Skokomish Delta, they do not support the hypothesis that project water diversions alone have caused the observed changes. All of the existing data come from observational studies lacking any measurement of, or control over, other confounding factors that could have affected sediment transport in the delta, including the effects of diking and increased sediment inputs from logging in the basin.

The possibility that diking could have altered flow patterns and contributed to delta recession and shoaling is indicated by Jay's (1995) and Tacoma's findings (letter from Paul H. Svoboda, Natural Resources Manager, Tacoma Public Utilities, Tacoma, Washington, October 20, 1994) that delta recession is greatest at the western and northwestern edges that are closest to the diked areas and that no longer have an active distributary channel. The development of a new distributary channel in the northeastern portion of the delta and progradation in this area might also be related to altered flow patterns.

Extensive clearcutting and road building in the South Fork drainage has substantially increased suspended and bedload sediment inputs to the estuary (section 3.2.2). Because the Skokomish is a relatively shallow, partially mixed positive estuary (Dyer, 1979) with moderately strong tidal fluctuations, tidal rather than river flows should be responsible for the vast majority of bedload and suspended sediment transport on the delta, including those inner areas where Jay reported shoaling. Thus, river flow regulation should have limited effects on transport of increased sediments on the delta.

That the delta has receded in some areas, prograded or shoaled in others, and developed new channels indicates to us that natural fluctuations, flow regulation, increased sedimentation, and diking have all had an effect on the Skokomish Estuary. Because estuaries are normally very dynamic, and because the observed changes over a 100-year period are relatively small, we conclude that project diversions combined with increased sediment loads and dike-altered flow patterns have had relatively minor effects on the estuary and its flora and fauna.

The estuary's marshes provide important foraging habitat for juvenile chinook salmon (Simenstad, 1983), as well as egrets and great blue herons. Yoshinaka and Ellifrit (1974) found that muddy substrates in the Great Bend area, including the Skokomish Estuary, support Hood Canal's highest densities of clams, including butter, native littleneck, Japanese littleneck, gaper, macoma, false mya, and softshell clams. These habitats also support oysters and several crab species, including dungeness crabs. Yoshinaka and Ellifrit (1974) also found that mud substrates, including eelgrass beds, supported the greatest number of fish species. Results reported by Yoshinaka and Ellifrit (1974) and Simenstad (1983; 1992) suggest that Skokomish Estuary mudflat and eelgrass habitats are heavily used by various life-stages of chum, chinook, and coho salmon, cutthroat trout, starry flounder, Pacific herring, surf smelt, sole, and perch. In particular, estuary residence times for Hood Canal chum (up to 32 days per individual and 23 weeks overall), coho (up to 6 days per individual and 15 weeks overall), and chinook (13 weeks overall) are longer than any other area in Puget Sound (Simenstad, 1983). The estuary's mudflats also provide high-quality foraging habitat for shorebirds including western sandpipers, dunlins, and sanderlings, and the eelgrass beds provide important forage for migrating brant. Hundreds of harbor seals rest on mudflats and islands of marsh in the estuary, and forage in the estuary's channels and tide waters.

3.5 Terrestrial Resources

3.5.1 Vegetation

Project lands are within the Pacific Northwest's Western Hemlock Zone (Franklin and Dyrness, 1973). The climax vegetation in this zone is dominated by western hemlock and western red cedar. Most coniferous forests in the region have been disturbed, however, and Douglas fir, a subclimax species, is the most dominant species on most sites. Other coniferous overstory species occurring at lower densities include grand fir, Sitka spruce, and western white pine. Common forest understory plants include bracken fern, sword fern, deer fern, salal, Oregon grape, red huckleberry, Scouler's willow, ocean spray, and vine maple.

Hardwood species, including red alder and big-leaf maple, are typical of disturbed sites and of riparian areas, where they occur with black cottonwood and Oregon ash. In addition to those species found in coniferous forest understories, the understory in disturbed and riparian areas also commonly includes dogwood, elderberry, blackberry, currant, lady fern, shield fern, maiden hair fern, and herbs such as vanilla leaf, wild ginger, strawberry, and buttercup.

The region includes a diverse array of wetlands. The reservoirs and other local lakes are lacustrine wetlands (wetland nomenclature follows Cowardin et al., 1979). The North Fork and mainstem and their tributaries are all riverine wetlands. Estuarine wetlands are created where the mainstem meets Hood Canal, a marine wetland. Palustrine wetlands occur in association with the lakes, rivers, and estuaries, and in low-lying areas such as Lilliwaup Swamp.

Vegetation was studied as part of the HEP analyses (appendix E) used by Tacoma and JRP to quantify wildlife habitat on project lands and on off-project lands proposed for habitat enhancements (parcels) (Tacoma, 1990; 1991b; 1993a; 1994b; and letter from Eileen McLanahan, Project Biologist, Harza Northwest, Inc., Bellevue, Washington, June 6, 1996). Figure 2-2 indicates the locations of these parcels. A total of 24 vegetation or habitat cover types, based on an FWS classification system (Proctor et al., 1980), occur within the project transmission line ROW and on the parcels (table E-1). The distributions of these vegetation types within each parcel were mapped by Tacoma from aerial photographs and verified by site visits. The current acreages for each habitat type in the ROW are listed in appendix E, table E-1, and current acreages for each enhancement parcel are listed as target year (TY) 0 values in tables E-2, E-3, E-4, and E-5. Sections 3.5.1.1 and 3.5.1.2 briefly describe parcel boundaries, dominant habitat features, and recent vegetation management practices used on project lands and each of the parcels. Section 3.5.1.3 presents the results of Tacoma's (1990, 1993b) rare plant surveys. Appendix F lists the plant species potentially occurring in the project vicinity.

Table 3-8. Vegetation on project lands and enhancement parcels. [1]

Area	Vegetation	Acres (Tacoma)	Acres[2]
Transmission line ROW	Forested	270	
	Palustrine wetlands	29	
	Lacustrine wetlands	16	
	Deciduous scrub/shrub	94	
	Developed land (roads, etc).	61	
	Other mixed vegetation	38	
Enhancement parcels:			
Westside	Coniferous forest	193	
Dow Mountain	Coniferous forest	225	
Lake Standstill	Forest	21	
	Palustrine/lacustrine wetlands	34	
Deer Meadow	Coniferous forest	175	
	Mixed forest	152	
	Deciduous forest	92	
	Wetland	21	
Potlatch	Coniferous forest	187	
LCSP	Forested	306	
	Palustrine wetlands	29	
Northern Lower North Fork	Mixed forest	104	96
	Coniferous forest	960	848
	Deciduous forest	307	294
	Wetlands	98	90
Southern Lower North Fork	Coniferous forest		1,011
	Deciduous forest		494
	Mixed forest		121
	Wetlands		65
	Agricultural/forestry		457
	Developed		8
Purdy Creek	Palustrine wetlands	86	156
	Coniferous/deciduous forest	36	30
	Agriculture/pasture	65	65
Nalley Ranch	Estuarine wetlands		339
	Palustrine wetlands		197
	Riverine wetlands		72
	Lacustrine wetlands		26
	Forested		16
	Agricultural pasture		246
Belfair Wetlands	Estuarine wetlands		188
	Deciduous forest		81
	Agriculture - grazing		49
	Developed		5
Lilliwaup Swamp	BPA transmission ROW		71
	Palustrine wetlands		644
	Lacustrine wetland		137
	Coniferous forest		7,371
	Deciduous forest		985
	Mixed forest		230
	Private ownership		863

1 Source: the staff.
2 Unless specifically noted, acreages are the same in the JRP-proposed enhancement parcels as in Tacoma's Proposal.

3.5.1.1 Project Lands

Project lands owned and developed by Tacoma for power production include the transmission line ROW and the reservoirs. Along its 42-mile route from the project to Tacoma, the transmission line ROW passes through a diverse array of habitat types (table 3-8 and appendix E).

Tacoma has managed the ROW to prevent power line hazards by removing any potentially hazardous vegetation, particularly trees. Mechanical means have been used for most vegetation removal. Tacoma has in the past also used aerially applied herbicides to control vegetation in some areas. Since 1985, however, herbicide applications have been limited to more direct methods including cut surface and basal applications, and injections. Other ROW management activities include pole replacement and road maintenance.

Lakes Cushman and Kokanee cover 3,918 (at elevation 731) and 100 acres, respectively (4,018 acres total; appendix E). These areas can be classified as lacustrine wetlands. There is little palustrine wetland bordering the lakes because of water level fluctuations associated with project operations.

3.5.1.2 Enhancement Parcels

Tacoma and JRP have proposed habitat enhancement on a number of parcels of land, either owned or to be acquired by Tacoma. The following text describes parcel boundaries and current use. Table 3-8 lists general habit types within each parcel.

Undeveloped Tacoma Lands

Tacoma currently owns and controls approximately 1,060 acres on or adjacent to the project that have not been highly developed and have been proposed for enhancement. These lands include areas located:

- on the west side of Lake Cushman near Dry Creek (Westside; 193 acres);
- at Dow Mountain (225 acres);
- at Lake Standstill (55 acres);
- at Deer Meadow (400 acres); and
- along the Powerhouse No. 1 transmission line and Powerhouse No. 2 power tunnel route (Potlatch Area, 187 acres).

Tacoma also proposes to acquire development rights to undeveloped lands that Tacoma leased to LCSP (335 acres) and to Simpson Timber Company-owned lands adjacent to Deer Meadow (40 acres).

Northern Lower North Fork

This parcel includes the North Fork from Dam No. 2 to approximately 2.5 miles downstream and adjacent lands. The boundaries of this parcel are slightly different under Tacoma- and JRP-proposed enhancement plans. Simpson Timber Company owns most of the Northern Lower North Fork lands, and Robert Stoher owns the remainder. These lands have been managed almost solely for forest production. Some Simpson land is managed for Christmas tree cultivation. The remaining lands have been managed for timber production. Most of the Stoher property has been clearcut since 1988.

Southern Lower North Fork

This parcel extends from the JRP's Northern Lower North Fork southern boundary, downstream along the North Fork to its confluence with the South Fork. Most of this area (1,460 acres) is owned by Simpson Timber Company and managed for timber production as in the Northern Lower North Fork parcel. Approximately 696 acres of lands at the North and South Fork confluence are Richert Farm property and are managed for agricultural (primarily beef cattle) and timber production. Timber harvests on these lands are ongoing.

Purdy Creek

The Purdy Creek parcel is located along the lower mainstem. Development activities on the parcel, which is owned by a trust, have not been highly intensive. Agricultural lands have been managed for hay and pasture, and timber harvest has been limited to firewood production in palustrine forests. Even so, the mixed forest is at a harvestable age and could be logged.

Nalley Ranch

The Nalley Ranch parcel covers approximately 880 acres at the Skokomish River mouth. Agricultural lands created by a series of dikes on this parcel have been managed primarily for pasture and haying. Tacoma recently purchased this property for future enhancement purposes (Tacoma, 1993b) and has continued to manage these lands as they were prior to acquisition, pending the development of land management plans for the area. The dikes were breached at some locations during the December 1994 flood, and estuarine conditions have been restored in these areas.

Belfair Wetlands

The Belfair Wetlands are located at the eastern end of Hood Canal and includes 323 acres at the Union River mouth. Because the parcel's estuarine wetlands are highly valuable native habitats, the state has sought to acquire it and manage it for native habitat values. Lands within the parcel are owned by several different private parties and a local school district. The school district land, known as the Theler Wetlands, is managed to protect plant and wildlife resources for educational purposes. WDFW and the Hood Canal Land Trust own lands on the parcel's northeastern and western boundaries, respectively, and manage them to protect native plant and wildlife values.

Lilliwaup Swamp

This parcel is located east of Lake Cushman and covers a total of 9,438 acres, including 71 acres of unclassified vegetation within a BPA transmission line ROW that crosses the parcel. The parcel is characterized by the Lilliwaup Swamp and Price Lake bottomlands surrounding Saddle Mountain and includes a 644-acre palustrine wetland complex that is the largest of its type in the region.

WDNR owns most of this parcel and manages it primarily for timber production. The remainder (863 acres) is in private ownership. Present and proposed near-future logging rates within the parcel are not high though, because most timber stands in the parcel aren't scheduled for logging under current WDNR plans until they reach harvestable ages in 5 to 20 years.

3.5.1.3 Sensitive Plant Species

WDNR classifies four plants as sensitive species that might occur in the proposed project area.

On the Olympic Peninsula, chain fern appears to occur most commonly in moist areas on relatively steep and open stream and river banks (Tacoma, 1993b). No specimens were found during surveys of suitable habitat on project lands.

Adder's tongue has been reported in wet meadow, bog, and forested wetland habitats. No specimens of Adder's tongue were detected during surveys of potential habitat on project lands in 1989 or during rare plant surveys conducted at Deer Meadow in 1988 (Tacoma, 1990).

Buxbaum's sedge has been reported in wet meadow, bog, and forested wetland habitats. No specimens were detected during surveys of potential habitat within the proposed project area in 1989 or during rare plant surveys conducted at Deer Meadow in 1988 (Tacoma, 1990).

Documented specimens of scurvy grass have been found at the Finch and Eagle Creek mouths along Hood Canal, on gravelly substrates near the high tide mark (Tacoma, 1993b). Similar habitat occurs on project lands adjacent to Powerhouse No. 2 at Potlatch. No specimens of scurvy grass were found during surveys of this area.

3.5.2 Wildlife

The diverse habitats within the project region support many wildlife species. Though it is not intended to be a comprehensive listing of all species found in the region, appendix G lists species that are characteristic of the region. The following sections briefly describe some of these species. For those species analyzed in the HEP, the current number of habitat units (HUs) in each of the enhancement parcels are presented as target year (TY) 0 values in appendix E, tables E-6, E-7, E-8, and E-9. Section 3.5.3 presents species that have been designated by FWS as threatened, endangered, or proposed for threatened or endangered status.

3.5.2.1 Amphibians and Reptiles

The region's generally cool and moist habitats support a large and diverse group of amphibian species that are an important component of the region's forest ecosystems (Nussbaum et al., 1983; Stebbins, 1985; Bury, 1988). One species, Cope's giant salamander, is endemic to creeks in the Lake Cushman vicinity. Its occurrence on project-related lands has been documented (Tacoma, 1990); however, population densities and specific habitat requirements are not yet known. Suitable habitat for northern red-legged frogs, a Category 1 candidate species that typically inhabits forested areas near streams, ponds, or swamps in the Pacific Northwest (Leonard et al., 1993), exists at project vicinity sites such as Deer Meadow and Lilliwaup Swamp, but no red-legged frog observations have been documented within the project area. In contrast to amphibians, there are only a few common reptile species in the project vicinity.

3.5.2.2 Birds

Lake Cushman, Lake Kokanee, and the Skokomish River provide habitat for a variety of wading birds and waterfowl. Great blue herons, which are listed as a monitor species by WDFW, are colonial nesters, and their rookeries are usually located on large trees in forested areas near water (Short and Cooper, 1985). Suitable nesting habitat is available on project lands, and nesting has been documented near the Skokomish Estuary. Fish are preferred prey, but they also forage opportunistically on small mammals, birds, snakes, frogs, and invertebrates. HEP results indicate that Lilliwaup Swamp, Nalley Ranch, Belfair Wetlands, and Purdy Creek currently provide the most habitat for great blue herons among the proposed enhancement parcels (see TY0 values in appendix E).

Brant are a WDFW priority species that concentrate on the Skokomish Estuary where they roost and forage on eelgrass (section 3.4.6) while migrating during fall and winter. Wood ducks, another WDFW priority species, are year-round breeding residents in the area, nesting in tree cavities near most lakes, ponds, and swamps. Mallards are year-round breeding residents that nest near most lakes, ponds, and swamps. For dabbling ducks such as mallards, HEP results indicated that Nalley Ranch provides the most significant amount of habitat among the proposed wildlife habitat enhancement parcels (appendix E).

Ospreys are a WDFW monitor species that prefer large, flat-topped or broken trees, or snags, within 240 feet of water for nesting (Vana-Miller, 1987). Optimal feeding habitats are lakes and rivers with clear water and shorelines with at least 10 trees per mile that provide adequate perch sites near water. Recently active osprey nests in the project region are located at the northern end of Lake Cushman, on Lake Kokanee just below Dam No. 1, and at Price Lake (Tacoma, 1990a). Ospreys have been observed foraging on fish at Lake Cushman. Because only lacustrine wetlands were evaluated as habitat under the HSI model used for osprey, HEP results indicated that only the reservoirs and Lilliwaup Swamp (because it includes Price Lake) provide significant habitat for osprey. Nevertheless, ospreys also forage on and nest along riverine, estuarine, and marine wetlands as well, and other parcels, Nalley Ranch in particular, also provide potential osprey habitat.

Northern goshawks are a FWS-listed Category 2 candidate species that nest and forage in mature conifer forests or mixed stands of conifers and deciduous trees. Northern goshawks are breeding residents on the Olympic Peninsula where they have been observed year-round, and they probably occur in the project vicinity.

Mountain quail are also a FWS-listed Category 2 candidate species. Mountain quail nest on mountains with relatively open stands of trees and brush and winter in mixed forest habitats. Suitable habitat exists on project lands, but mountain quail have not been documented on them.

Band-tailed pigeons, a WDFW priority species, nest in forest habitats and forage on available nuts, seeds, and berries. Band-tailed pigeons are common breeding residents, present in the area from spring through fall.

Vaux's swifts are a WDFW-listed candidate species. Because this species generally requires snags that are more than 40 feet tall and greater than 25 inches diameter breast height (dbh) for nesting, optimal breeding habitat is generally provided by mature and old-growth forests in riparian or upland areas (Brown, 1985). Vaux's swifts feed exclusively on flying insects captured in mid-air over a variety of open habitats, including forest clearings, lakes, and streams (Verner and Boss, 1980). They are common summer breeding residents on the Olympic Peninsula.

WDFW also lists pileated woodpeckers as a candidate species. They are primary cavity nesters and their optimal habitats contain high densities of large snags, trees, and logs for nesting and foraging (Schroeder, 1983). Stands of large trees exist on project lands, but snag densities are low because the stands are relatively young and snags have been cut for firewood. Documented observations have confirmed the presence of pileated woodpeckers on project lands. Hairy woodpeckers are also primary cavity nesters that generally prefer mature forest stands because they require large snags or trees with heart-rot for nesting (Meslow and Wright, 1975; Noon et al., 1979; Thomas et al., 1979). They forage in a variety of forested habitats and have been regularly observed throughout the project vicinity. Because they include large amounts of forest, the proposed Lilliwaup Swamp, Southern Lower North Fork, and Northern Lower North Fork enhancement parcels currently provide the greatest number of HUs for hairy woodpeckers (appendix E).

A large number of songbirds breed or reside in the project vicinity. American dippers breed along the river and its tributaries. Yellow warblers should be common in palustrine scrub-shrub habitats during the breeding season, though their actual abundance and distribution in the vicinity has not been reported. Lilliwaup Swamp, Nalley Ranch, and Purdy Creek currently contain the greatest amounts of palustrine scrub-shrub habitat among the proposed enhancement parcels, and thus provide the greatest number of HUs for yellow warblers (appendix E).

3.5.2.3 Mammals

A variety of small- and medium-sized mammal species occur throughout the Skokomish drainage. Douglas squirrels, a HEP species dependent on mature Douglas fir trees for forage and reproductive cover, have been frequently observed on project lands. Because they depend on conifer forests, Douglas squirrel habitat is currently most abundant at Lilliwaup Swamp, Southern Lower North Fork, Northern Lower North Fork, Deer Meadow, LCSP, and Dow Mountain (appendix E).

Beavers, raccoons, and river otters use local riverine wetland habitats. Mink, a WDFW priority species, also use aquatic habitats, including riverine and lacustrine wetlands, and palustrine wetlands with emergent, shrubby, or forest vegetation. They forage opportunistically on available aquatic (crayfish, fish), semi-aquatic (waterfowl, muskrats), or terrestrial (rabbits and rodents) prey. They are also usually associated with brushy or wooded vegetation or debris that provides cover for foraging and denning. There have not been any documented observations of mink on project lands; however, they are assumed to occur in the area, and the HEP results indicate that all of the proposed enhancement parcels, except Westside, Dow Mountain, and Potlatch, currently provide at least some habitat for mink.

FWS lists Pacific fishers as a Category 2 candidate species. Fishers are medium-sized, weasel-like mammals that inhabit large tracts of dense mature or old-growth coniferous and mixed coniferous-deciduous forests with continuous canopy closure (Allen, 1983). The last confirmed sighting of a fisher on the Olympic Peninsula was at Lilliwaup Swamp in 1969 (Tacoma, 1993b); however, fishers are believed to occur in ONP and might occur on project lands. Because they include relatively large tracts of forest, Lilliwaup Swamp, Southern Lower North Fork, and Northern Lower North Fork enhancement parcels currently provide the greatest amount of potential habitat for fishers (appendix E).

Martens, a WDFW priority species, are also weasel-like mammals that inhabit late successional coniferous forests (Allen, 1982). They are fairly common throughout ONP, and probably occur on project lands. Black bears are also relatively common in ONP (FERC, 1993), and black bears along the South Fork, lower North Fork, and mainstem probably scavenge on salmon carcasses.

Roosevelt elk are another WDFW priority species. On the Olympic Peninsula, elk occur in herds that are either resident or migratory (Schwartz and Mitchell, 1945). On the east side of the peninsula, where the project is located, most elk are migratory, typically using subalpine parklands within ONP during summer, lower-elevation valleys and bottomlands during winter and the calving season (April-May), and riparian habitats as migration corridors between summer and winter range (Schroer, 1986). Winter habitats preferred by elk include a mixture of forage and cover areas in close proximity. Preferred habitats generally occur where dominant trees average 21 inches dbh or greater, have 70 percent or greater crown closure, and are in mature or old-growth stands (Witmer et al., 1985). The availability of optimal cover can be the most important factor affecting Roosevelt elk population densities (Smithey et al., 1985).

Two herds of elk, known as the Lilliwaup and Skokomish herds, use project and nearby lands for winter range and migration. Each herd is composed of subherds. Three Lilliwaup subherds use areas near upper Lake Cushman. One subherd is resident in ONP, a second is migratory between ONP and Lilliwaup Swamp, and the third is resident at Lilliwaup Swamp. The migratory subherd's migration corridor roughly parallels Lake Cushman's north shore, extending from the Staircase area across Mt. Rose's south slope and through the northeast corner of LCSP into Lilliwaup Swamp.

ONP records indicate that, during the 1960's, total numbers of elk in ONP-resident and Lilliwaup Swamp-migratory subherds were as high as 80 to more than 100 (NPS, 1994). WDFW records indicate there were 45 to 65 elk in the Lilliwaup Swamp-resident subherd (letter from Curt Leigh, Mitigation Resolution, WDW, Olympia, Washington, December 30, 1992). These data suggest that the entire Lilliwaup herd totaled from 125 to more than 165 elk. In 1979, WDFW records indicate there were a total of at least 150 elk in the entire Lilliwaup herd. In 1991, WDFW estimated at least 89 elk in the entire Lilliwaup herd, including 12 elk in the Lilliwaup Swamp-resident subherd, with ONP records indicating at least 77 resident and migratory elk on ONP lands. In 1995, there was an estimated total of at least 58 elk in the entire Lilliwaup herd, including 6 elk resident in ONP, 10 elk in the migratory subherd, and 42 elk in the Lilliwaup Swamp resident subherd (letter from Sally Nickelson, Wildlife Management Planning Director, Point No Point Treaty Council, Kingston, Washington, January 8, 1996). Reports suggest that the Lilliwaup herd size has been reduced primarily by unregulated harvest levels and perhaps secondarily by winter habitat availability (Houston et al., 1990; NPS, 1994). To reduce disturbance to elk and increase their numbers, WDFW has recently suspended elk hunting seasons on the eastern side of the

Olympic Peninsula, and in conjunction with WDNR, closed roads around Lilliwaup Swamp from October 1 to April 15.

The Skokomish herd includes two subherds that both winter on Southern Lower North Fork parcel lands. One of these subherds also uses Northern Lower North Fork lands during winter and migrates through this parcel to summer range in the South Fork drainage. The second subherd includes resident and migratory elk that use areas near the confluence of the North and South Forks. WDFW estimates that the confluence subherd has decreased from more than 100 elk in 1977 to about 28 elk in 1992, while the total Skokomish herd including both the confluence subherd and the South Fork-migratory subherd declined from about 150 animals in 1984 to about 72 elk in 1992 (letter from Curt Leigh, Mitigation Resolution, WDW, Olympia, Washington, December 30, 1992). In 1995, the entire Skokomish herd was estimated at about 30 elk, with as few as 3 elk resident near the confluence of the North and South Forks (letter from Sally Nickelson, Wildlife Management Planning Director, Point No Point Treaty Council, Kingston, Washington, January 8, 1996).

Because of their preference for forest habitats, HEP results indicated that elk habitat on proposed enhancement parcels is currently greatest at Lilliwaup Swamp, Southern Lower North Fork, Northern Lower North Fork, Deer Meadow, and LCSP (appendix E).

Black-tailed deer are also a WDFW priority species and their habitat requirements are similar to elk. Black-tailed deer on the lower-elevation project lands are probably year-round residents. Though deer population densities on project and adjacent lands have not been determined, they have been commonly observed on project lands (Tacoma, 1990). Densities are probably moderately high because abundant browse on the eastern side of the Olympic Peninsula creates high quality deer habitat.

3.5.3 Threatened and Endangered Species

There are four species that FWS has listed as threatened or endangered species that might occur within the study area.

Peregrine falcons are listed by FWS as an endangered species. Falcons might occur in the study area as migrants during spring and fall, but there are no documented observations.

Marbled murrelets are listed by FWS as a threatened species. In the Pacific Northwest, marbled murrelets nest on trees in old-growth forest stands and forage on coastal marine waters. Nests are usually located near coasts, but nests up to 52 miles inland have been found in Washington (Hamer et al., 1991). In consultation with FWS, WDW, FS, and NPS, and following standard protocols, Tacoma initiated murrelet surveys adjacent to areas of suitable habitat along the north shore of Lake Cushman. Marbled murrelets were detected on 111 separate occasions during surveys in 1993 (Tacoma, 1993b). Murrelet activity was highest in the Dry Creek, Timber Mountain, Copper Creek, and Bear Gulch drainages, and near Mt. Rose. Murrelet behavior indicated occupancy or nesting in stands with suitable nesting habitat in the Copper Creek and Bear Gulch drainages, but surveyors were unable to locate any murrelet nests during ground searches of these areas.

FWS lists northern spotted owls as threatened. These owls require unlogged old-growth forests or mixed forests of mature and old-growth timber for breeding and foraging (Forsman et al., 1984). Forests with old-growth characteristics occur throughout the North Fork drainage in ONP, but most of the forests on project and enhancement parcel lands are not suitable habitat because they are less than 100 years old and lack the old-growth characteristics required by this species. Spotted owl surveys in 1991 detected a pair of spotted owls on FS land in the Dry Creek drainage approximately 1.8 miles from the Copper Creek trailhead, and a single male on FS land in the Big Creek drainage about 2.0 miles from the Big Creek Campground (Tacoma, 1991b).

FWS lists bald eagles as a threatened species. Wintering eagles require sheltered roosts for cover at night and during severe weather. Bald eagles forage opportunistically on available prey. Within the project vicinity they probably feed on glaucous-winged gulls and other shorebirds along the coast, salmon carcasses in the lower river section, resident fish stocks in the reservoirs, and carrion.

Project and nearby lands are most commonly used by wintering eagles between October 31 and March 31, but bald eagles have been observed throughout the vicinity year-round (Tacoma, 1990). Tacoma surveyed project lands for bald eagles from November 1988 to March 1989, and single eagles were observed either perched or in flight on four separate occasions. Surveys conducted on the lower North Fork from January to May 1989 indicated that eagle density on the lower North Fork was highest during mid-January. A communal roost site at the confluence of the North and South Forks was surveyed in January and February 1989 and from December 1989 to February 1990. Use of this roost was greatest in January. WDFW coordinated annual midwinter bald eagle surveys on the South Fork from 1983 to 1989 that indicated low but increasing numbers of eagles there.

3.6 Land Use

Like most of the Olympic Peninsula, the Skokomish River Basin has traditionally been used for recreation, timber production, fish harvest, agriculture, and residences. The upper reaches of both the North and South Forks are in ONP, while the lower reaches of both forks and the mainstem have more mixed uses. We describe land use in the following subsections in terms of land ownership, existing land use, and the proposed land exchange. We identify relevant regional and local management plans in section 6.3. Figure 3-12 shows general land use in the project area.

3.6.1 Land Ownership

The entire upper reach of the North Fork is within ONP lands administered by NPS (figure 3-1). ONP contains over 900,000 acres, nearly all of which is outside of the project area, and has three significant special designations that recognize the exceptional qualities of the existing natural environment. Most of ONP has been designated as Wilderness under the Washington Park Wilderness Act of 1988. The wilderness area includes nonroaded portions of the North Fork Valley above Lake Cushman and is managed so that the presence and effects of humans remain unnoticed. ONP is also designated as both a Biosphere Reserve and a World Heritage Site.

Tacoma owns approximately 9,254 acres in the project vicinity, of which approximately 5,441 acres are within the project boundary (table 3-9). The proposed project boundary for the Cushman Project encompasses all project works, including the transmission line extending to the Vaughn Tap on the Kitsap Peninsula. Tacoma owns nearly all lands within the project boundary. Within the 742-foot contour that forms the proposed project boundary around upper Lake Cushman are approximately 14 acres of FS land and about 20 acres of NPS land.

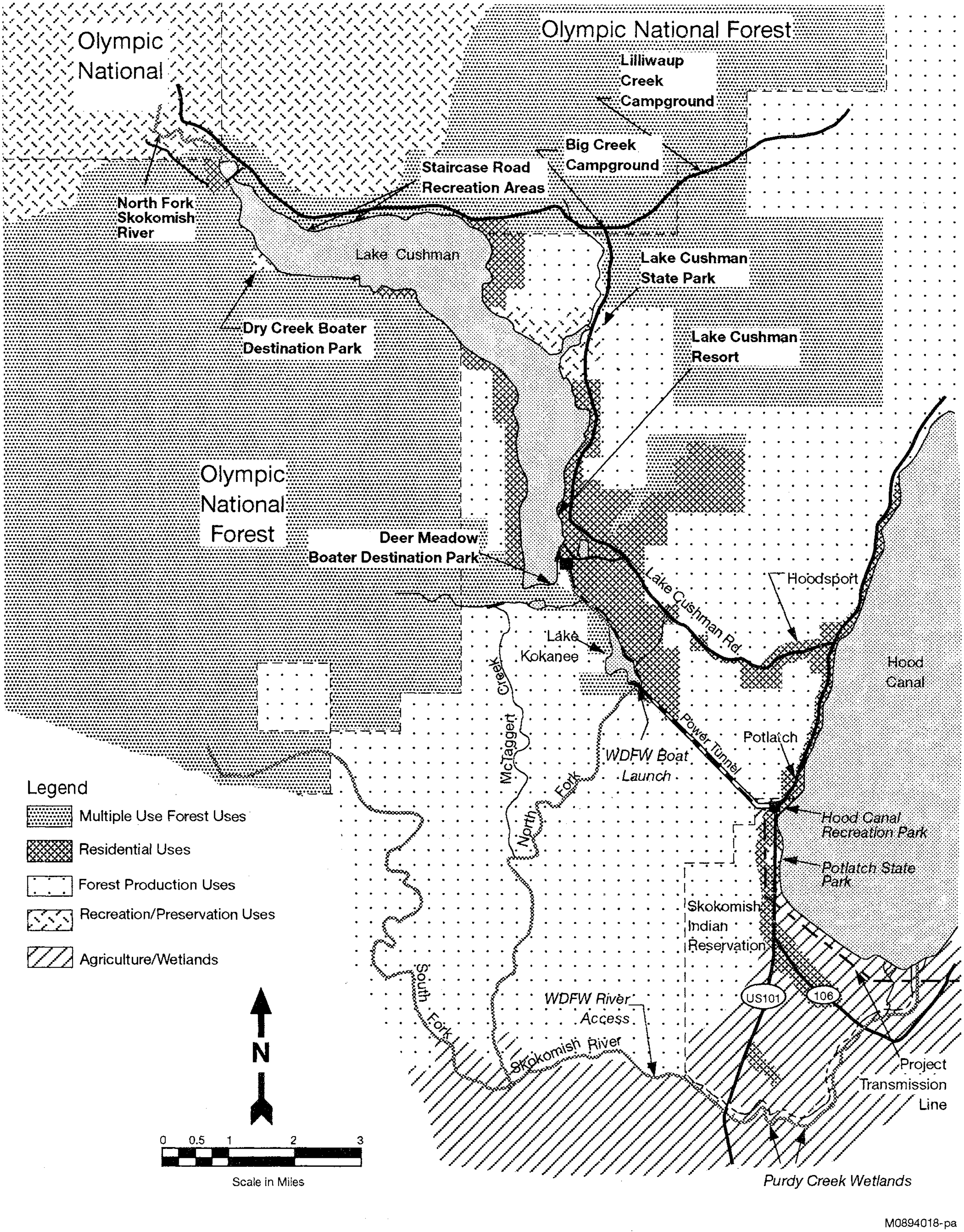

Figure 3-12. Generalized land use in the project area.

Table 3-9. Approximate acreage of lands within the Cushman Project boundary.[1]

Lands	Acres
Tacoma lands	
Lake Cushman	4,058
Lake Kokanee	100
Project operation lands	50
Transmission line ROW	325
Recreation lands	
Staircase Road Recreation Area	298
Hood Canal Recreation Park	5
Lake Kokanee boat access	4
LCSP	601
Total Tacoma lands within the proposed project boundary	5,441
Other lands	
Federal lands	
NPS, ONP lands	20
FS, ONF lands	14
Total of other lands within the project boundary	34

[1] Source: the staff.

The remainder of the land adjacent to the project boundary and along the lower North Fork includes lands within ONF, lands owned by timber companies, small farms, and private holdings. Additionally, along the mainstem there are federal lands held in trust on the Skokomish Indian Reservation.

The Skokomish Indian Reservation consists of approximately 5,000 acres situated at the mouth of the Skokomish River. The lands were set aside by the Point No Point Treaty on January 26, 1855 (12 Stat., P.934). By Executive Order, on February 25, 1874, these lands were designated as the Skokomish Indian Reservation.

3.6.2 Existing Land Use

Land use in Mason County is dominated by forestry. Approximately 60 percent of all land in the county is privately held, of which more than 80 percent is dedicated to raising trees for commercial purposes. Of the 40 percent of all county lands that are held publicly, a majority are under the control of WDNR (7 percent) and FS (28 percent). In total, 81 percent of all land in the county is devoted to forestry management (Mason County, 1992).

Within the project vicinity, the North Fork Valley is used for preservation, forestry, rural residential, limited agricultural, commercial, and recreational uses. ONP land use management of the upper North Fork area is closely coordinated with the preservation and protection of the flora and fauna of the region, which include fishery, botanical, and wildlife resources. FS, Tacoma, WDNR, WDFW, and Mason County manage natural resources and developed lands outside the park.

Within the project boundary, most developed land uses (residential and recreational) are located along the eastern side of the project reservoirs. Only minimal intermittent residential development has occurred along the western shore of Lake Cushman, largely because of the area's inaccessibility.

Approximately 3,515 acres of Tacoma-owned land on or adjacent to the project have been developed, including about 50 acres of land occupied by project facilities, such as the dams, powerhouses, and other structures. Tacoma leases another 3,166 acres of land to the Lake Cushman Development Corporation (LCDC). LCDC lands have been subdivided into 2,954 lots, 0.5 to 5 acres in size, and developed for residential use (figure 3-12). As of 1990, there were 537 permanent buildings and 742 nonpermanent structures, such as trailers and small cabins, on these lots. Tacoma also leases 601 acres to LCSP, of which 266 acres are in or surrounding recreation sites. Within the project boundary, more than 900 acres of land are dedicated for public recreational use, including fishing, boating, hiking, camping, swimming, and sightseeing (section 3.7).

In the lower North Fork, the predominant land use is forestry. Forestry uses give way to residential and agricultural uses at the confluence of the North Fork and South Fork. Timber production and forest management in both the North and South Fork drainages occur on lands managed by ONF and private timber companies. A cooperative forestry management agreement (the Shelton CSYU) between Simpson Timber Company and FS has been established to stabilize the economy of Mason County.

On the Skokomish Indian Reservation, land use primarily consists of residential and agricultural uses with minor amounts of forestry.

The Skokomish Tribe and the PortGample S'Klallam, the Jamestown S'Klallam and the Elwha S'Kallem Tribes have "access to usual and accustomed fishing areas and hunting and gathering rights on open and unclaimed land" in the Skokomish River Basin (letter from William Taylor, DOI, to Lois Cashell, FERC, March 29, 1996).

3.6.3 Shoreline and River Land Use Designations

Mason County has no comprehensive county-wide zoning measures in place at this time. The county is preparing a new comprehensive plan under the State Growth Management Act guidelines. The Mason County Comprehensive Plan and the Mason County Building Code provide general guidance for residential, commercial, and industrial uses. Although the Skokomish River floods several times a year, neither the comprehensive plan nor the building code contain special regulations regarding construction within flood plains. Mason County has participated in the National Flood Insurance Program since 1977. Preliminary Federal Emergency Management Agency (FEMA) floodway mapping indicates that the entire Skokomish Valley is within the 100-year flood plain of the Skokomish River. Because of concerns about the restrictiveness of the FEMA flood plain regulations, however, Mason County has adopted a flood damage reduction ordinance for the lower Skokomish Valley. Recently a comprehensive flood control management plan has been drafted for the Skokomish River system to address the numerous unresolved flood control problems.

Because Mason County is one of Washington's 15 coastal counties, the county's Shoreline Master Program (SMP) is also part of the Washington State Coastal Zone Management Program (CZMP). As such, actions requiring federal approval are required under Section 307 of the Coastal Zone Management Act of 1972 to be consistent to the maximum extent feasible with the State's CZMP. Washington's CZMP centers on the controls provided in the State's Shoreline Management Act, which is implemented through the county and city SMPs. Generally, projects that are consistent with the SMP will also be consistent with the CZMP. Powerhouse No. 2 and Hood Canal Recreation Park are within the coastal zone resource boundary. Although most of the project is not within the coastal zone resource boundary, any use occurring completely or partially within the resource boundary has a potential impact on coastal waters. Generally, new developments within the resource boundary require a Substantial Development Permit under the local SMP when total cost or fair market value exceeds $2,500 or if the development interferes with normal public use of water or shorelines of the state (Mason County, 1994).

The Mason County SMP addresses land use within 200 feet of most rivers, streams, lakefronts, and coastal shorelines. The plan's goal is to preserve, to the extent possible, the scenic, aesthetic, and ecological qualities of Mason County shorelines. The plan is implemented through county-wide shoreline designations. Figure 3-13 shows the shoreline designations for the Cushman Project area. Because the upper North Fork is in ONP, which is federally protected land, it has no shoreline designation.

The shorelines of Lake Cushman and Lake Kokanee possess a variety of environments and therefore have been assigned a variety of shoreline designations (Natural, Conservancy, Rural, Urban Residential). Lake Cushman is designated as Natural along the Staircase Road area. Lake Kokanee is designated as Natural along most of its western shore. The Natural designation pertains to areas that are largely undeveloped and are intolerant of intensive human use. LCSP and the Deer Meadow area are designated as Conservancy. The objective of the Conservancy designation is to protect, conserve, and manage existing natural resources and historic and cultural areas "to ensure a continuous flow of recreational benefits to the public" (Mason County, 1994). Nearly all of Lake Cushman's western shore is designated as Rural, which means it supports intensive agricultural or recreational use. In 1994, the Mason County Shoreline Protection Project recommended that the rural designation of the west side of Lake Cushman be changed to Conservancy or Natural, or a combination of both. The project also recommended that undesignated portions of the North Fork Skokomish south of Lake Kokanee and north of the section currently designated Conservancy be designated either Conservancy, Natural, or both. The rationale for both recommendations is that access is difficult, the area is undeveloped and in relatively natural condition, and there are few, if any services. With the exception of the Staircase Road area and LCSP, the eastern shore of Lake Cushman is designated as Urban Residential. Lake Kokanee's eastern shore is also designated as Urban Residential. The Urban Residential designation refers to an area of high intensity residential land use. The SMP policies regarding utilities primarily address the placement of new power lines and the potential for using powerline ROWs for recreation access.

The mainstem Skokomish River, including the south shoreline opposite the Skokomish Indian Reservation boundary, is designated as Rural. The SMP has no jurisdiction on federally held Skokomish Indian Reservation lands. The Washington CZMP and Mason County SMP, however, do have jurisdiction over non-reservation lands within the reservation, including Hood Canal Recreation Park.

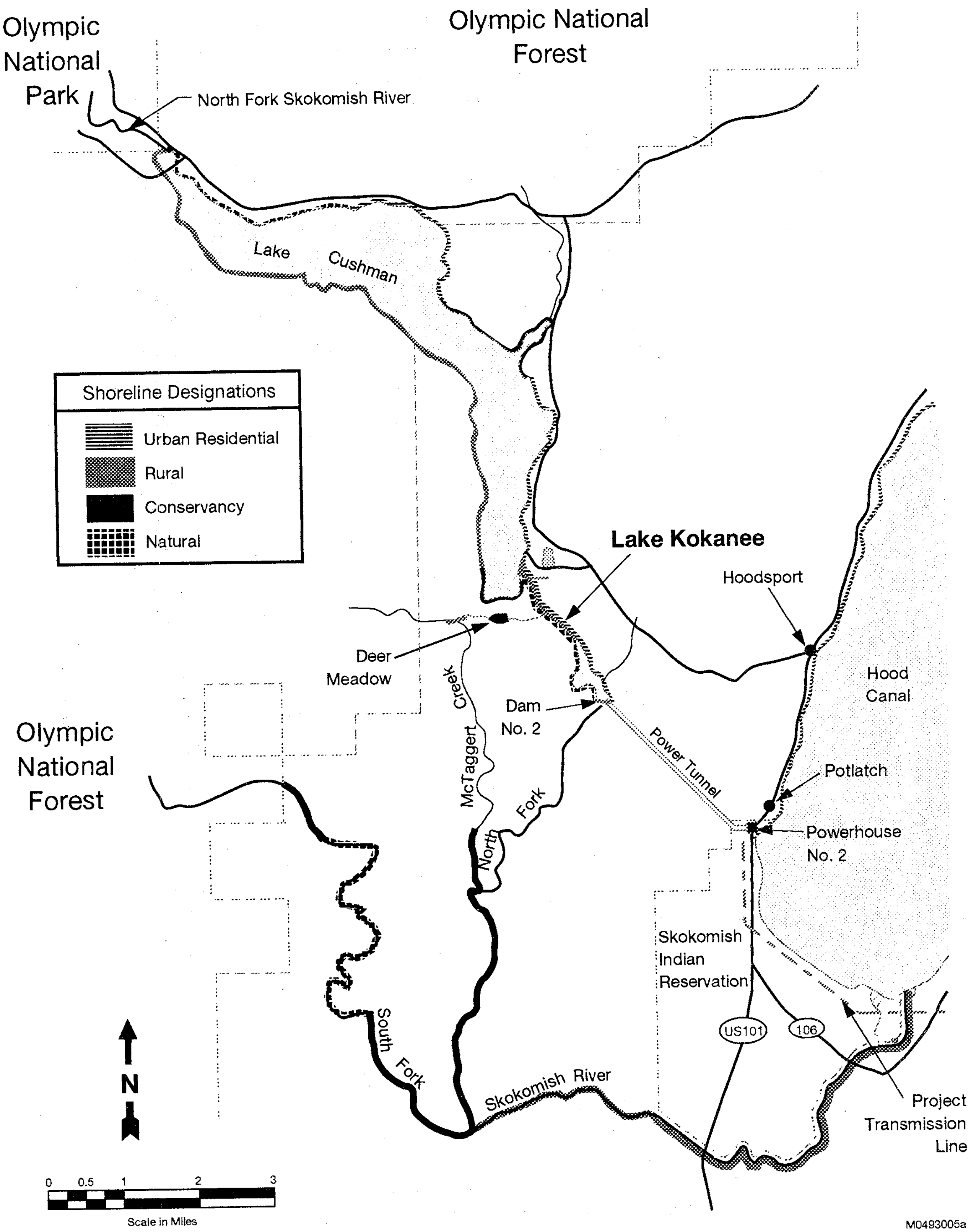

Figure 3-13. Mason County Shoreline Management Program shoreline designations. (Source: the staff.)

Lake Cushman and the mainstem Skokomish River (excluding the portion within the Skokomish Indian Reservation) are considered to be Shorelines of Statewide Significance. An area with the Shoreline of Statewide Significance designation requires local governments to recognize statewide interest over local interest, to preserve the natural character of the shoreline, and to enhance public access and recreation opportunities when implementing shoreline regulations and permitting shoreline uses (Mason County, 1994).

The Washington Rivers Inventory, compiled by WSPRC and NPS, identifies rivers in Washington State that might qualify for protective status under the state Scenic Rivers Program, the NPPC Protected Areas Amendments, or the federal Wild and Scenic Rivers Program. Although no segment of the Skokomish River system is listed on the Washington Rivers Inventory, the North Fork is regarded by ONP as eligible for designation as a wild and scenic river (NPS, 1991). FS has determined that the mainstem is ineligible for wild and scenic river status (FS, 1990).

3.6.4 Proposed Land Exchanges

Tacoma and NPS are negotiating a land exchange to prevent reservoir encroachment on ONP (section 1.2). The land exchange and subsequent national park boundary change would remove lands directly affected by the Cushman Project from ONP.

Tacoma is also negotiating a land exchange with FS to prevent Lake Cushman from occupying ONF lands. As these negotiations currently stand, about 11 acres of ONF land that are along Staircase Road and that are inundated by Lake Cushman, along with about 22 acres of FS lands that are inundated by Tacoma's Nisqually Hydroelectric Project (FERC Project No. 1862), would be conveyed to Tacoma by FS (Tacoma, 1993b). In exchange for these inundated lands, approximately 33 acres of Tacoma-owned land on Lake Cushman's northwest shore at the Dry Creek mouth would be conveyed to FS by Tacoma. These lands are currently encumbered by a lease to WSPRC for use as a boat park, but the lease is revocable and Tacoma is negotiating with WSPRC to resolve the encumbrance. FS has stated that it is prepared to issue a special use permit to Tacoma for lands occupied and flooded by the project in the event the land exchange is delayed (letter from FS to the Commission, March 14, 1996).

3.6.5 Comprehensive Plans

The following is a list of staff-reviewed federal and state plans that the Commission accepted as comprehensive plans pursuant to Section 10(a)(2) of the FPA.

- 1987-1988 Winter and Summer Steelhead Forecasts and Management Recommendations (WDW and Point No Point Treaty Council, 1987).
- Biennial Final State of Washington Natural Heritage Plan (WDNR, 1989).
- Final EIS and Fishery Management Plan for Commercial and Recreational Salmon Fisheries Off the Coasts of Washington, Oregon, and California Commencing in 1978 (NMFS, 1978).
- Eighth Amendment to the Fishery Management Plan for Commercial and Recreational Salmon Fisheries Off the Coasts of Washington, Oregon, and California Commencing in 1978 (PFMC, 1988).

- Hood Canal Salmon Management Plan (WDF et al., 1986).
- Hydroelectric Project Assessment Guidelines (WDF, 1987a).
- Northwest Conservation and Electric Power Plan (NPPC, 1991).
- Nationwide Rivers Inventory (NPS, 1982).
- Land and Resource Management Plan, Olympic National Forest (FS, 1990).
- Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA and DOI, 1994).
- Resource Protection Planning Process — Southern Puget Sound Study Unit (Washington State Department of Community Development, 1987).
- Resource Protection Planning Process — Study Unit Transportation (Washington State Department of Community Development, 1989).
- Strategies for Washington's Wildlife, 1987-1993 (Washington Department of Game, 1987).
- Washington's Statewide Comprehensive Outdoor Recreation Plan (Interagency Committee for Outdoor Recreation [ICOR], 1985).
- Washington Outdoors: Assessment and Policy Plan for 1990 — 1995 (ICOR, 1990).
- Washington State Trails Plan: Policy and Action Document (ICOR, 1991).
- Scenic Rivers Program — Report (WSPRC, 1988).
- Statute Establishing the State Scenic River System, Chapter 79.72 Revised Codes of Washington (RCW) (State of Washington, 1977).
- Washington State Scenic River Assessment (WSPRC et al., 1988).
- Shoreline Master Program Handbook (WDOE, 1994).
- Application of Shoreline Management to Hydroelectric Developments (WDOE, 1986).
- Washington Wetlands Priority Plan, State of Washington (ICOR, 1987).

3.6.6 Other Plans

The Cushman Project consultation process found these additional plans to be of interest to resource agencies, intervenors, and the Tribe. Though they do not meet the Commission's definition of a comprehensive plan, these plans address local land use concerns in the project area.

- 1991 Puget Sound Water Quality Management Plan (Puget Sound Water Quality Authority, 1991).

- Aquatic Lands, Strategic Plan (WDNR, 1992a).
- Comprehensive Plan, Skokomish Indian Reservation (Skokomish Indian Tribe, 1974).
- Final Framework Amendment for Managing Ocean Salmon Fisheries off the Coasts of Washington, Oregon, and California Commencing in 1985 (the sixth amendment) (PFMC, 1984).
- Hood Canal — Priorities for Tomorrow, an Initial Report on Fish and Wildlife, Developmental Aspects and Planning Considerations for Hood Canal, Washington (Yoshinaka and Ellifrit, 1974).
- Mason County Conservation District Long Range Plan (SCS, 1994).
- Mason County Shoreline Master Program, Amended (Mason County Planning Department, 1988).
- Master Plan, Olympic National Park (NPS, 1974).
- Olympic National Park Land Protection Plan (NPS, 1983).
- Resources Management Plan (NPS, 1991).
- State of Washington Natural Resources Conservation Areas Statewide Management Plan (WDNR, 1992b).
- Recreational Shellfish Action Plan, Public Review Draft (WDOE et al., 1993).
- Salmon 2000, Phase 2: Puget Sound, Washington Coast and Integrated Planning (WDF, 1992).
- Skokomish River Comprehensive Flood Control Management Plan, Preliminary Draft Plan (WDOE, 1988).
- Skokomish River Comprehensive Flood Hazard Management Plan, Volume II, Draft Report (Mason County, 1993).
- Washington State Coastal Zone Management Program (WDOE, 1994).
- Water Resources of the Skokomish Indian Tribe (James and Martino, 1980).
- Watershed Planning Proposed Enhancement Report (WDF, 1987b).
- Coastal Zone Considerations, Skokomish Indian Tribe (Pacific Rim Planners, Inc., 1981).
- Overall Economic Development Plan, Skokomish Indian Tribe (South Puget Intertribal Planning Agency and Skokomish Consulting Services, 1979).

3.7 Recreation Resources

The Cushman Project is situated within a regionally important recreation area of the Olympic Peninsula. Recreation access to Lake Cushman is directly associated with an important portal to ONP, Washington State's most visited national park. Lake Cushman is the largest freshwater body in Mason County. The project reservoirs support a moderate amount of recreational use compared to the other recreation areas on the Olympic Peninsula. During the peak-use summer season, though, Lake Cushman's northeast shore along Staircase Road and the Hood Canal Recreation Park experience intense recreational use.

3.7.1 Regional Recreation Resources

The Olympic Peninsula contains numerous federal, state, and county administered recreation areas (figure 3-14). ONP and ONF represent the two largest public recreational use areas on the peninsula. WSPRC, WDNR, and WDFW all maintain smaller subordinate recreation facilities. Indian Tribal governments, counties, cities, ports, and non-profit community organizations provide other recreation opportunities intended to meet the needs of local residents and visitors.

ONP comprises 927,626 acres and receives approximately 3,500,000 visitors per year, primarily from the Puget Sound region. Among the major park attractions are Lake Crescent, the Hoh Rain Forest, Hurricane Ridge, and Ozette Lake. Other important visitor areas in the eastern portion are Dosewallips, Soleduck, Graves Creek, and Staircase Campgrounds. In total there are approximately 1,000 developed campsites within the park.

ONF generally surrounds the park and encompasses 649,975 acres. The forest has developed campgrounds with 379 campsites and an extensive trail network, with most trails providing access to the adjoining park.

Popular forms of dispersed recreational activity in the region include backcountry hiking, camping, sightseeing, wildlife observation, and angling. Some hunting occurs in the region; however, hunting is not allowed within the park or on project lands.

Many areas on the Olympic Peninsula contain developed day-use areas suitable for sightseeing, picnicking, swimming, and other water activities. Sightseeing involves roadside or trailside wildlife observation, visits to museums and interpretive facilities, and roadside viewpoint pull-offs.

The Olympic Peninsula contains a variety of saltwater and freshwater fishing opportunities. Saltwater fishing for salmon, ling cod, and halibut is excellent along the north coast from Neah Bay to Port Townsend. Hood Canal also offers good saltwater angling opportunities, but is particularly noted for good shellfish gathering opportunities. Salmon, steelhead, and other trout fishing occurs on the Soleduck, Queets, Dungeness, Hamma Hamma, Dosewallips, and Skokomish rivers.

Outside the national park and national forest boundaries are other important tourist destinations and recreation areas, including Port Townsend, a historic waterfront city; Neah Bay, a Makah Indian town with an excellent saltwater sport fishery and cultural heritage museum; Lake Quinault, a resort area; Hood Canal, a popular waterfront area for second homes and retirees; and Lake Cushman, which provides recreational fishing opportunities and seasonal homes.

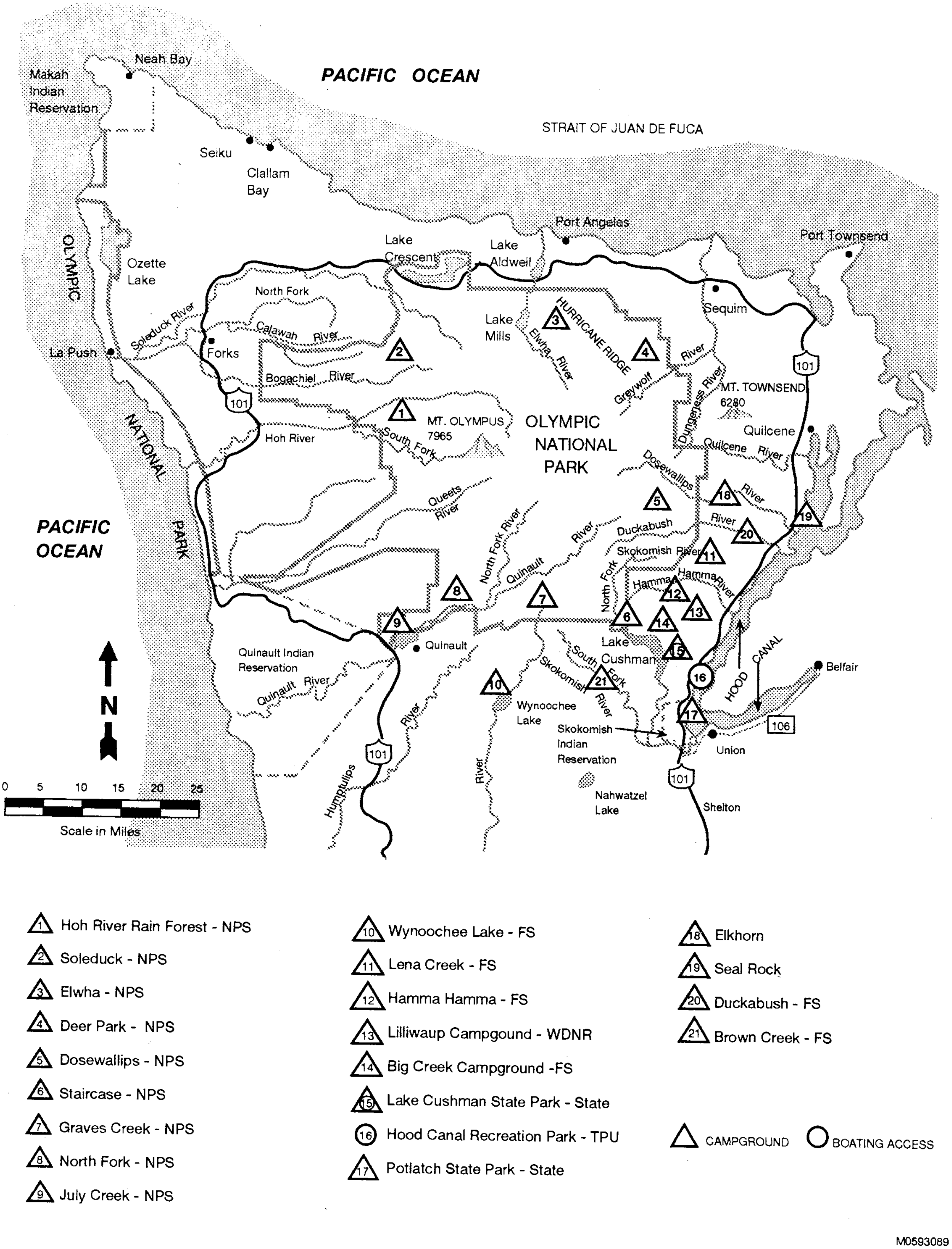

Figure 3-14. Map of the recreation resources in the project region. (Source: the staff.)

3.7.2 Project Area Recreation Resources

The most prominent recreational uses in the Skokomish River Basin are sightseeing, fishing, hiking, boating, and camping. Other less prevalent uses include swimming, picnicking, wildlife observation, and hunting.

The major recreation resources of the Cushman Project area include the Staircase area of ONP, the Hoodsport Ranger District of ONF, the lands and waters of the upper reaches of the North and South Forks, Lake Cushman, and Lake Kokanee. Hood Canal is an important saltwater recreation resource that is adjacent to the project.

Access to the Skokomish River Basin is primarily via local roads connecting to US 101 (figure 3-15). Staircase Road provides vehicular access to Lake Cushman and ends at the NPS Staircase Campground and Ranger Station. The upper 12 miles of the North Fork are accessible only by trails that originate from the campground area. Most of the lower North Fork is inaccessible because of the deep gorge and steep banks that characterize this reach. Vehicular access to the lower North Fork is only available at one point, the Wet Crossing at RM 12.6.

Staircase Campground, open year-round, is the main NPS recreation development in the project area. The campground is on the North Fork just upstream of Lake Cushman. Six of the 60 campsites in the campground are located along the river. Staircase Campground includes a picnic area and the trailhead for the Skokomish River Trail (NPS Trail No. 110). The upper North Fork is a popular catch and release (lures only) trout river.

Two FS trailheads are within the immediate project vicinity: Mt. Rose Trail (FS Trail No. 814) and Dry Creek Trail (FS Trail No. 872). Both trails originate near the northern shores of Lake Cushman and provide opportunities for day hiking, backpacking, wildlife observation, and scenic views. Big Creek Campground is the only overnight FS facility in the general project area with campsites along the Big Creek shoreline. WDNR manages the nearby Lilliwaup Creek Campground, just east of the Big Creek Campground.

Informal pullouts along Staircase Road are used to access popular public day-use sites along the reservoir at Staircase Road and Bear Gulch Recreation Areas. These sites have little or no development. In addition to providing public recreation lands, LCDC has developed six private lakeshore community parks specifically for the residents of Lake Cushman and Lake Kokanee. LCDC subleases the privately developed homesites for some full-time residents and more frequently as second homes built for recreation purposes.

The Lake Cushman Resort and the Lake Cushman Golf Course are commercial recreation facilities next to Lake Cushman that are open to the public. Services and amenities at the resort include boat rental, boat launch, a dock and moorage, and playground and beach access.

The shoreline of Lake Cushman is also accessible to the public via three public recreation areas managed by WSPRC under use permits from Tacoma: LCSP, Dry Creek Boater Destination Park, and Deer Meadow Boater Destination Park. The 601-acre LCSP, a full-service camping, boating, and day-use state park, is the major recreation development on the upper reservoir. The Deer Meadow site is fully developed and primarily accessible by boat, and the Dry Creek site is undeveloped and accessible by boat or trail. WSPRC typically manages sites for a diverse set of opportunities that range from natural history and historic heritage sites to full-service campgrounds.

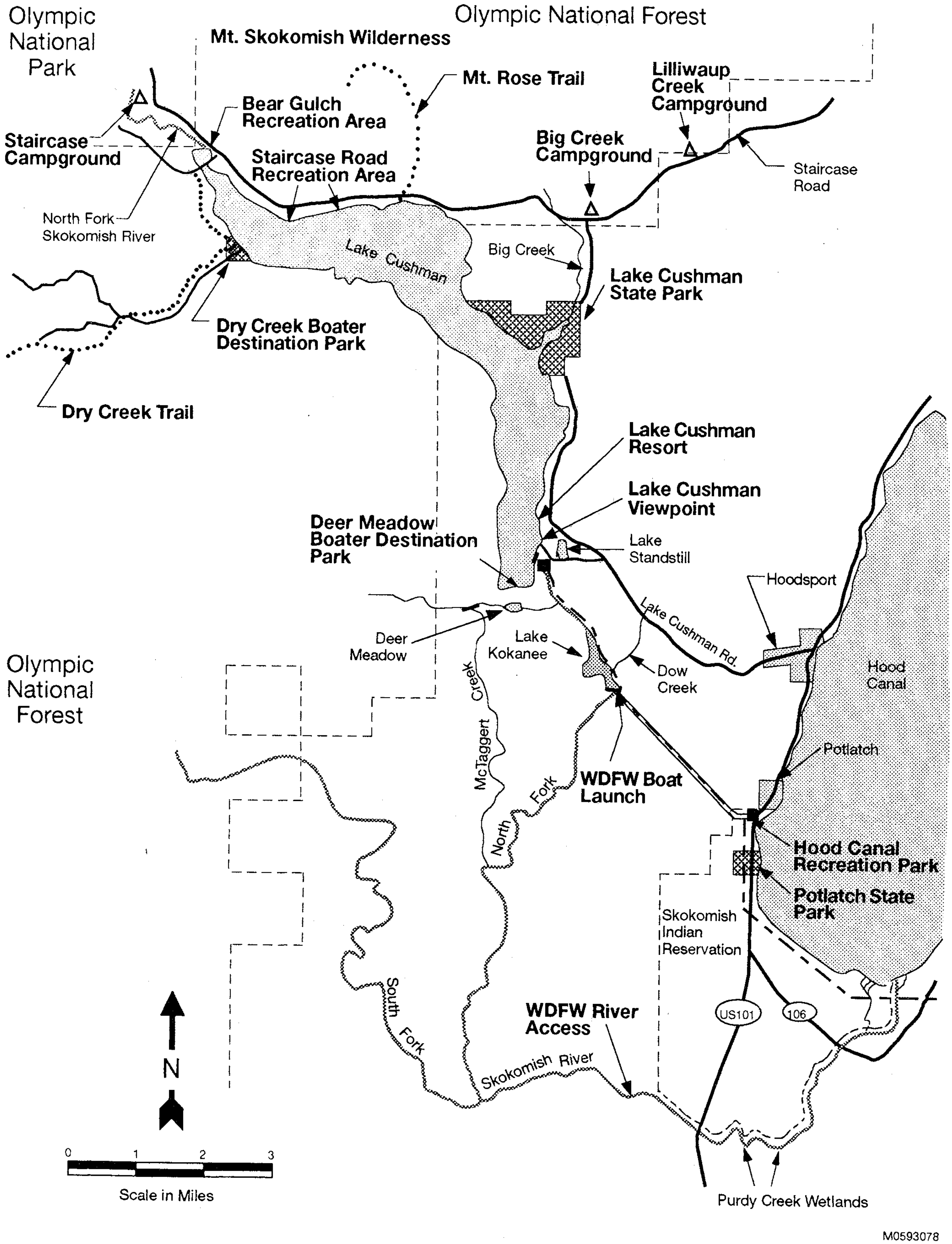

Figure 3-15. Public recreation areas and facilities in the Cushman Project vicinity. (Source: the staff.)

At Lake Kokanee, WDFW administers a boat launching facility near the dam. The facility consists of a concrete-surfaced boat launch, a large gravel-surfaced parking area, and pit toilet facilities. WDFW also operates a partially developed river access site on the mainstem Skokomish River.

The two project reservoirs provide a range of recreation opportunities and experiences. Both reservoirs offer angling opportunities. Lake Cushman is approximately 40 times larger than Lake Kokanee and is well-suited to large motorboat activities such as waterskiing. Lake Kokanee is a smaller, calmer waterbody that is better suited to activities like canoeing and bird watching. Lake Kokanee attracts fewer and smaller groups, primarily because public access is limited and the lake is very small and secluded. Both project reservoirs have private shoreline parks for residents of the Lake Cushman subdivisions.

Handicapped-accessible facilities in the project area are limited. LCSP has handicapped-accessible parking spaces and restrooms.

The existing recreation facilities at Lake Cushman, both public and private, are oriented along the shoreline based on the typical summer water level of 738 feet. As the reservoir level is drafted below elevation 738 feet, the docks, beaches, boat ramps, and other recreation facilities become less functional. Below elevation 725 feet, all boat ramps and docks are unusable. Additionally, drafting the reservoir below 738 feet exposes the rocky shore and stumps, which create a potential safety hazard to recreationists. In addition to the safety hazards and loss of boat launching and docking capabilities, many facilities such as picnic sites and beaches lose their appeal as recreation areas when the reservoir is drafted below elevation 738 feet. The level of Lake Kokanee fluctuates little, and the ability to use the reservoir for boating and other uses varies little throughout the season.

Hood Canal Recreation Park, also known as Hydro Park or Saltwater Park, is located on Hood Canal across US 101 from Powerhouse No. 2 and is managed by Tacoma. The facility consists of a concrete boat ramp, a gravel-surfaced parking area, picnicking areas, and toilet facilities. This facility provides for recreational activities based on the saltwater resources of Hood Canal. The boat ramp is the major recreation boat access point to southern Hood Canal.

Potlatch State Park (managed by WSPRC) is located on US 101, just south of Powerhouse No. 2. The park offers camping, picnicking, hiking, and clam digging opportunities.

Fishing in the upper North Fork is subject to NPS regulations. Currently, the fishing regulations are similar to WDFW state regulations, except that no fishing license is required within the park. WDFW state regulations apply to the project reservoirs, the lower reach of the North Fork, and saltwater resources including the southern hook of Hood Canal. WDFW is responsible for providing freshwater boat access where possible and for managing and permitting the harvest of freshwater game fisheries and upland game species. WDFW also manages and permits the recreational and commercial harvest of freshwater and saltwater salmon fisheries, shellfish fisheries, and other saltwater fisheries.

3.7.3 Use Levels and User Characteristics

The Statewide Comprehensive Outdoor Recreation Plan (SCORP) divides the state into four geographic regions to help determine regional differences in use based on origin of users. The

Cushman Project is in Region 2. This region is characterized as the source of the majority of the state's recreation demand for all recreational activity categories. With the exception of camping, Region 2 is also used as the destination for more recreation demand than any other region in the state. Many households in this region, however, recreate in other regions to satisfy their great demand. Throughout the state, activities such as saltwater fishing from a boat, swimming and wading at a beach, water skiing, lake power boating, lake non-motorized boating, visiting interpretive centers and displays, wildlife observation, outdoor photography, day hiking, walking in a neighborhood park, backpacking, tent camping, recreational vehicle camping, sightseeing, and picnicking are anticipated to grow over 30 percent by the year 2000 (ICOR, 1990). The SCORP identifies a statewide need for trails and public access to water and shorelines.

Though comprehensive visitation records of recreational use in the Skokomish River Basin are not available, NPS does estimate park visitation. Campground use information, based on park fee collection schedules, is also available. NPS statistics for ONP's Staircase Park Campground use shows irregular visitation, with the number of visitors varying from about 58,000 in 1989 to about 90,000 in 1992 (ONP, 1992-1994). Peak visitation occurs between June and October.

Of the 14 state parks in the Olympic Peninsula region, LCSP ranked fourth in total overnight visitation from 1980 to 1988. LCSP visitation increased 63.6 percent in the period 1986 to 1990.

There are no use data available for the Hood Canal Recreation Park. With the exception of shrimp season and low clamming tides, the facility is not used to capacity. During the shrimp season, which at this location extends from the third weekend in May until it is closed by WDFW, the boat launch and parking area are crowded and exceed capacity. This situation can be problematic as this facility abuts the road and spillover from the parking lot or boat launch can affect traffic flow on US 101.

There are also no data available for the Staircase Road Recreation Area. The areas receive intensive use during the peak recreation season (Memorial Day through Labor Day). Dispersed recreational use in the Staircase Road Recreation Area (figure 3-15) has created problems with sanitation, litter, and fire hazards. FS owns a few parcels in the Staircase Road area and large tracts north of the road. Although it has no formal responsibility for managing Tacoma-owned lands in the Staircase Road area, FS has taken actions on Tacoma land to prevent wildfire and to remove substantial amounts of garbage from the Staircase Road Recreation Area. FS describes this increasingly popular, unregulated area as "a public health hazard, a source of pollution entering the lake and surrounding streams, and a fire risk to surrounding lands" (letter from D. Craig, District Ranger, FS, Hoodsport, Washington, December 10, 1992). Tacoma has been working with FS to design developed recreation facilities to minimize these problems. Recently some sanitary facilities have been provided and the area has been posted for no overnight camping. Through an agreement signed in 1995, Tacoma and the FS co-manage the Staircase Road area to prevent overnight camping and provide sanitary facilities (Tacoma 1996).

WDFW has noted that demand is increasing substantially with time in the Skokomish watershed. WDFW has stated that "During peak periods, demand exceeds existing facility capacity, as evidenced by full campgrounds, long waits at boat launches, and the occurrence of roadside camping. High demand demonstrates a need for recreational facility expansion." (Letter from Curt Leigh, Mitigation Resolution, WDFW, Olympia, Washington, October 26, 1994.)

3.8 Aesthetic Resources

In the following sections, we describe the regional landscape, the project components, the landscape immediately surrounding the project area, and the aesthetic experiences currently available within the project area. We also describe the existing visual management of the project area.

3.8.1 Regional Landscape Setting

The Cushman Project is located on the southeastern edge of the Olympic Peninsula and is dominated by the backdrop of the 8,000-foot-high Olympic Mountains. ONP, the core of the Olympic Peninsula, is famous for its snowcapped peaks; remote, wet old-growth forest valleys; and water-carved rock and sand beaches along its coastal section. The park and portions of the surrounding ONF contain landforms that show evidence of extensive glaciation, such as broad U-shaped river valleys and rocky peaks surrounded by alpine cirques, lakes, and meadows.

Recent and past logging on private and public timberlands outside the park boundary have made ONP a highly visible forest oasis. As seen from roads, trails, and viewpoints, the boundaries are frequently obvious because of adjacent logging. NPS has not developed a specific visual resource management system, because its resource preservation goals and management policies already protect visual resources.

ONF surrounds most of ONP. FS uses the Visual Management System to manage its visual resources. The Visual Management System sets Visual Quality Objective classifications, which are used as goals for aesthetics on FS lands. Most of ONF is classified under the VQO of Modification or Maximum Modification (where management activities may dominate the natural landscape but should attempt to repeat natural occurrences). Other Visual Quality Objectives in ONF are Retention (where management activities are not apparent), Partial Retention (management activities may be evident but do not dominate the landscape), and Preservation (generally only ecological changes alter the landscape). FS manages the Mount Skokomish Wilderness area, located about 0.5 mile east and about 1,400 feet above the project, as a Preservation area.

The principal characteristic of the Skokomish River Basin is the steep, heavily timbered terrain found throughout the watershed except for the lower Skokomish River, which passes through a broad flood plain. The North and South Forks have formed spectacular, deep canyons. Below the canyons of the North and South Forks, the valley floor widens. The broad, fertile valley occupies the lowermost sections of the forks and the mainstem.

Lake Cushman, Lake Kokanee, the delta, and scenic Hood Canal are among the most prominent features associated with the Skokomish River.

3.8.2 Aesthetic Resource Management

The varied pattern of land ownership and management surrounding the Cushman Project has created diversity in the aesthetic qualities of the area. Lands within ONP boundaries to the north have been maintained in a relatively natural state since the park was established in 1938. No park buildings or structures are visible from the project works vicinity.

The surrounding multiple-use FS lands within the north Lake Cushman viewshed are classified as Preservation, Retention, or Partial Retention lands for visual management purposes. Only minimal evidence of forest harvest areas is visible from the Lake Cushman viewshed.

LCDC manages approximately 3,166 acres of land adjacent to the Cushman Project and subleases most of it as private residences. LCDC has shoreline development policies and covenants that are designed, in part, to protect visual resources at Lake Cushman and Lake Kokanee. These covenants include restrictions on clear cutting.

Within the project viewshed are numerous parcels of public lands managed by NPS, FS, and WDNR. NPS and FS manage their lands to protect visual resources using agency policies or visual management programs. The Mason County Shoreline Management Program has regulations that indirectly protect visual quality of private lands along the project shoreline.

Project hydropower facilities are listed in the National Register of Historic Places. The State Historic Preservation Officer (SHPO) is responsible for administering federal guidelines for protecting the historic structures and their contextual landscape settings. The SHPO must be consulted prior to implementing measures that may affect historic properties to mitigate any impacts on them. For nationally registered historic facilities, appropriate visual management objectives may include restoration and protection of historic context.

3.8.3 Project Features and Visibility

The project dams and reservoirs are within a few minutes drive of the town of Hoodsport, located along scenic Hood Canal. Access to project facilities is provided via US 101, Lake Cushman Road, and some secondary roads. Figure 3-16 shows key viewing areas from which project facilities are visible, and table 3-10 provides estimated number of viewers at each viewing location.

3.8.3.1 Dam No. 1 and Lake Cushman

Visitors can access both Dam No. 1 and a small, unmarked overlook via Standstill Drive South, a signed dead-end road. From the overlook, visitors can view the upper portion of the dam's downstream face, the powerhouse access tramway, maintenance buildings, and switchyard. The view, dominated by transmission lines, provides an aesthetic experience to those visitors interested in the project works. A fence cuts off public access to the dam and the canyon. The public is generally unable to view Powerhouse No. 1, which is at the base of Dam No. 1 in a steep narrow canyon. The tailrace, which discharges directly into Lake Kokanee, is also not accessible to the public. Portions of the dam structure are partially visible from the southernmost portion of the reservoir and shorelines. A log boom at the upper end of Lake Kokanee prevents boaters from viewing Dam No. 1 facilities.

The dam appears as a large, arched wedge spanning the uppermost portion of a deep canyon. The weathered and stained concrete surface blends with the adjacent rock color. The switchyard and several small operation and maintenance structures are located on the north bank near the dam, creating a cluttered appearance. The buildings consist of differing architectural styles, materials, and colors.

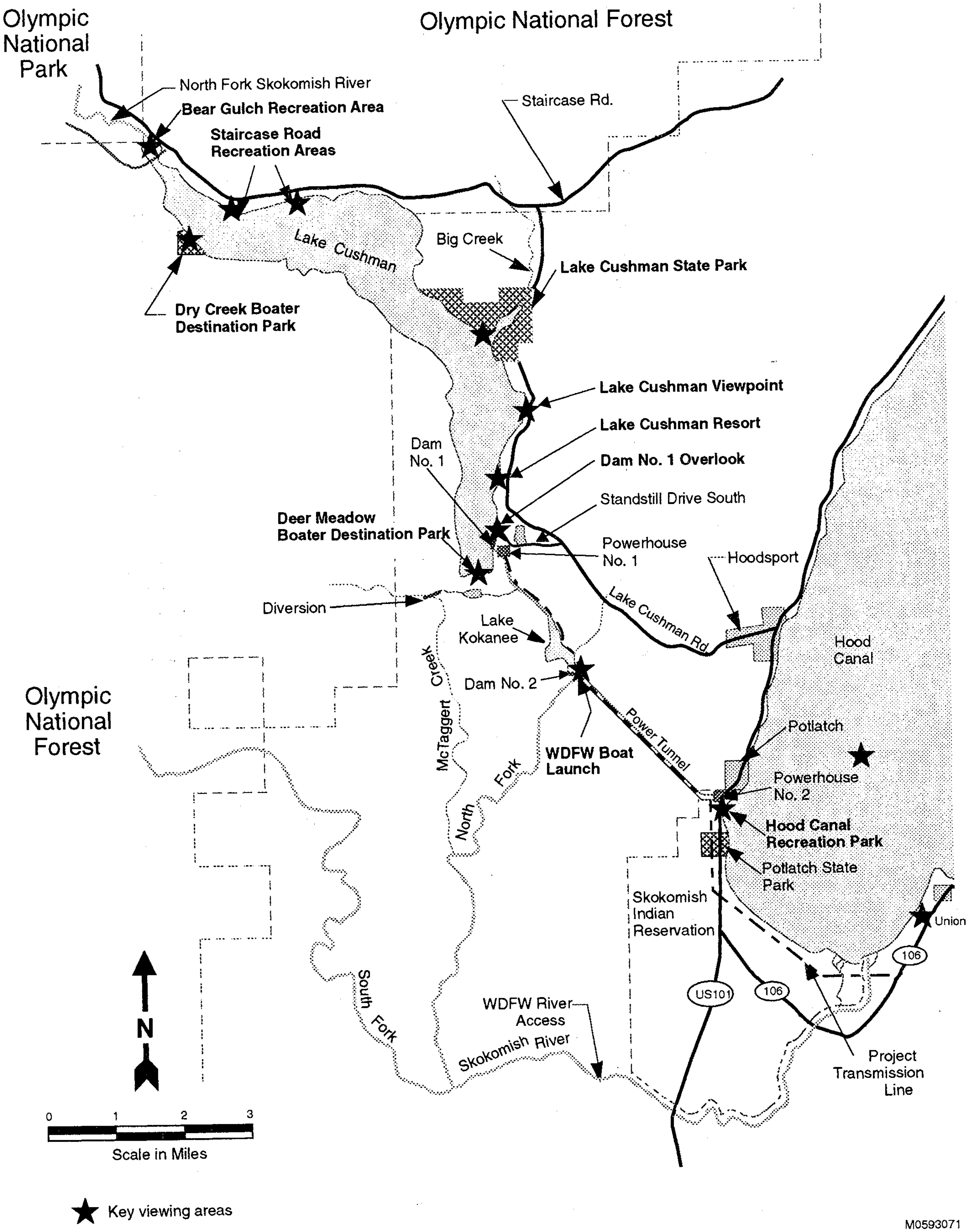

Figure 3-16. Cushman Project key viewing areas. (Source: the staff.)

Table 3-10. Estimated[1] numbers of visitors per day during the peak recreation season at key viewing areas.[2]

Visual feature / Key viewing area	Uses [3]	Access [3]	Visitors per day
Dam No. 1	NA	B	1,000-2,000
Dam No. 1 overlook	H,R	M	25-50
Lake Cushman	R	M,B	1,000-2,000
Lake Cushman Viewpoint	R,H,C	M	1,000-2,000
Staircase Road and Bear Gulch Recreation Areas	R,H,C	M,B	500-1,000
Lake Cushman State Park	R	M,B	500-1,000
Dry Creek Boater Destination Park	R	B	10-25
Deer Meadow Boater Destination Park	R	B	25-50
Lake Cushman Resort	R,C	M,B	100-250
Dam No. 2 and Lake Kokanee	R	M,B	25-100
WDFW boat launch	R	M,B	25-50
Powerhouse No. 2	R	M,B	5,000-10,000
U.S. Highway 101	R,H,C	M	5,000-10,000
State Highway 106	R,C,H	M	1,000-2,000
Hood Canal-SW shore	R,C	M,B	1,000-2,000
Hood Canal Recreation Park	R,C	M,B	1,000-2,000

1 Average visitors per day estimated by Tacoma in 1987.
2 Source: Tacoma, 1990; staff.
3 R = recreation C = commercial M = motor vehicle
H = residential NA = not applicable B = boat

The recently reconstructed Cushman spillway structure is tucked back in a small bay along Lake Cushman's southern shore, which discharges into Deer Meadow Creek. The top of the spillway is fenced for safety reasons. A view of the top of the spillway is not generally possible, except by boat on Lake Cushman. Unlike the older dam structures of the project, the recently constructed spillway structure has a clean concrete surface that contrasts with the adjacent rock.

Although Lake Cushman Road parallels the southwestern shore of Lake Cushman for nearly 5 miles, direct views of the reservoir are often limited by vegetation and topography. A designated viewpoint is located on Lake Cushman Road south of LCSP and provides a limited view of the reservoir's western shore as well as a view of the LCDC's Pioneer Village development. The view is somewhat obstructed by trees. Staircase Road, which parallels the north shore of the reservoir for approximately 4.5 miles, provides a panoramic view of the western shoreline, forested uplands, and rugged mountain scenery. A medium-size clear cut area on the northwestern side of the reservoir is visible from this road.

Several recreation areas provide views of Lake Cushman: LCSP, Dry Creek Boater Destination Park, Deer Meadow Boater Destination Park, Staircase Road and Bear Gulch Recreation Areas, and Lake Cushman Resort.

Lake Cushman is a large, natural-appearing lake. The mountainous, forested terrain surrounding the reservoir is generally rugged and very scenic as viewed from the lake. Mount Ellinor and Mount Washington are visible from almost anywhere on the reservoir. Residential subdivisions, patches of harvested timber, recreation sites, and the project facilities are also visible from the lake.

Significant reservoir fluctuations have a major impact on the visual quality of Lake Cushman's shoreline. Under current operating modes, the pool elevation varies greatly with the seasons. During the peak recreation season (Memorial Day to Labor Day), the pool elevation is generally maintained at 738 feet. Winter draw-downs may drop the reservoir as low as 690 feet. When the reservoir is drafted below 738 feet, a wide band of unvegetated shoreline is exposed and thousands of tree stumps project above the surface. Additionally, large jagged rocky outcrops are widely visible along the upper shorelines of the lake. These outcrops become progressively more visible as the lake is drawn down from elevation 738 feet.

3.8.3.2 Dam No. 2, Lake Kokanee, and the North Fork

The top 15 feet of Dam No. 2 is visible from lower Lake Kokanee shorelines and from the WDFW boating access facility on the north side of the lake. The gated dam access road prevents public access and viewing of the downstream faces of the dam, spillway, and lower North Fork gorge. The dam's weathered surface blends with the adjacent rock.

Lower Lake Kokanee can be viewed from the WDFW boating access. The lake is situated in a narrow valley and is surrounded by somewhat mountainous, wooded terrain. There are many residences nestled among the trees on a high plateau above the lake's eastern shoreline. The normal water surface elevation of Lake Kokanee varies little throughout the year. The visible developments on the reservoir shoreline are the dam facilities, the WDFW boat launch, and the private residences and recreation areas along the east shore.

The project is currently operated to provide a continuous 30-cfs discharge to the North Fork downstream from Dam No. 2. The 8-mile reach of the lower North Fork from Dam No. 2 to the confluence with the mainstem has virtually no overlooks. There are no public viewpoints between Powerhouse No. 2 and the lower North Fork's confluence with McTaggert Creek. Between the confluence with McTaggert Creek and the confluence with the South Fork, the lower North Fork is characterized by dense vegetation, rapids, deep pools, moderate currents, and waterfalls. The same characteristics that define the scenic quality of the river also contribute to the difficult physical and visual access. The area known as the Wet Crossing, accessed from the west via FS Road 2202 and from the east via Stevens Road, is the only location accessible to the public but is only of local importance and few viewers are aware of it.

3.8.3.3 Powerhouse No. 2

Views of the powerhouse and associated facilities are provided from US 101 (which runs adjacent to the powerhouse) and Hood Canal Recreation Park (located across the highway from the powerhouse). A fence prohibits public access to the switchyard and operations area behind the powerhouse. The public may, however, view both sides and front of the federally listed historic powerhouse and use a walkway on the powerhouse front that spans the tailrace.

Powerhouse No. 2 and associated facilities are the most visually conspicuous components of the Cushman Project. Three silver painted penstocks, 12 feet in diameter, are highly visible as they extend down the steep hillside to the powerhouse. The surge tank, also painted silver, is silhouetted against the sky at the top of the hill where the penstocks begin their descent. A wide swath of native vegetation has been cleared on the otherwise heavily wooded hillside to make way for the surge tank and penstocks. Likewise, vegetation has been cleared around the utility buildings and structures so they are in open view. The facilities' proximity to the well-travelled US 101 makes them highly visible to visitors passing through the area. These structures contrast strongly with the natural appearing landscape, especially as viewed from Hood Canal, State Highway 106 across Hood Canal, Hood Canal Recreation Park, and other places on the Skokomish Delta.

3.8.3.4 Transmission Line

The 26.8-mile-long transmission line is visible from several locations between the project and the Vaughn Tap. The line parallels Potlatch Road for about 0.5 mile and US 101 for about 1 mile before crossing US 101. It is visible from several other highways including State Highway 106 (1 mile south of Union City), State Highway 3 (0.5 mile north of Allyn), State Highway 302 (0.5 mile north of Victor and approximately 1 mile from Wauna), and State Highway 16 (at Purdy). The transmission line has two sets of conductors with three conductors per set. The transmission line ROW has varying vegetation, including cultivated Christmas trees.

3.9 Socioeconomic Resources

The socioeconomic area most relevant to the Cushman Project encompasses Mason County, which includes the city of Shelton and the Skokomish Indian Reservation. The area's economy is based largely on the region's natural resources. As the largest industry in the county, the forest products industry has historically played a significant role in the region and continues to do so. The area's numerous scenic attractions, recreation opportunities, freshwater and marine resources, and moderate climate attract recreationists, tourists, anglers, and retired people. These groups are significant to the local economies in that they create a market for the service and retail trade sectors in Mason County.

3.9.1 Social Characteristics

3.9.1.1 Population

Mason County has experienced significant but sporadic population growth over the past 25 years. Between 1970 and 1973, the county's population grew by less than 1 percent. From 1973 to 1980, however, population growth increased and grew by nearly 50 percent, from 21,100 to 31,184 (ESD, 1989). Growth slowed again in the early 1980's, with a 12 percent increase occurring between 1980 and 1984, followed by no population increase in 1985. From 1985 to 1990, the Mason County population grew about 10 percent to a total of 38,341 (ESD, 1989; OFM, 1992b).

In-migration contributed just over half of the population growth in Mason County between 1980 and 1990 (OFM, 1992b). According to the Washington State Employment Security Division (ESD), "recent growth in Mason County is generally linked to its proximity to other fast growing Puget Sound counties, namely Thurston and Kitsap" (ESD, 1989). Mason County is considered to be a bedroom community for these counties and a continually increasing number of families have chosen to live in Mason County and commute to work in Thurston and Kitsap Counties.

From 1980 to 1990, the portion of Mason County's retirement aged population (65 years and older) increased by about 60 percent, more than any other age group. This group represents about

16 percent of the county's population (ESD, 1991). The only age group that declined during that same period was the 16 to 21-year-old group, which decreased by about 16 percent (ESD, 1991). OFM anticipates that the population will continue to grow older with median age increasing from just under 37 in 1990 to just under 40 in 2010 (OFM, 1992a).

The city of Shelton, the only incorporated area in Mason County, has not experienced the same growth as the rest of the county. Although its population decreased by 5 percent between 1980 and 1990, Shelton remains the largest population center in Mason County, with an estimated 25 percent of the county's population (ESD, 1991).

The Washington Office of Financial Management (OFM) forecasts that the population of Mason County will continue to grow to a total of about 51,335 persons by year 2010, with decennial increases of about 17 percent projected between 1990 to 2000 and 15 percent between 2000 and 2010 (OFM, 1992a).

3.9.1.2 Employment

In 1990, the total civilian labor force in Mason County numbered 14,600 with average annual employment of 13,700 individuals (ESD, 1991). Between 1981 and 1990, Mason County had a 3.5 percent annual growth in employment. Among the county's fastest growing industries were tourism, recreation, and health care (Mason County, 1992).

Historically, manufacturing, particularly the lumber and wood products industry, has been a dominant force in the Mason County economy. Since the 1950's, manufacturing activities in the county have been declining. During the 1970's, the manufacturing sector's share of total county employment fluctuated between 30 and 34 percent. Over the years, however, the county's economy has diversified and other business sectors have grown. In 1990, the manufacturing sector accounted for about 23 percent of county non-agricultural employment (ESD, 1991), with the lumber and wood products industries representing more than a 50 percent share of all Mason County manufacturing jobs (ESD, 1989).

Within the state of Washington, forest products manufacturing is second only to the transportation equipment sector in terms of employment and income contribution to the Washington economy (OFM and ESD, 1992). Composed of two sectors, lumber and wood products, and pulp and paper products, the forest products manufacturing industry employed approximately 18 percent of the total manufacturing labor within the state (OFM and ESD, 1992). According to OFM, over the past decade, productivity gains were achieved through the substitution of capital for labor. As a result, "lumber output in the late-1980s reached pre-recession levels with a quarter less workers" (OFM and ESD, 1992).

OFM projects the future for employment, production, and profitability in the forest products industries to be "clouded by environmental concerns" (OFM and ESD, 1992). With the listing of the northern spotted owl as a threatened species in 1990 and the subsequent development of plans to minimize the disruption of the owl's life cycle, a significant portion of FS land has been removed from logging. Although demand for lumber and wood products shows no prospect of diminishing, OFM anticipates that the reduction in available timber supply will lead to a shaking-out among smaller operators and a reduction in forest products related employment over the next decade (OFM and ESD, 1992). Mason County, with high levels of private timber ownership, large mills, and little dependence on log exporting, is unlikely to be as affected by problems facing the industry as are other nearby counties (Mason County, 1992).

The second most prominent employment sector in Mason County is government, which employed about 33 percent of the county's population in 1988. Other county employment was split between trade, 21 percent; services, 13 percent; finance, insurance, and real estate, 4 percent; and transportation and public utilities, and construction and mining, each employing about 3 percent (ESD, 1989).

According to the Mason County Planning Commission, many residents of the county commute to outside areas to work. It is anticipated that the population of the county will continue to grow even though its main economic base, the timber industry, is likely to continue to decline in size (Mason County, 1991).

The unemployment rate in Mason County has been higher than that of the state since at least the early 1980's. In 1990, the unemployment rate in Mason County was 6.2 percent (ESD, 1991). Although that rate was significantly lower than the 1982 high of 14.7 percent, it was still above the state's 1990 average of 4.9 percent (ESD, 1989; OFM and ESD, 1992).

In 1992, Mason County was designated as a "labor surplus area" by the U.S. Department of Labor. The purpose of the labor surplus designation is to help guide a portion of the government's procurement dollars into those areas with the highest unemployment. The labor surplus classification is based on an area's unemployment rate for the previous 2-year period during which time the area must have had an unemployment rate of over 6.6 percent (ESD, 1991).

Mason County was also designated as a "distressed area" in 1991. This designation is for the purposes of consideration for special assistance and is based on a 3-year average unemployment rate that is at least 20 percent above the state's average (ESD, 1991).

As noted in section 3.9.1.1, the retirement aged population in Mason County has grown considerably in recent years. With this population projected to grow another 15 percent by the year 2000, it is anticipated that new jobs will be created as a result of the increasing demand for and use of medical facilities, retirement homes, and nursing care services (ESD, 1989).

3.9.1.3 Income

In 1989, 55 percent of total personal income in Mason County was derived from labor income, 21 percent from investment income (dividends, interest and real estate), and 24 percent from transfer payments.

For the United States and Washington state, 1989 per capita income was $17,592 and $17,696, respectively, indicating Washington to be an average state (Mason County, 1992). The 1989 per capita income within Mason County was $13,072, considerably below the federal and state averages (ESD, 1991). Mason County's real per capita income (numbers adjusted for inflation using the Gross National Product deflator for consumption and shown in constant dollars) has consistently been below the state levels over the past 25 years and has progressively lost ground against the state average since that time. In the early 1970's, local per capita income was about 90 percent of the state average; by the latter half of the decade it had receded to around 85 percent. By

1987 it was down to just more than 75 percent of the state average and, according to the Washington State Employment Security Department (ESD), still falling (ESD, 1989).

Although it has posted consistently positive increases in per capita income, when compared to the state, Mason County has seen a higher than average growth in the number of persons living below the poverty level. Just over 13 percent of the county's population fell into this category in 1989, up from 10.2 percent in 1979. Within the state as a whole, the 1989 average of just under 11 percent of the population living below the poverty level represented less than a 2 percentage point increase over the 1979 average of 9.8 percent (OFM, 1992b).

Recent trends indicate that as the older, retirement aged population has increased, the sources of personal income in Mason County have been shifting from wages and salaries to retirement-related transfer payments (social security, government medical insurance programs, and specific government retirement programs) and investment incomes. In real terms, retirement-related transfer payments grew from $16,833,000 in 1970 to $64,767,000 in 1987, a total of 285 percent. During that same time period, retirement-related transfer payments rose steadily as a share of total county personal income; from 8 percent in 1970 to nearly 15 percent in 1987 (ESD, 1989). According to ESD, this "suggests that the income of resident retirees may enhance the local economy and that retirement-related transfer payments and investment incomes may be less sensitive to business cycles and structural changes" (ESD, 1989).

3.9.1.4 Housing Characteristics

As of April 1990, there were 14,565 total households in Mason County. Of these households, 73.4 percent contained two or more people. Of the family households, more than half were made up of married couples without children (Mason County, 1992).

In 1990, there were 22,292 housing units in Mason County. Of these, only 14,565 (65.3 percent) were occupied. This is by far the lowest occupancy rate of any of the counties in the region and much lower than the 92 percent occupancy found statewide. The low occupancy rate predominantly reflects conditions outside of the Shelton area and reflects the large number of housing units that are for seasonal, recreational, or occasional use. In total, 29.5 percent of all housing units in the county, and 88.5 percent of all units in the Olympic Division of the county that includes Lake Cushman, were identified as vacant or unoccupied in 1990 (Mason County, 1992). This reflects the almost exclusive focus towards recreation or retirement housing within the vicinity of Lake Cushman (Mason County, 1992).

A survey of Mason County building permits, focusing on the 1985 to 1991 period, revealed that of 3,072 permits for new residential construction, 58 percent were single-family permits and more than 41 percent were for manufactured homes. This percentage of new manufactured homes is almost double the existing percentage in the county. The lack of zoning constraints and the greater affordability of this type of housing is making it an increasingly prominent element of the county's housing stock (Mason County, 1992).

Recent residential growth has been concentrated along the saltwater and freshwater shores of the county, with freshwater lakes, like Lake Cushman and Lake Kokanee, exhibiting the greatest growth.

3.9.2 Tribal Characteristics

In 1992, the Skokomish Tribe consisted of 525 on-reservation enrolled members and 570 off-reservation enrolled members (Mason County, 1992).

Facilities owned by the tribe include a tribal community center, health clinic, gymnasium, fisheries management building, youth services building, social services building, and the Enetai Fish Hatchery. Services provided by the state include public school facilities (grades 1 through 12).

The Tribe has had limited opportunities for employment on reservation lands. Good agricultural land and development potential on the reservation are limited, in part, because of the presence of large tracts of wetlands and the flood hazard of the Skokomish River.

The Enetai Fish Hatchery, operated by the Tribe, provides Native American employment and improves the anadromous fish run on the Skokomish River, which in turn increases fish harvest. The hatchery produced almost 12,000 pounds of chum and fall chinook salmon in 1990.

The Skokomish River fishery is important to the tribe both economically and culturally. The subsistence and commercial fisheries activities on the river target chum, coho, summer-fall chinook, and pink salmon. Fishing provides important income primarily from October to February. Fish and shellfish play an important part in the Tribe's food supply and some residents hunt deer and wild fowl to supplement their diet. Beaver, muskrat, and mink trapping also provides limited income.

Employment opportunities available near the reservation are predominantly in the logging and timber products industries, commercial fisheries, and seasonal agriculture. Agricultural crops consist of grain, clover, timothy hay, berries, and other fruits. Livestock graze in valley bottoms approximately 10 months a year.

3.9.3 Flood Damage Estimates

Flooding in Mason County generally occurs from November through April. The major causes of Skokomish River flooding include heavy rainfall, snowmelt, logging and roadbuilding and aggradation of the streambed. In recent history, large flood events in 1955, 1972, 1990, and 1994 damaged many homes, pastures, and personal property. Lesser damage occurs on a more frequent basis because of smaller flood events (Mason County, 1992).

The limited information on damage cost estimates is based on various sources. We summarized what is known of flood damage costs from the best available sources in table 3-11.

3.10 Cultural Resources

3.10.1 Background

Prior to the construction of Dam No. 1 and the reservoir, Lake Cushman was a glacially formed lake at a wide section of the North Fork. There is a relatively clear record of historic development for this area, but only limited historic resource studies have been conducted. Knowledge of prehistoric activities in the project region is very limited, and debate continues on the chronology of prehistoric cultural development. A number of different cultural resource studies

Table 3-11. Estimated flood damage costs in the Skokomish Valley.[1]

Year	Flood damage (dollars)	Year	Flood damage (dollars)
1926	13,400	1940	13,400
1927	13,400	1941	13,400
1928	13,400	1955	125,000
1929	13,400	1959	71,000
1930	13,400	1959	56,000
1931	13,400	1961	114,000
1932	13,400	1962	1,218
1933	56,600	1964	31,486
1934	13,400	1972	no data
1935	13,400	1972	no data
1936	13,400	1974	20,652
1937	13,400	1975	6,924
1938	13,400	1986	110,000
1939	13,400		

1 Source: Canning et al., 1988.

have been conducted in the vicinity of Lake Cushman over the past decade, however, that provide some insight into the activities of the area's prehistoric occupants.

The native occupants of the project area are part of a linguistic group referred to as the Twana ("Toanhooches" in the Point No Point Treaty of 1855). The Twana are members of the "Central Salish," which is part of the broader regional culture group of peoples referred to as the "Southern Coast Salish" (Bouchard and Kennedy, 1994).

The traditional territory of the Twana included the entire length of the Hood Canal and the lands surrounding it. The northern limit of this territory was in the vicinity of Squamish Harbor and Port Gamble, and the approximate southern boundary was the highland between Shelton and the "Great Bend" of Hood Canal (Bouchard and Kennedy, 1994). The Skokomish, one of the divisions of the Twana, occupied the lands near the mouth of the Skokomish River in the area of the Cushman Project (Wessen, 1990).

By the late nineteenth century, the Twana were encouraged to move to the Skokomish Reservation created by the federal government under the Point No Point Treaty of 1855. Over time, Twana communities eventually became one group and adopted the name "Skokomish" (CEHP Incorporated et al., 1994). The Tribe is currently recognized by the federal government as the Skokomish Indian Tribe of the Skokomish Reservation (BIA, 1993).

The Skokomish were fishermen, hunters, and gatherers of plant material who possessed a considerable amount of knowledge about the resources available in their environment. They followed a subsistence pattern characterized by a series of movements determined by the availability of different seasonal resources. This included a substantial winter village located along Hood Canal or the lower Skokomish River and a number of dispersed smaller summer camps that supported such activities as plant or shellfish collecting and hunting. Most of their economic activities were oriented towards marine and riverine environments, while upland settings were probably of secondary importance (Wessen, 1990).

Information on the specific location and character of Skokomish settlements is limited. Work by Elmendorf, James, Thompson, and Bouchard provides some information on Skokomish culture and related physical locations within the area of potential effect (APE) of the Cushman Project; however, the information is often contradictory in some details. No two sources give identical accounts, although similarities exist. All of the sources agree, however, that most Skokomish settlements were located along the western shore of Hood Canal and the lower reaches of the Skokomish River (Wessen, 1990).

The Skokomish continue to maintain a close association with the area. Tribal members reside within the project area and they continue to actively fish and hunt in the areas along the Skokomish River and Lake Cushman. Ethnographic studies of the Skokomish have identified cultural associations with specific properties in the Lake Cushman area that have lasted for over a century.

Though Lake Cushman was "discovered" and named in 1852 by Benjamin F. Shaw, Euro-American settlement of the lake area did not occur until 1885. As the area settled, the primary focus for economic development was hunting and fishing, and sportsmen, hunters, and anglers comprised the majority of visitors to the area (Overland, 1992).

In 1890, the first resort hotel, Cushman House, was constructed on the west side of the lake for anglers and hunters. Cushman House was joined in 1899 by the Antlers Hotel, an exclusive resort that was in its prime during the early 20th century when many prominent social leaders of New York visited. The first car trip from Seattle to Lake Cushman occurred in 1908 and the subsequent rise in automobile travel quickly and drastically affected the business of the Cushman House. Visitors would drive up and stay for the weekend only, instead of staying for weeks at a time (Overland, 1992). Cushman House was closed in 1914. The Antlers Hotel operated until 1922, when it closed to make way for Dam No. 1 and the impoundment (Overland, 1992).

In 1888, iron deposits were discovered in the vicinity of Lake Cushman, and, in 1890, the Mason County Mining and Development Company was organized. The company located several claims above Lake Cushman on Dry Creek that were mined for several years. The strikes were not as rich as first rumored, however, and the mines eventually folded (Overland, 1992).

In 1920, the city of Tacoma filed for and was granted a lease from Mason County for a dam on Lake Cushman. Before construction of the dam could begin, however, the city faced a number of legal difficulties. In 1921, suits for condemnation of the lands required for the Tacoma power project began, and in the end only two of the original settlers, Russell Homan and his attaché, Rueben Harps, remained in the area. Homan located his new home on the south side of the lake and lived out the remainder of his life there. The house, located on the west side of Lake Cushman, was inherited by Harps upon Homan's death and was sold to Marcus Nalley following Harps' death (Overland, 1992).

Marcus Nalley, the founder of Nalley's Fine Foods in Tacoma, Washington, also acquired property near the mouth of the Skokomish River to develop duck hunting habitat and to operate a dairy farm. Nalley significantly altered his property by constructing three levees that claimed an additional 600 acres of land from tideland (Tacoma, 1995b). Prior to Nalley's ownership and through the end of the 19th century, the Nalley property was the site of the Skokomish Reservation Agency and a boarding school (Tacoma, 1995b).

Two construction camps were built to house and feed the workers brought in to construct the Cushman hydropower facilities. Camp A was located above Lake Standstill and served workmen at Dam No. 1. Camp B, which served workers from Powerhouse No. 2, was located along Hood Canal near Potlatch (Tacoma, 1995b).

Land clearing for the dam began in 1920 and it took 6 years to complete the project. Upon completion, the dam was 50 feet thick at the base, tapering to 8 feet at the top. It stretched 770 feet in length across a broad, deep, rock-walled canyon and formed the second largest reservoir in the west, ten times larger than the original Lake Cushman (Overland, 1992). The power plant started generating electricity in May 1926.

Between 1935 and 1937 the Civilian Conservation Corps (CCC) established "Camp Cushman" at the southern end of Lake Cushman to provide housing and training for CCC workers. CCC teams worked primarily within FS lands in the Staircase Road area and ran telephone lines and improved trails to aid in land management and protection.

3.10.2 Cultural Resource Studies in the Area of Potential Environmental Impact

3.10.2.1 Archeological Studies

Archeological research on the Olympic Peninsula of Washington is a recent phenomenon. No regional research design has been developed to coordinate and/or integrate the archeological investigations that have taken place (CEHP Incorporated et al., 1994). Three separate cultural histories have been proposed by different researchers. Though all three address the peninsula as a whole, they all rely on data and insights obtained from archeological investigations conducted elsewhere on the southern Northwest Coast. The three proposed histories share some basic elements: each suggests a lengthy period of limited cultural change during the first half of the Holocene with the greater rates of change occurring in the second half of that period. Furthermore, each of these reconstructions is viewed as a sequence that begins with hunting and gathering foragers and ends with hunting and gathering collectors. It is speculated that the changes in behavior occurred as a result of shifts in residence patterns, food storage behavior, and the intensity and emphasis of food procurement. It is unclear, however, when and why the transition occurred (CEHP Incorporated et al., 1994).

A number of archeological investigations have occurred within the project area in the past that identified sites within the APE. Although the previous surveys offer little insight into the area, they have demonstrated that archeological resources are present although not numerous (CEHP Incorporated et al., 1994). Areas surveyed on Tacoma property directly related to the Cushman Project include:

- the Lake Cushman Basin;
- the Lake Kokanee Basin;
- the area surrounding Dam No. 1 and Powerhouse No. 1;

- the spillway;
- the area surrounding Dam No. 2 and Powerhouse No. 2;
- the power tunnel between Dam No. 2 and Powerhouse No. 2; and
- the transmission line corridor between Powerhouse No. 1 and No. 2 (CEHP Incorporated et al., 1994).

Additional surveys between June 1994 and June 1995 covered the following areas proposed for recreation enhancements:

- Dry Creek Trailhead;
- Big Creek Campground;
- LCSP; and
- Hood Canal Recreation Park.

The archeological sites identified by the surveys can be grouped into three specific geographic portions of the project area: the reservoirs, the transmission line corridor, and the Skokomish River-Hood Canal. Of the nine identified sites, only 45MS100 and 45MS105 were found to be potentially eligible for listing in the National Register of Historic Places.

Four of the sites (45MS100, 45MS101, 45MS102, and 45MS105) appear to be broadly contemporaneous and show evidence of relationships from the same or very closely related cultural system. Analysis undertaken as part of the investigations for relicensing suggests that differences in assemblage contents may reflect differing site functions (Wessen, 1993).

Site 45MS100 contains evidence of multiple similar occupation episodes and probably represents a seasonal residential camp that was occupied repeatedly over a considerable period of time. Based on materials found, the site was probably a hub for nearby extractive locations. Activities such as stone tool manufacture, hunting, and processing of game occurred at this hub, and the broad range of scrapers and other unifacial tools found suggest that various organic materials were processed as well (Wessen, 1990). The site's occupants appear to represent an early hunting and gathering culture, referred to as Old Cordilleran or Olcott. Wessen (1993) concluded that the site has the ability to yield information important to the prehistory of the region and can be considered a significant resource under Criterion D of the National Register. A National Register nomination form has been completed for this site. Though the area in which this site is located is undeveloped, it is being affected by the ongoing use of all-terrain vehicles when the pool level is low (CEHP Incorporated et al., 1994).

Sites 45MS101, 45MS102, and 45MS105 appear to have been more concentrated, short-term occupation sites that were likely to have been associated with 45MS100 (Wessen, 1993). Site 45MS105 has been recommended as eligible for inclusion in the National Register and a nomination form has been prepared. Sites 45MS101 and 45MS102, both in the vicinity of the Dam No. 1 spillway, were affected by modifications to that structure in the late 1980's (Welch, 1991) and have been determined to be ineligible (Tacoma, 1994a).

The three isolated finds were prehistoric lithic materials consisting of one interior flake, a bifacial blank, and a split cobble core. All three were found within the Lake Cushman draw-down zone (Wessen, 1993).

No organic materials suitable for dating were found, but dating of the sites based on stylistic comparisons with materials recovered from throughout the Pacific Northwest region indicates they were active during the Early to Middle Holocene period or between ca. 8,000 and 5,000 years before present (Wessen, 1993).

The two archeological sites located within the transmission line corridor between Powerhouse No. 2 and the City of Tacoma, 45MS51 and 45MS56, represent late prehistoric to early historic occupations (Wessen, 1993). Site 45MS51 is a shell midden in the vicinity of the Skokomish Fish Hatchery, and 45MS56 is the location of an "1873 Indian House" and shell midden, both at Annas Bay (Wessen, 1993). It is unclear whether or not the proposed project would affect these sites. To date, only Phase I surveys have occurred on these sites and no determinations of eligibility have been made (CEHP Incorporated et al., 1994). Site 45MS107 is highly disturbed and deemed ineligible (CEHP Incorporated et al., 1994).

Surveys along the North Fork, mainstem, and Annas Bay are incomplete (major portions of the mainstem are in private ownership and permission for surveys was not obtained). Past survey and geomorphic investigations suggest that erosion and siltation along the Skokomish River have significantly affected archeological resources. The ethnographic and historic record, however, suggest that significant sites are likely to be deeply buried in the river delta (CEHP Incorporated et al., 1994). Two sites, 45MS53 and 45MS108, have been located in this area.

Site 45MS53 is a prehistoric shell midden located along the eastern margin of the Skokomish Delta. The site was originally identified by Kennedy in 1979 and re-surveyed in 1993 by Wessen and Chesmore who determined that portions of the site are still intact. Site 45MS108 is a deeply buried prehistoric shell midden located near the modern Skokomish River channel. Both sites will require further examination before determinations of National Register eligibility can be made.

3.10.2.2 Ethnographic Studies

Ethnographic studies of the Skokomish people have been compiled by a number of researchers, starting with the Reverend Myron Eells, a missionary assigned to the Skokomish Tribe in the late 1800's. The available studies include 19th and 20th century reports spanning more than 100 years. Most recently, Bouchard identified 72 ethnographic sites of historical importance to the Tribe (Tacoma, 1995b).

Based on his research, Bouchard has recommended that three Traditional Cultural Property (TCP) districts be established: The Skokomish Settlement Sites TCP District, which includes the locations of historical Skokomish settlement sites along Hood Canal from Potlatch to Enati Creek; the Skokomish Resource Procurement Sites TCP District, which includes traditional resource procurement areas in the tidelands between Enetai and Union and including the tidelands at the mouth of the Skokomish River; and the Skokomish Salmon Fishing Sites TCP District that includes traditional fishing sites from the mouth of the Skokomish River to its confluence with the North and South Forks (Tacoma, 1995a). Of the properties included in the districts, only one of the settlement sites, two of the procurement sites, and five of the salmon fishing sites are within the project area.

Nomination forms for the National Register of Historic Places have been completed by Tacoma for each of the three districts.

In addition to those properties included in the proposed TCP districts, Bouchard also identified a number of other properties that warrant further attention. The North Fork, one of the other properties, was identified as a traditional location for fishing, hunting, and trapping. Although fish populations declined substantially on the North Fork following the construction of the Cushman dams, the Skokomish still consider this to be an important hunting area (Tacoma, 1995b).

A Programmatic Agreement (PA) has been executed to protect TCPs and traditional land use areas of the Tribe (FERC et al., 1994). The PA requires Tacoma to identify TCPs of importance to the Tribe in the APE by direct and indirect impact areas and to provide sufficient information on these properties to apply the Register's criteria for evaluation, subject to the constraints of the Protocol and Confidentiality Agreement (FERC et al., 1994). The PA also provides the protocol for agency consultation and review to ensure compliance with Section 106 of the National Historic Preservation Act, as amended.

3.10.2.3 Historic Structures

A number of structures relating to a variety of historical activities in the Lake Cushman area have been identified as potentially significant. Though the historical development of Mason County has much in common with other Puget Sound communities, there are some unique elements that are important in determining the significance of specific resources. The history of Lake Cushman as a resort community for "remittance men," or easterners escaping East Coast urbanization and industrialization, is one such element. The properties on which the Antlers and Cushman House hotels were located were flooded following the construction of Dam No. 1. Site investigations conducted by Tacoma maintenance personnel found no evidence of the cabin rumored to contain remains of the Homan/Harps cabin (Tacoma, 1995b).

The Nalley property contains no standing structures from Marcus Nalley's time, aside from the levees constructed by Nalley. Recent surveys of the levees indicate that the dikes have not been maintained and do not retain integrity. They are therefore not considered eligible for inclusion in the National Register of Historic Places (Tacoma, 1995b).

Additional surveys by Tacoma found no evidence of the Dam No. 1 construction camp, nor was evidence found of the CCC Camp Cushman. Three log bridges were identified on Old Staircase Road that appear to be from the period when the CCC was active in the area (Tacoma, 1995b). Further work is required to determine the significance of the bridges and Old Staircase Road and their connection to the CCC.

The "Cushman Hydroelectric Power Plant No. 1" and "Cushman Hydroelectric Power Plant No. 2" (so designated on the National Register Nomination forms) were listed in the National Register of Historic Places on December 15, 1988 as significant examples of medium head hydropower technology in the West from the 1920's and early 1930's. Beginning with the construction of Powerhouse No. 1, the hydropower facilities have played a significant role in the history of Lake Cushman and the development of the Tacoma vicinity (CEHP Incorporated et al., 1994).

4.0 ENVIRONMENTAL IMPACTS

In this section, we describe the anticipated effects of relicensing the Cushman Project. Our analysis is presented by alternative within each affected resource area and includes agency and Tribe recommendations, staff conclusions and recommendations, and the rationale for our conclusions and recommendations. Cumulative impacts, unavoidable adverse impacts, and any irreversible and irretrievable commitment of resources that would be incurred if the proposed action were implemented are discussed at the end of this section.

4.1 Geology, Soils, and Channel Morphometry

Historic project operations have had very minor effects on soil and geologic resources. The project has, however, affected channel morphometry in the lower North Fork and in the Skokomish River downstream from the North Fork confluence. Over the nearly 70 years of project operation the lower North Fork has adapted to very low flow conditions by narrowing, aggrading, and substrate fining. The riparian corridor, including much of the pre-project channel, has become heavily vegetated with grasses and alders.

Project-caused mainstem flow reduction is also partially responsible for mainstem channel and estuary aggradation (Simenstad, 1994; Jay, 1994; Dawdy, 1994; Watson, 1994; Simons & Associates, 1993, 1995, and 1996). Mainstem aggradation has reduced the channel's conveyance capacity. Historically, the channel could convey about 12,000 cfs without flowing over its banks. Today, flooding occurs at flows of about 4,650 cfs or more (Canning, 1988). Because the North Fork is not a major contributor of sediments to the mainstem (section 3.2.3.3), increased erosion rates in the South Fork drainage are the primary source of sediment accumulations in the mainstem. Over 40 percent of the South Fork watershed has been logged since 1935 (KCM, 1993).

ONF has found several drainages in the South Fork watershed to be at risk due to the cumulative effects of past forest management and is engaged in watershed restoration. Among the projects completed thus far is the obliteration of 53 miles of road (pulled culvert, outsloped road surface). Other projects being considered include hydro-mulching, stream treatments (check dams and channel stabilization), and monitoring (KCM, 1993). These measures are expected to reduce erosion rates and mass wasting (slumps and landslides) in the watershed and the rate that sediment is delivered to the South Fork. We anticipate that sediment loads in the mainstem will decrease with time.

Simulations of mainstem aggradation based on laboratory-derived bedload transport equations (Simons & Associates, 1993) estimate average annual mainstem aggradation rates at 0.04 foot per year.[1] Cushman Project water diversions reduce mainstem bedload sediment transport rates by about half (Simons & Associates, 1996). Simons & Associates (1996) conclude that while the project reduces bedload transport rates by about half, the project's contribution to mainstem

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[1] Historical aggradation rates have been much higher than these estimates at some sites. Between 1979 and 1992, the thalweg elevation (deepest portion of the channel) at the US 101 bridge rose by about 14 feet (Tacoma, 1993a), an aggradation rate of more than 1 foot per year.

aggradation is small (less than 4 percent of historic aggradation) because the sediment supply is substantially larger than estimated bedload transport rates with or without the project.

Under Tacoma's Proposal and Alternatives 2, 3, and 4, flow in project-affected river reaches would be increased. Sediment transport, including bedload transport, occurs over a wide range of discharges and increases exponentially with discharge. Increasing flow would increase the streams' sediment transport capacity. Removing dikes in the Nalley Ranch under Alternatives 2 and 3 would increase flows in the tidally affected reaches of the mainstem by increasing intertidal area.

Simons & Associates (1995) fit a sediment transport model to conditions in the mainstem that accurately predicts channel aggradation and degradation for short time periods. We are interested in long-term effects of flow alteration on channel morphometry. Empirical relationships between channel morphometry parameters (meander length, radius, and belt width, channel depth, and others) and bankfull width or bankfull discharge, dominant discharge, or the 1.5- to 2-year return interval flood have been developed by Leopold and Wolman (1960), Carlston (1965), Williams (1986), and others. The term "dominant discharge" refers to that discharge which due to the combined qualities of bedload sediment transport capacity and frequency of occurrence is responsible for the majority of sediment transport and thus channel morphometry. Because flows in the lower North Fork are "dominated" by the MIF downstream from Dam No. 2 and the 1.5- to 2-year flood downstream from the McTaggert Creek, we assume that the maximum annual MIF would be the dominant discharge downstream from Dam No. 2 and that the dominant discharge downstream from the McTaggert Creek confluence would be the 1.5- to 2-year return period flood plus the maximum MIF. Because it is difficult to accurately quantify the likely outcomes of these flow increases on channel morphometry, in the following discussions we present qualitative discussions of the likely outcomes based on these fluvial morphometry/discharge relationships.

ONF is engaged in watershed restoration projects in the South Fork watershed, and has reclaimed 53 miles of road (pulled culvert, outsloped road surface). These measures are expected to reduce erosion rates in the watershed and the rate that sediment is delivered to the South Fork.

Under Tacoma's Proposal and Alternatives 2, 3, and 4, increasing the flow in project-affected river reaches caused by increased releases to the lower North Fork at Dam No. 2 and removal of the McTaggert Creek diversion would affect channel morphometry. Removing dikes in the Nalley Ranch under Alternatives 2 and 3 would affect channel morphometry in the lower mainstem by increasing tidal flows. Morphometric changes resulting from these flow increases are difficult to accurately predict. We estimated these effects based on site investigations and general fluvial morphometry principals developed by Leopold et al. (1964) and Rosgen (1994). Sediment transport, including bedload transport, increases exponentially with discharge. Channel morphometry is driven by the dominant discharge (bankfull discharge or the 1.5- to 2-year return interval flood).

4.1.1 Tacoma's Proposal

Tacoma's Proposal would slightly increase flows in the North Fork downstream from Dam No. 2 (RM 13.3 to RM 17.3). We anticipate that upstream of McTaggert Creek the lower North Fork channel would widen and deepen slightly to convey the dominant flow (100 cfs) and sediment transport would increase slightly. Providing 48 hours of flushing flows at 300 cfs every third year would help remove accumulated silts and debris from the channel and substrates. Because the flushing flow releases would be infrequent and short in duration, however, they would not have an appreciable effect on channel morphometry. These effects would be beneficial, long-term, and minor as compared with existing conditions. Downstream from McTaggert Creek, the increased MIF would increase the dominant discharge by 100 cfs.

Removing the McTaggert Creek diversion would restore full natural flows, including natural flood flows to the creek downstream from the diversion. Sediment transport rates would also increase. Gibbons Creek, a small perennial tributary, enters McTaggert Creek about 1 mile downstream from the diversion structure. A substantial amount of channel filling has occurred between the diversion structure and the Gibbons Creek confluence. We anticipate that following removal of the diversion structure, McTaggert Creek would rapidly reclaim its original stream channel in this first mile downstream from the diversion resulting in a brief period of increased debris and sediment loads in the stream. Removing the McTaggert Creek diversion would also increase the average and dominant discharge rates in the lower North Fork downstream from McTaggert Creek. This would increase the sediment transport capacity of the stream and would probably increase channel depth and width slightly.

Between the diversion structure and the Gibbons Creek confluence, McTaggert Creek crosses under two FS roads. Existing crossings may not be adequate to convey the design flow from McTaggert Creek once the diversion is removed, and they may need to be replaced.

Because changes in the mainstem's dominant discharge would be very small, no noticeable effects on channel morphometry or sediment transport are expected in the mainstem downstream from the North Fork confluence. Ongoing aggradation and the loss of conveyance capacity would continue. Mainstem channel capacity improvement, which would result from FS watershed restoration efforts in the South Fork drainage, would be slow to occur and slight.

4.1.2 Alternative 1 (No Action)

Continued project operation under existing license conditions is not expected to have any substantial effects on geologic or soil resources. Sediment transport capacities in the lower North Fork and in the mainstem would remain at current levels. Riparian vegetation along the lower North Fork would continue to mature making the channel banks increasingly resistant to erosion. Based on the Simons & Associates (1993) analysis of mainstem aggradation, Alternative 1 would produce an average annual aggradation rate of about 0.04 foot per year. Mainstem responses to reduced sediment loads caused by South Fork watershed recovery efforts recently undertaken by FS would be slow. Alternative 1, no action, would have adverse, long-term, minor effects on the conveyance capacity of the lower North Fork and mainstem.

4.1.3 Alternative 2

Under this alternative, Tacoma would cease out-of-basin diversions except to the extent necessary to minimize downstream flooding. This alternative would dramatically affect the lower North Fork and could substantially affect the mainstem.

Because Lake Cushman would be operated to minimize downstream flooding, the dominant flow (average flood) in the North Fork downstream from Dam No. 2 would be about 2,900 cfs (about half the mainstem flooding trigger). The initial response in the confined portion of the lower North Fork would be channel deepening, braiding, and substrate coarsening as the higher flows created new channels within the riparian corridor to convey the increased flow. A series of treed islands would be created that would eventually erode away as sediment loads in the lower North Fork lessened. Within the life of the license, we anticipate that the channel would reclaim much of its original form with several side channels, a few treed islands, deeper pools, and generally coarser substrates.

Unconfined portions of the lower North Fork within the alluvial valley near the mainstem could adjust to the increased flows by reclaiming old meander channels (most likely) or by cutting a new channel (less likely) to increase the meander length to accommodate the higher dominant discharge. This effect would move a large quantity of alluvial sediments and soils and could disrupt existing land uses in the area.

Because this alternative is designed to curtail Dam No. 2 discharges when flows in the mainstem exceed 5,000 cfs, a plateau would occur in the mainstem flow frequency curve at 5,000 cfs with infrequent flood flows of over 10,000 cfs (section 4.2). The morphometric outcome of this flow regime within the mainstem valley is difficult to predict. The sediment transport capacity would be increased, suggesting that the channel would deepen and substrates coarsen. Because the average flood would not change, channel meander length, slope, and bankfull width are not expected to change appreciably. Simons & Associates (1996) estimate that this alternative would about double existing bedload sediment transport rates. Because the sediment load is substantially higher than these transport rates, it is unclear whether this increase in the bedload transport rate would substantially reduce existing aggradation rates. Because we anticipate that rehabilitation of the South Fork watershed will reduce sediment loads in time, this alternative would eventually bring bedload input and transport rates closer together, thus reducing aggradation rates.

NMFS, WDFW, and the Tribe recommend that measures to increase the mainstem's conveyance capacity be required. Dredging of various scales has been considered as one means to enhance the channel's conveyance capacity (KCM, 1993) (Corps, 1995). We include the Corps' hypothetical dredging measure in this alternative. The dredging would conform to modern river engineering principals and would maintain the channel's current meander pattern. The Corps (1995) estimates that dredging would produce about 1,000,000 cubic yards of material to be transported and disposed, and would reduce the water surface elevation by about 1 foot at the US 101 bridge during the 100-year flood. Additional engineering and environmental studies would be needed to fully define the effects of this alternative. We assume that such studies would be conducted to develop the information needed by the Corps to issue a 404 permit.

Selective removal of dikes in the Nalley Ranch would cause higher tidal flows, thus increasing the sediment transport rates in the estuary. This effect would likely create small new tidal channels in the estuary and could increase river flows in the tidally influenced portion of the river (mouth to RM 3.7) leading to increased channel depth near its mouth. Lesser effects would extend upstream as the river adjusts to the new channel slope at the mouth.

The combined effects of estuary channel development, dredging, increased sediment transport capacity, and South Fork watershed recovery efforts could produce measurable increases in mainstem channel conveyance capacity. These effects would be substantial, long-term, and beneficial in reducing mainstem flooding.

4.1.4 Alternative 3

This alternative's instream flow schedule was developed to enhance fish habitat through flow-induced modification of channel morphometry and increases in flow-dependent habitat characteristics. Objectives for the morphometric improvement include channel deepening, maintaining substrates suitable for spawning, and creation of side-channel habitat. Because the channel banks are heavily armored by alders and other riparian vegetation, frequent discharge of slightly out-of-bank flows would tend to cause channel downcutting and side-channel formation rather than widespread channel widening. Fallen trees are important components of some fish habitats, and this flow regime would likely increase the number of fallen trees in the channel. Tacoma has shown that flows greater than 200 cfs are sufficient to maintain clean substrates (Tacoma, 1991b).

Increasing flows in the lower North Fork would cause the channel to expand to convey the dominant flow (400 cfs). The sediment transport capacity would increase modestly. Similar but lesser serial changes in channel morphometry than those described for Alternative 2 would take place. These effects would be measurable throughout the lower North Fork and would be most noticeable between the McTaggert Creek confluence and Dam No. 2 (RM 13.3 to RM 17.3). We expect these effects would be beneficial, long-term, and moderate as compared with existing conditions. Because flows released under this instream flow alternative would not substantially affect mainstem high flow frequency, small to negligible flow-induced effects on channel morphometry or sediment transport are expected in the mainstem downstream from the North Fork confluence.

This alternative would also include McTaggert Creek diversion structure removal and selective dike removal at the Nalley Ranch (see discussions in sections 4.1.1. and 4.1.3, respectively).

Mason County is nearing completion of a comprehensive flood hazard management plan for the Skokomish River (letter from Mason County Board of Commissioners, Shelton, Washington, June 13, 1995). Under Alternative 3, Tacoma would participate in implementing priority projects developed in Mason County's Final Flood Hazard Management Plan to increase the mainstem's conveyance capacity. Completion of these projects would measurably enhance the mainstem's conveyance capacity and provide long-term flood hazard reduction benefits to residents and property owners along the mainstem. Mason County has defined several possible measures (selective gravel deposit removal, overbank channel restoration, side-channel enhancement, river bank stabilization, widening openings through US 101, debris blockage removal, and local drainage improvements) to enhance the mainstem's conveyance capacity (Mason County, 1993) but has not yet defined the relative effectiveness of these measures. Finalization of this plan will define those actions that are considered cost-effective in reducing flood hazards (Mason County, 1993), thus providing much of the information requested by NMFS, WDFW, and the Tribe to define measures to increase the mainstem's conveyance capacity.

Under this alternative, Tacoma would consult with the Tribe, EPA, the Corps, WDOE, WDFW, Mason County, and FEMA to identify cost-effective measures to increase the Skokomish River's conveyance capacity and thereby reduce the human health and welfare risks from flooding. Within 1 year of license issuance, Tacoma would submit to the Commission a final channel conveyance capacity enhancement plan including: recommended measures to reduce flood hazards to an acceptable level, cost estimates for the selected measures, options for financing the project(s) including Tacoma's proposed level of contribution, and any comments on the report from plan participants. We estimate the total cost of this measure at $5,000,000.

Increasing the length of time that near flood flows occur could help maintain and enhance the mainstem's conveyance capacity.[2] Under this alternative, Tacoma would also conduct an investigation of channel maintenance flows in consultation with the Tribe and the agencies. Tacoma would make up to 25,000 acre-feet of water per year available for delivery to the mainstem for up to 5 years during the study to facilitate evaluation of the effects of augmented flows on Skokomish River channel capacity. Such releases would be managed to avoid downstream flooding. Tacoma and the agencies would develop a study plan to evaluate the effectiveness of this allotment. The 25,000-acre-foot allotment would provide 5 days of continuous flow at 2,500 cfs (about half of the mainstem's current conveyance capacity). Tacoma would provide a final channel maintenance flow study report to the Commission within 6 years of license issuance. The final channel maintenance flow study report would include a discussion of the effectiveness of channel maintenance flows in maintaining the mainstem's conveyance capacity and a recommendation whether to continue or abandon efforts to maintain the river's capacity through flow manipulation.

4.1.5 *Alternative 4 (Decommissioning)*

If the dams were removed, full natural flows would return to the lower North Fork and flood potential would increase. This alternative would cause more rapid and dramatic changes in lower North Fork channel morphometry than Alternative 2 (section 4.1.3). The channel would rapidly reclaim its pre-project form, particularly where it is confined within the canyon. The lower, unconfined portion of the channel would become highly dynamic and could adversely affect land use.

The 100-acre inundated area of Lake Kokanee and 3,736 acres of Lake Cushman (area of current Lake Cushman minus area of natural Lake Cushman) would be exposed in an unvegetated state. Substantial planning and implementation of erosion control measures would be required to prevent catastrophic erosion effects. Very likely the dams would be removed in stages with revegetation efforts undertaken between successive stages. Channel reconstruction and/or stabilization would be required at the face of the sediment delta at the inlet to Lake Cushman to prevent excessive channel erosion. Observation of the inlet area under low flows, however, has shown that sediment deposition is slight, and reconstruction efforts would probably not be extensive.

Return of natural flows to the mainstem Skokomish River would substantially affect channel morphometry and sediment transport characteristics. Removing the dams would increase flows by about 60 percent. All of the morphometric characteristics associated with dominant discharge would adjust to the new flow regime. It is not possible to confidently predict the post-dam removal channel characteristics because the stream type (Rosgen, 1994) could change. Assuming the stream

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2 We note that Tacoma (Simons & Associates, 1996) has demonstrated that very large flows (circa 200,000 cfs) would be required to reverse aggradation under current sediment loads and channel conditions. Because we anticipate future reductions in existing sediment delivery rates and are recommending improvements in the channel's conveyance capacity, we consider evaluation of the potential beneficial effects of mainstem flushing flows to be a reasonable approach to answering the question: "Can flushing flows reduce, arrest, or reverse ongoing aggradation in the mainstem."

type did not change, the increase in bankfull discharge would increase the meander length, radii, and belt width; the channel would widen and deepen; and the substrates would coarsen. These channel adjustments could adversely affect current land uses in the valley. Over time, these effects would increase the capacity of the channel; however, the flood potential would be higher than it is currently until the channel fully adjusted to its new flow regime. Depending on the frequency of floods and the extent of human-caused perturbations of the process, mainstem channel adjustments and increased flooding potential could extend for several decades following dam removal.

Because of project-afforded flood protection benefits, the project could be decommissioned with dam retention and operations similar to those contemplated under Alternative 2. Higher flows than those considered under Alternative 2 would occasionally be released at Dam No. 2, unless the diversion system were maintained and used to divert excess water (up to 2,940 cfs) during floods. The morphometric effects of implementing such a scenario would be similar to those of Alternative 2 (section 4.1.3). The lower North Fork channel would reclaim much of its pre-project form with several side channels, a few treed islands, deeper pools and coarser substrates. Because flood frequency in the mainstem would not change, the channel meander length, slope, and bankfull width are not expected to change appreciably. Because the sediment transport capacity would be increased, the channel would likely deepen and the substrates coarsen. The mainstem's conveyance capacity would thus gradually increase, reducing flood hazards. These effects would be beneficial and long-term.

4.1.6 Lower Lake Cushman Option

Maintaining Lake Cushman water levels below 725 feet would permanently expose 278 acres of unvegetated shoreline around the lake. An additional 470 acres would be exposed at the target low water level (700 feet), 211 acres more than are exposed under the current minimum target elevation of 712 feet. This would temporarily increase the area susceptible to erosion and would increase the sediment load into the lake. As the permanently exposed area revegetated, erosion rates and sediment loads would return to current levels. These effects would be localized, minor, and short-term.

Approximately 1,500 feet of the upper North Fork would be permanently converted from a lentic (stillwater) to a lotic (flowing water) environment. Because the lake is currently drawn down annually to 712 feet during the high-flow fall and winter period, the river within the upper reaches of Lake Cushman has maintained its riverine channel morphometry for much of this length. Under this option, the river is expected to entrench slightly through time as the banks become vegetated and armored. Substantial changes in channel morphometry, however, are not expected.

4.1.7 Fish Passage Option

Land disturbing activities associated with fish passage facility construction would have localized, minor, short-term erosion effects on soil resources. Because soils in the canyon below Dam No. 2 are thin to non-existent, the disturbed area would be very small (1 to 3 acres), and all land-disturbing activities at the project would be conducted in accordance with a Commission-approved erosion and sediment control plan (ESCP), we expect that these potential effects would be negligible.

4.1.8 Staff Conclusions

Much of the mainstem's historical conveyance capacity has been lost due to aggradation (Simons and Associates, 1993; Jay, 1994). The two principal causes of mainstem aggradation are reduced peak flows caused by the Cushman Project, and increased sediment loads, mostly from extensive logging in the South Fork watershed. Other factors contributing to flooding in the Skokomish Valley include the filling of side channels and tidal sloughs, highway fills that traverse the valley, and inadequate road drainage.

Reducing sediment loads and increasing the length of time that near-flood flows (about 5,000 cfs) occur would gradually increase the channel capacity. Channel manipulation could be used to accelerate these natural processes but cannot replace them. Mechanical channel manipulations (dredging and diking), without concurrent reductions in sediment loads or increases in sediment transport rates, would only temporarily improve channel conveyance conditions (Corps, 1995). Over time the river would naturally adjust to hydrologic and sediment regimes.

Erosion control efforts currently underway by FS in the South Fork watershed should eventually reduce sediment loads reaching the mainstem. If this program substantially reduces mainstem sediment loads, existing aggradation rates could be reduced or arrested. Mason County is nearing completion of a Skokomish River Flood Hazard Management Plan that includes measures designed to increase the mainstem's conveyance capacity and reduce flood hazards (letter from Mason County Board of Commissioners, Shelton, Washington, June 13, 1995).

We conclude that the Cushman Project has contributed to aggradation in the mainstem Skokomish River and that these effects increase the severity of flood effects (overbank flows). It is also true, however, that flood flow attenuation in Lake Cushman reduces mainstem flood peak flows. Overall, the Cushman Project reduces flooding along the mainstem (Tacoma, 1994a).

Tacoma does not propose any measures to increase the mainstem's conveyance capacity. There would be no project-related change in the mainstem's aggradation rate or conveyance capacity.

Under Alternative 1, no action, there would be no project-related change in the mainstem's aggradation rate or conveyance capacity.

By combining mechanical conveyance capacity improvements with more frequent near-flood flows, as recommended by NMFS, WDFW, and the Tribe, Alternative 2 would have the largest effect on reducing mainstem flood hazards of the alternatives considered.

We conclude that because aggradation in the lower Skokomish River causes higher flood water levels and because mainstem aggradation is partially attributable to Cushman Project operations, Tacoma should participate in Mason County Flood Hazard Management Plan projects to increase the Skokomish River's conveyance capacity. This measure is therefore included in Alternative 3.

Tacoma should consult with the Tribe, EPA, the Corps, WDOE, WDFW, Mason County, and FEMA to identify cost-effective measures to increase the conveyance capacity of the mainstem and to minimize property damage and human health risks from flooding on the Skokomish River.

Under Alternative 3, Tacoma would provide up to 25,000 acre-feet of water to evaluate the effectiveness of augmented flows to maintain and enhance Skokomish River conveyance capacity. If this measure is effective at maintaining mainstem conveyance capacity, it should be extended to occur throughout the new license period. If this measure is unsuccessful, Tacoma should develop and participate in a mainstem capacity maintenance program.

Under Alternative 4 with dam removal, the return of natural flows to the mainstem Skokomish River would substantially affect channel morphometry and sediment transport characteristics. Removing the dams would increase flood flows by about 60 percent. All of the morphometric characteristics associated with dominant discharge would adjust to the new flow regime. This alternative could result in a loss of usable lands, reduce property values, and displace current residents in the Skokomish Valley.

Under Alternative 4 with dam retention, the morphometric effects of implementing such a scenario would be similar to those of Alternative 2 (section 4.1.3).

It is likely that the lower North Fork channel's morphometry would change under Alternatives 2 and 4 (near natural flows) and Alternative 3 (table 2-5), and it is not possible to fully predict the outcome prior to implementing these flow regimes. Under Alternative 2 or 3, therefore, Tacoma should develop, in consultation with the agencies, a plan to document changes in the lower North Fork channel's morphometry and habitat conditions caused by the new flow regime, and submit a study report, together with any comments from the study participants, to the Commission within 5 years of license issuance. This study should be conducted in concert with the fish habitat needs analysis described in section 4.4.8.

Existing FS road crossing culverts on McTaggert Creek downstream from the diversion dam may become inadequate to convey the design flow (prescribed by FS) following diversion dam removal, under Tacoma's Proposal, Alternative 2, or Alternative 3. Tacoma therefore should, in consultation with FS, determine the adequacy of these culverts and replace them if necessary.

4.2 Water Quantity

In the following sections, we describe each alternative's anticipated effects on water allocation among the project facilities and instream flows to the lower North Fork and mainstem. We estimated potential flood effects of project operation under the Lake Cushman rule curve for each alternative. Although water allocation affects power production (section 5), channel morphometry (section 4.1), fish habitat (section 4.4), and water quality (section 4.3), we do not present water allocation or instream flow recommendations in this section. We present agency recommendations regarding water allocation within the sections applicable to the resources those recommendations are intended to protect. We discussed our rationale for recommending the instream flow schedule presented under Alternative 3 in sections 4.1.8 and 4.4.8.

We estimated the water allocation effects of each alternative using a model developed by the Tribe (Watson, 1994) and modified by the staff. The model uses a 22-year period of estimated daily project inflows (October 1967 through September 1989) and allocates water among powerhouse flows, spills, and reservoir level maintenance according to the constraints imposed by each alternative. During the period of record, estimated project inflows averaged 784 cfs. Side-by-side daily duration graphics of lower North Fork discharge (figure 4-1), mainstem discharge (figure 4-2), Powerhouse No. 2 discharge (figure 4-3), and Lake Cushman water surface elevation (figure 4-4)[3] illustrate the hydrologic effects of the alternatives. Graphics of monthly durations for lower North Fork discharge, mainstem discharge, Powerhouse No. 2 discharge, and Lake Cushman water surface elevations are presented in appendix H. Annual North Fork and mainstem peak flows for each alternative for the 22-year simulation period are shown in table 4-1.

We used the same model to estimate the effects of each alternative on power generation (section 5).

DOI, WDFW, FWS, and NMFS have recommended that monitoring compliance with the instream flow requirements would require continued operation of one or more streamgages (figure 3-4) along the North Fork, and continued operation of a water level gage at Lake Cushman. Streamgages would be required under Tacoma's Proposal or Alternatives 1, 2, or 3.

4.2.1 Tacoma's Proposal

Under Tacoma's Proposal, more of the water flowing into the Cushman Project would be distributed to downstream bypass flows, and slightly less water would be distributed to power production than occurs today. Based on hydrologic modeling of this alternative, the average discharge to Powerhouse No. 1 would be 784 cfs, the average discharge to Powerhouse No. 2 would be 684 cfs, the average discharge to the lower North Fork would be 100 cfs, and average mainstem flows would be 1,218 cfs.

Because Lake Cushman would continue to be operated under the current rule curve, the project would continue to provide a high degree of downstream flood protection during the high-flow fall and winter period. The highest annual mainstem peak flow during the 22-year simulation period was 14,500 cfs (table 4-1), a 70-cfs increase as compared with no action. The 70-cfs increase in peak flows would be caused by a 70-cfs increase in the minimum release rate at Dam No. 2. This change in downstream peak flows would be negligible. The project would continue to reduce mainstem flooding (Tacoma, 1994a). This effect would be beneficial and long-term.

4.2.2 Alternative 1 (No Action)

Under Alternative 1, no action, inflow to the Cushman Project would continue to be distributed among the uses of water level management, power production, and downstream bypass flows. Based on hydrologic modeling of this alternative, the average discharge to Powerhouse No.

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3 We note that our model allows Lake Cushman water levels to rise above the monthly maxima (tables 2-3 and 2-4) to reduce downstream flooding. In reality, this is allowed only when weather and hydrologic conditions indicate that it is safe to do so. The monthly water level maxima are designed to allow the reservoir to store part of the probable maximum flood (PMF) and pass the remainder through the emergency spillways. The spillways cannot pass the entire PMF without overtopping and potentially destroying the dams. Thus incursions into this volume would not always be allowed as is assumed in the model and releases to the lower North Fork and mainstem, particularly during flooding, would be somewhat more frequent and severe than presented here.

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Table 4-1. Simulated annual peak flows in the North Fork and mainstem Skokomish Rivers for each alternative for water years 1968 through 1989.[1]

Year	Mainstem peak flows					North Fork peak flows				
	Tacoma's Proposal	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Decomm.)	Tacoma's Proposal	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Decomm.)
1968	10,310	10,240	10,450	10,450	15,756	100	30	3,615	400	6,383
1969	7,761	7,691	7,901	7,901	10,800	100	30	2,725	400	3,139
1970	6,464	6,394	6,604	6,604	9,491	100	30	2,940	400	3,331
1971	9,215	9,145	9,355	9,355	12,558	100	30	2,905	400	3,443
1972	11,400	11,330	11,540	11,540	14,664	100	30	2,940	400	4,128
1973	10,163	10,093	10,303	10,303	10,424	100	30	2,940	400	3,743
1974	9,838	9,768	9,978	9,978	12,267	100	30	2,946	400	8,721
1975	10,095	10,025	10,235	10,235	11,039	100	30	2,940	400	3,821
1976	12,470	12,400	12,610	12,610	13,327	100	30	2,940	400	5,708
1977	10,190	10,120	10,330	10,330	10,306	100	30	2,791	400	2,808
1978	8,974	8,904	9,114	9,114	12,640	100	30	3,368	400	4,573
1979	8,350	8,280	8,490	8,490	11,252	100	30	2,201	400	3,002
1980	14,500	14,430	14,640	14,640	19,720	100	30	3,555	400	7,058
1981	13,680	13,610	13,820	13,820	21,084	100	30	3,231	400	7,504
1982	11,586	11,516	11,726	11,726	15,549	100	30	3,315	400	4,916
1983	10,527	10,457	10,667	10,667	17,210	100	30	3,184	400	6,783
1984	14,220	14,150	14,360	14,520	21,885	100	30	3,678	400	7,765
1985	6,449	6,379	6,589	6,749	9,203	100	30	2,654	400	2,854
1986	12,905	12,835	13,045	13,045	23,041	100	30	3,230	400	10,235
1987	11,900	11,830	12,040	12,200	16,662	100	30	2,980	400	5,728
1988	11,463	11,393	11,603	11,603	14,479	100	30	2,951	400	4,627
1989	8,639	8,569	8,779	8,779	10,523	100	30	2,241	400	2,212
Period peak flow	14,500	14,430	14,640	14,640	23,041	100	30	3,678	400	10,235

Source: the staff (adapted from Watson, 1994).

1 would continue to be 784 cfs, the average discharge to Powerhouse No. 2 would continue to be 754 cfs (figure 4-3), the average discharge to the lower North Fork would continue to be 30 cfs (figure 4-1), and average mainstem flows would continue to be 1,148 cfs.

By drafting Lake Cushman to low levels (November target level = 712 feet) during the high-flow fall and winter period, the Cushman Project provides up to 98,346 acre-feet of storage to attenuate downstream flooding. The highest annual mainstem peak flow during the 22-year simulation period was 14,430 cfs (table 4-1). There would be no change in existing flood frequency and magnitude under this alternative. The project would continue to reduce mainstem flooding (Tacoma, 1994a). This effect would continue to be beneficial and long-term.

4.2.3 Alternative 2

Minimizing out-of-basin diversions would dramatically increase the amount of water released at Dam No. 2 to the lower North Fork through Powerhouse No. 3 or spills and substantially reduce the amount of water distributed to power production compared with no action. Based on hydrologic modeling of this alternative, the average discharge to Powerhouse No. 1 would be 765 cfs, the average discharge to Powerhouse No. 2 would be 22 cfs, the average discharge to the lower North Fork would be 762 cfs, and average mainstem flows would be 1,881 cfs.

By maintaining a higher reservoir level during the winter, the flood reduction benefits of Lake Cushman would be reduced. Under the current rule curve, 98,346 acre-feet of storage is available in November between the target level (712 feet) and full pool (738 feet) to attenuate floods. Under Alternative 2 there would be 54,718 acre-feet of storage available in November between the target level (724 feet) and full pool to attenuate floods, a 44 percent reduction. This reduction in available flood storage would increase the frequency with which Tacoma would have to store water, encroaching on the storage usually available to contain the PMF (violating the rule curve), or release the flow and add to downstream flooding. Tacoma, Commission dam safety staff, the Corps, local residents, and other interested parties have expressed concern regarding this loss of flood storage capacity. The highest mainstem peak flow during the 22-year simulation period was 14,640 cfs (table 4-1), a 210-cfs increase as compared with Alternative 1. The 210-cfs increase in peak flows would be caused by a 210-cfs increase in the release rate at Dam No. 2. This increase in downstream peak flows would be negligible. Combining the reduction in peak flows with the conveyance capacity enhancement effects of dredging and the increased frequency of near-flood flows (section 4.1.3) that would be provided under this alternative makes it the most effective alternative considered in reducing mainstem flood hazards. This effect would be beneficial and long-term. This alternative, however, would cause a significant loss in hydropower generation and capacity (section 5.1.3).

4.2.4 Alternative 3

Under Alternative 3, reducing out-of-basin diversions would modestly increase the amount of water distributed to downstream bypass flows and would reduce the amount of water distributed to power production. Based on hydrologic modeling of this alternative, the average discharge to Powerhouse No. 1 would be 784 cfs, the average discharge to Powerhouse No. 2 would be 534 cfs, the average discharge to the lower North Fork would be 250 cfs, and average mainstem flows would be 1,368 cfs.

Because this alternative includes the same reservoir rule curve and minimum release rate during downstream flooding as Alternative 2, the project's effects on peak flow reduction would be the same as described in section 4.2.3. Combining the reduction in peak flows with the conveyance capacity enhancement effects of implementing projects in Mason County's Final Flood Hazard Reduction Plan would make this alternative highly effective in reducing mainstem flood hazards. This effect would be beneficial and long-term.

4.2.5 Alternative 4 (Decommissioning)

If the dams were removed, full natural flows would return to the lower North Fork, resulting in average flows of 784 cfs downstream from Dam No. 2 and average flows of about 2,000 cfs in the mainstem. Peak flows in the mainstem would dramatically increase. Removing the Cushman Project dams would have significant, long-term, adverse effects on downstream flooding in the lower North Fork and mainstem downstream from the project. The highest mainstem peak flow during the 22-year simulation period was 23,041 cfs (table 4-1). This 60 percent increase in downstream peak flows would measurably increase downstream flooding and ensuing property damage and risks to human life.

We assume that if the dams were retained the project would be operated to minimize out-of-basin diversion while providing flood control benefits. Under this scenario, water allocation and flood control benefits would be similar to those described for Alternative 2 (section 4.2.3).

4.2.6 Lower Lake Cushman Option

There would not be any expected change in water allocation as a result of permanently lowering Lake Cushman water levels. Unless operations were designed to maintain Lake Cushman water levels below 725 feet during all floods, flood control would improve. These effects would be minor, long-term, and beneficial.

4.2.7 Fish Passage Option

Implementing a fish passage system would not affect water allocation at the project. We anticipate that Tacoma would incorporate attraction flows into the MIF.

4.2.8 Staff Conclusions

The Cushman Project has long-term beneficial effects on peak flows downstream from the project. Peak flows would be similar under all of the alternatives except decommissioning with dam removal (Alternative 4) which would increase flows by about 60 percent. Alternatives 2 and 3 would have the most significant beneficial effects on downstream flood hazards because they combine the peak flow reducing effects of the project with mainstem conveyance capacity enhancement. Due to the long-term channel maintenance benefits provided by frequent near-flood flows in the mainstem, Alternative 2 would provide the highest flood hazard reduction benefits of the alternatives considered. This benefit would result in a significant loss of hydropower generation (section 5.1.3) and could cause significant adverse environmental effects (section 4.1).

DOI, WDFW, FWS, and NMFS recommend that, to verify compliance with recommended streamflow conditions, Tacoma establish telemetered streamflow gaging stations on the North Fork within 1 mile downstream from Dam No. 2, on the South Fork just upstream of its confluence with the North Fork, and on the mainstem immediately downstream from the confluence of the North and South Forks.

We agree that streamflow monitoring is necessary to demonstrate compliance with MIF requirements and that improvements in the existing streamgage network are needed. We therefore conclude that Tacoma, in consultation with USGS, should telemeter the existing North Fork stream gages (USGS Stations No. 12058800 and 12059500). Because USGS Station No. 12060500 on the South Fork was abandoned due to unreliability (the rating curve changed frequently) we recommend that Tacoma, in consultation with the U.S. Geological Survey, identify an appropriate site and install a telemetered streamgage on the South Fork Skokomish River in the vicinity of the channel's transition from confined to unconfined (valley floor) conditions. USGS Station No. 12058800 would be needed to demonstrate compliance with our recommended MIFs. The recommended stations on the lower North Fork and lower South Fork would be useful for the recommended channel maintenance flow program (section 4.1.8) and would improve mainstem flow and flood forecasting.

4.3 Water Quality

In this section we describe the potential and anticipated impacts of each alternative on water quality. We presented background information on temperature, dissolved oxygen, and other water quality indicators in section 3.3.2, which establishes the baseline for comparing water quality impacts of each alternative.

4.3.1 Tacoma's Proposal

4.3.1.1 Construction Impacts

Tacoma's proposed construction activities would have minor, adverse short-term impacts on water quality. Construction activities in the river and sensitive riparian areas would temporarily increase turbidity and suspended solids and would temporarily increase the risk of fuel, oil, or hydraulic fluid spills in the river. Tacoma's construction activities would include removing the McTaggert Creek diversion and excavating 300 feet of creek channel, building a new powerhouse at the base of Dam No. 2, and constructing fish passage and habitat enhancements. Recreation facility construction would include adding campsites and picnic areas and trail improvements. Terrestrial vegetation and wildlife habitat construction would include creating wetland ponds and forage plots.

Tacoma would develop an ESCP to minimize construction impacts. The Commission would review and approve this plan prior to any land-disturbing construction activity at the project. Tacoma proposes that construction in McTaggert Creek should occur during the low-flow months of August and September, disturbed areas would be hydroseeded, and silt fences should be used to prevent erosion (Tacoma, 1991b). Conducting construction in accordance with a Commission-approved ESCP would minimize potential adverse construction-caused water quality impacts.

4.3.1.2 Long-term Impacts

100-cfs Minimum Instream Flow to the Lower North Fork

Tacoma's Proposal to increase MIFs from 30 to 100 cfs year-round below Dam No. 2 would not cause long-term adverse impacts on water quality. Tacoma performed lower North Fork temperature and DO modeling for 30- and 100-cfs minimum flows. Water temperatures would change as discussed below, and DO concentrations would not be substantially affected. WDOE's Class AA (extraordinary) water quality standards for extraordinary waters would be met. Class AA water quality, WDOE's best water quality category (section 3.3.2), markedly and uniformly exceeds the requirements for all or substantially all uses, including water supply, fish and shellfish, wildlife, and recreation. Decreased water temperatures (discussed below), however, could affect aquatic resources.

Lower North Fork temperature modeling predicts that increasing the minimum flow from 30 to 100 cfs below the project would decrease late winter and spring mean daily temperatures by 0.2 to 0.7°C and decrease summer mean daily temperatures by 1.0 to 2.5°C (Tacoma, 1993a). Tacoma's Lake Kokanee temperature model indicates that Lake Kokanee would still stratify in the upper 30 feet with a 100-cfs instream flow release (Tacoma, 1991a). We conclude that the downstream temperature decrease with 100-cfs flows suggests that the upper layer of warm water in Lake Kokanee is depleted faster by the 100-cfs discharge than by the 30-cfs discharge. The upper layer is then replaced by cooler water from the Lake Cushman inflow.

Lower North Fork temperature modeling also predicts that increasing the minimum flow from 30 to 100 cfs would slightly increase autumn and early winter mean daily temperatures by 0.0 to 1.0°C. The temperature increase is caused by the reservoir release temperature exceeding the river equilibrium temperature. The larger water volume (100 cfs) would be cooled more slowly than by a smaller 30-cfs release (Tacoma, 1993a).

The change in lower North Fork water temperature, as predicted by temperature modeling under a 100-cfs MIF, would not cause a violation of Class AA water quality standards and would not adversely affect water quality. Water temperature is a primary consideration with respect to fish impacts in the lower North Fork. Releasing cold water into a river can delay fry emergence, reduce juvenile growth rates, delay smolt outmigration, and delay spawning and migration (Tacoma, 1991a). We discussed these effects in section 4.4.1.

Tacoma also modeled the effect of increasing Dam No. 2 releases from 30 to 100 cfs on downstream DO concentrations. DO concentrations equaled or exceeded the Class AA water quality standard of 9.5 mg/l, except for 9 mg/l at Dam No. 2 that was due to a modeling assumption. Lower North Fork DO concentration, therefore, would not be substantially affected.

Pulse and Flushing Flows

Tacoma's Proposal to release 120 cfs for a total of 11 days in the spring and fall and to release 300 cfs for 3 days in November every 3 years would not cause long-term adverse impacts on water quality. Water temperature would change as discussed below, but Class AA water quality standards would be met. DO concentrations would not be substantially affected.

Tacoma did not perform temperature and DO modeling for 120- and 300-cfs discharges. We compared the relative temperature response under the proposed discharges to the existing 30-cfs release. Because the pulse and flushing flow releases are for a short time, we expect the temperature response under these flows to be similar to the 100-cfs release. Pulse releases of 120 cfs in the spring might slightly decrease the mean daily water temperature. Pulse releases in the fall and a 300-cfs flushing flow in November would slightly increase mean daily water temperatures. Lake Kokanee begins to mix in the fall and is almost completely mixed by November at a temperature of about 5 to 6°C. The fall reservoir release temperature would be greater than the receiving stream temperature, and North Fork water temperature would increase. This is consistent with results of autumn and early winter 100-cfs modeling. This temperature increase is small and would not adversely affect water quality.

DO concentration would not be affected because instream flow releases would be withdrawn from about 15 feet deep in the reservoir and would be well oxygenated.

Because silt has accumulated downstream from Dam No. 2, the release of higher discharges might cause short-term water quality degradation during the initial higher flow releases. Organic material creates a biological oxygen demand (BOD) that can decrease DO concentrations and adversely affect aquatic resources. This could violate Class AA DO and turbidity standards. As indicated by a 156-cfs test flush on September 4, 1990, water was very turbid and had a decaying organic matter smell 0.5 mile downstream from Dam No. 2. At the time of the test flush, organic material had accumulated for 9 years since the previous flood spill, and the 30-cfs discharge (Tacoma, 1991a) had been in effect for only 2 years.

Continuing Current Reservoir Operations

Tacoma proposes to continue current reservoir operations. To increase the MIF from 30 to 100 cfs, a new powerhouse would be built at the base of Dam No. 2, and water would be withdrawn from the top 30 feet of Lake Kokanee. Tacoma plans to replace Powerhouse No. 2 turbine runners thus increasing hydraulic capacity from 2,700 to about 3,000 cfs. These operating conditions would not cause long-term adverse impacts on water quality. Lake Kokanee water temperature would decrease slightly, DO would not be affected, and seasonal lake stratification would continue.

Lake Kokanee water temperature is influenced by many parameters: the variable volume and frequency of inflow and outflow, the amount of solar insolation upon the lake, the penetration of solar insolation affected by turbidity, and the water layer affected by instream flow release. Predicting Lake Kokanee water temperature under the new operating conditions is difficult. We compared the relative temperature response in the reservoir with a 100-cfs release to the existing 30-cfs release. Tacoma's basic temperature modeling indicates that Lake Kokanee would still stratify in the upper 30 feet with a 100-cfs instream flow release (Tacoma, 1991b). Reservoir water temperature would probably decrease slightly as the warm, upper layer of water is depleted faster by the 100-cfs release compared to the 30-cfs release. Lake monitoring in 1989 indicated that DO is almost always above 9 mg/l within the reservoir's first 70 feet. A small temperature change would not substantially affect DO.

Increasing flow by 300 cfs to the Powerhouse No. 2 intake for the new turbine runners would not cause long-term adverse impacts on water quality. The Powerhouse No. 2 intake in Lake Kokanee is located 16 feet deeper than the spillway (where minimum flow to the lower North Fork is released). During peaking operations in 1989, cold, dense water released from Lake Cushman was drawn into the deeper powerhouse intake instead of the spillway. As a result, the minimum flow release temperature did not substantially decrease (Tacoma, 1990). High and frequent inflows of cold water from Lake Cushman can reduce temperatures in Lake Kokanee and upset summer stratification, but it is not known at what flow destratification would occur. Replacing the turbine runners and increasing flow by 300 cfs to the Powerhouse No. 2 intake would not upset Lake Kokanee stratification and would not cause long-term adverse impacts on water quality.

Under Tacoma's Proposal, Lake Kokanee water temperature would decrease slightly with a 100-cfs release as compared to a 30-cfs release. Even so, continuing current reservoir operations would not cause long-term adverse impacts on water quality.

New Powerhouse Below Dam No. 2

Tacoma proposes to construct a new powerhouse at the base of Dam No. 2 to release the 100-cfs minimum flows to the North Fork. The new powerhouse should not affect water quality.

Restoring Flows to McTaggert Creek

Prior to May 1991, McTaggert Creek flow was diverted approximately 4 miles above the mouth to Deer Meadow and eventually into Lake Kokanee. Water temperature near the McTaggert Creek mouth ranged from 5.5°C in January 1991 to 12.5°C in September (Tacoma, 1992a). The flow restoration to McTaggert Creek would not cause long-term adverse impacts on water quality.

Restoring McTaggert Creek flows would be a substantial long-term enhancement and benefit to the river's water quality. Natural streamflows would restore McTaggert Creek's channel and riparian habitat which would keep stream temperatures cool and prevent erosion.

4.3.2 Alternative 1 (No Action)

Under current operating conditions, water quality is similar both upstream of and downstream from the project and complies with WDOE's Class AA water quality standards. Under Alternative 1, the 30-cfs minimum flow release below Lake Kokanee would continue as required by the Section 401 water quality certificate. The Skokomish River would continue to meet Class AA water quality standards, but the lower North Fork would still be listed as a water quality-limited water by WDOE because of inadequate instream flows for fish habitat.

4.3.3 Alternative 2

4.3.3.1 Construction Impacts

Construction impacts under this alternative would be essentially the same as under Tacoma's Proposal. Impacts on water quality would be minor, adverse, and short-term. Construction activities in the river and sensitive riparian areas would temporarily increase turbidity and suspended solids and would increase the risk of fuel, oil, or hydraulic fluid spills. These effects would be minimized by soil and erosion control measures required by the recommended ESCP.

4.3.3.2 Long-term Impacts

Return of Full Flows to the Lower North Fork

Under this alternative, Tacoma would return full flows to the North Fork over a 5-year period to allow channel enlargement and flood protection improvements. Mechanical dredging may be required to increase channel capacity. The MIF below Dam No. 2 for the first year would be 240 cfs. The average discharge to the lower North Fork would be 762 cfs (section 4.2.3). This alternative has manageable risks of initial and sporadic increases in turbidity and suspended solids caused by higher flows and floods, which could adversely affect water quality. North Fork summer water temperatures would decrease because of Lake Kokanee stratification breakup. Increased turbidity and suspended solids and decreased temperatures could affect aquatic resources (section 4.4.3). This alternative is likely to have the greatest long-term water quality benefits, however, because of the substantially increased flows.

We compared the relative response of turbidity and suspended solids under full river discharges to the existing 30-cfs release. As discussed in section 4.1.3, the North Fork channel morphology would be dramatically affected under this proposal. The response is expected to include channel deepening, braiding, and movement of a large quantity of sediment, possibly causing higher suspended solids and turbidity levels. This would occur initially in the project operation until the river's sediment carrying capacity reached equilibrium and also during higher flows and floods. Impacts on water quality would be adverse short-term, sporadic, and moderate. If mechanical dredging were needed it would substantially increase suspended solids and turbidity and degrade water quality. This effect would be long term and more severe than natural channel flushing.

Temperature modeling has not been performed for 762-cfs flows. We compared the relative temperature response in the North Fork with proposed discharges to the existing 30-cfs release. We based our analysis on temperature trends predicted in the 100-cfs temperature model (section 4.3.1.2). Increasing the North Fork minimum release from 30 to 100 cfs would decrease late winter, spring, and summer mean temperatures and increase fall and early winter mean temperatures. We conclude that the return of full flows, which would be greater than a 100-cfs release, would continue this temperature trend but could be avoided by construction of an adjustable or modified intake to withdraw warmer water from Lake Cushman.

Full flows would disrupt Lake Kokanee summer stratification, leading to very cold North Fork releases. This could adversely affect aquatic resources because releasing cold water into a river can delay fry emergence, reduce juvenile growth rates, delay smolt outmigration, and delay spawning and migration (Tacoma, 1991b). We discussed these effects in section 4.4.3.1.

Reservoir Operations

Under this alternative, a higher reservoir level would be maintained during the winter, but reservoir releases would be based on inflows and a reservoir rule curve to return nearly full flows to the North Fork below Dam No. 2. Lake Kokanee water temperature would decrease, especially in the summer, which would affect resident aquatic resources in the reservoir.

Lake Kokanee water temperature is influenced by many parameters, and predicting temperatures under the new release rate is difficult. We compared the relative temperature response in the reservoir with full flow release to the existing 30-cfs release. High and frequent inflows of cold water from Lake Cushman can reduce temperatures in Lake Kokanee and disrupt the smaller lake's summer stratification pattern. It is not known at what discharge destratification would occur. Destratification would probably occur under Alternative 2's high flow-through rates, however, and Lake Kokanee would mix under these flows, either because of the high inflow of cold water from Lake Cushman or because of more rapid depletion of warmer surface water in Lake Kokanee from the release of higher North Fork minimum flows, or both.

Water exits Lake Cushman through the Powerhouse No. 1 intake at a temperature of about 5°C. Lake Kokanee has a short hydraulic retention time of 5.4 days under present conditions, and a relatively small surface area to allow thermal warming. With complete mixing it is likely that the water temperature in Lake Kokanee would not be substantially greater than 5 to 6°C. These lower water temperatures would not violate Class AA standards or adversely affect water quality, but cooler water would affect aquatic resources within Lake Kokanee and in the lower North Fork as discussed in section 4.4.3.1.

We therefore recommend that Tacoma construct an adjustable or modified intake to withdraw warmer water from Lake Cushman. Warmer inflows would help mitigate cold temperatures in Lake Kokanee and the lower North Fork and adverse impacts on aquatic resources.

New Powerhouse Below Dam No. 2

Under this alternative, a new 16-MW underground powerhouse with a 1,300-cfs hydraulic capacity would be built at the base of Dam No. 2. The new Powerhouse No. 3 should not affect water quality.

Terrestrial Vegetation and Wildlife Habitat Enhancements

Under Alternative 2, terrestrial vegetation and wildlife habitat would be enhanced along the riparian corridors and substantial long-term positive benefits to the river's water quality would occur. Undisturbed riparian areas keep stream temperatures cool and prevent erosion that increases turbidity and river sediments.

Other Agency Recommendations

In addition to other agency recommendations previously discussed under this alternative, WDFW recommends that Tacoma develop a Water Quality Protection Program to ensure that project operations meet and maintain WDOE water quality standards for Class AA streams and to ensure that water quality is protected throughout the project's area of influence. Based on WDFW recommendations, Alternative 2 would include, at a minimum:

- an ESCP;
- construction scheduling guidelines;
- pollution control during operation;
- an oil and toxic spill response plan;
- dissolved gas monitoring;
- environmental monitoring;
- a penstock intake shut-off valve; and
- paving and maintaining North Shore (Staircase) Road.

Tacoma has no objection to many of these recommendations, but questions the need for this program because it has already received Section 401 water quality certification from WDOE, which conditioned project operations to certify compliance with Washington's state standards.

Gas supersaturation is not expected to be a problem because the North Fork instream flow release would be withdrawn from a 15-foot depth from Lake Kokanee. Tacoma, however, anticipates that dissolved gas monitoring will be required with the new turbine at Dam No. 2 during the initial years of operation (Tacoma, 1995a).

Tacoma objects to WDFW's recommendation for providing an emergency penstock shut-off valve because the Cushman No. 2 penstock already contains three butterfly shut-off valves. In addition, WDFW has not suggested that the existing valves are unsafe.

4.3.4 Alternative 3

4.3.4.1 Construction Impacts

Construction impacts under this alternative would be essentially the same as under Tacoma's Proposal. Impacts on water quality would be minor, adverse and short-term. Construction activities in the river and sensitive riparian areas would increase turbidity and suspended solids and would increase the risk of fuel, oil, or hydraulic fluid spills. These effects would be minimized by soil and erosion control measures required by the staff's recommended ESCP.

4.3.4.2 Long-term Impacts

Increased Minimum Flows in the Lower North Fork

Under this alternative, instream flows from Dam No. 2 to the North Fork would be increased to 240 cfs for most of the year with 400-cfs flows in November. North Fork water temperatures would change, and decreased temperatures could affect aquatic resources. Because of the higher flows, there would be a minor, adverse short-term increase in suspended solids and turbidity levels.

We compared the relative temperature response under the proposed discharges to the existing 30-cfs release. Since temperature modeling has not been performed for discharges of 240 and 400 cfs, we based our analysis on temperature trends predicted in Tacoma's 100-cfs temperature model (sections 4.3.1.2 and 4.3.3.2). We conclude that releases of 240 and 400 cfs, which would be greater than 100 cfs, would decrease lower North Fork water temperature during late winter, spring, and summer, and increase water temperature during fall and early winter compared to the existing 30-cfs release.

Decreased water temperatures would affect aquatic resources (section 4.3.3.2). There would also be a minor, adverse short-term increase in suspended solids and turbidity under the proposed flows compared to the existing 30-cfs release (section 4.3.1.2). Alternative 3's higher fall flow of 400 cfs is designed to modify channel form and increase capacity, which would subsequently prevent substantial erosion during increased flows and enhance water quality.

Reservoir Operations

Under this alternative, the project reservoirs would be operated in the same manner as today. Predicting Lake Kokanee water temperature under the new release rate is difficult, because it is not known at what flow destratification would occur. The decrease in Lake Kokanee summer water temperature would be moderate under lake stratification, to substantial under lake destratification (section 4.3.3.2). Alternative 3 would require that Tacoma construct an adjustable or modified intake to withdraw warmer water from Lake Cushman as discussed in section 4.3.3.2.

New Powerhouse Below Dam No. 2

Under this alternative, a new powerhouse would be built at the base of Dam No. 2 to release the average 240-cfs minimum flow to the North Fork. The new powerhouse should not affect water quality.

Terrestrial Vegetation and Wildlife Habitat Enhancements

Terrestrial vegetation and wildlife habitat would be enhanced along riparian corridors and substantial long-term positive benefits to the river's water quality would occur similar to those described under Alternative 2 (section 4.3.3.2). Undisturbed riparian areas prevent erosion that increases turbidity and river sediments.

Other Agency Recommendations

Implementation of WDFW's recommended Water Quality Protection Program (section 4.3.3.2) should minimize potential construction-caused adverse impacts on water quality. Under this alternative, Tacoma would provide and follow a Commission-approved ESCP and adhere to construction scheduling guidelines for all soil-disturbing activities. Tacoma has already provided a plan addressing unstable slopes, previous slides, and areas prone to slumping. Environmental monitoring, as recommended by WDFW, should not be necessary because the Commission would approve and oversee implementation of construction plans.

Tacoma would also continue to follow all pollution control laws and its Oil Spill Prevention, Control, and Countermeasure (OSPCC) plan, which would meet WDFW recommendations.

This alternative also includes WDFW's recommended emergency penstock shut-off valve and dissolved gas monitoring. Although it is unlikely, because of project design, that penstock rupture and gas supersaturation would occur, the recommended shut-off valve and 1-year gas monitoring are extremely low-cost measures. We have therefore included these recommendations in Alternative 3.

WDFW has recommended that Tacoma pave and maintain Staircase Road as a water quality protection measure. Staircase Road is located within mature or old-growth forest habitat on ONF lands that have been designated as late successional reserves (LSRs). We recommend that Tacoma develop and implement a road management plan in consultation with the Forest Service.

4.3.5 Alternative 4 (Decommissioning)

Decommissioning with dam removal would cause full, naturally varied discharges to flow through the North Fork and mainstem. Dam removal construction impacts would cause short-term adverse water quality impacts with moderate increases in turbidity and suspended solids.

If the dams were removed, accumulated sediments would be flushed from the backwater pool. Duration and severity of effects would depend on the method of accumulated sediment removal from the backwater. Liberating large quantities of oxygen-demanding sediments, relative to river volume flow, could deplete river DO and cause fish kills. Liberated sediments could also settle on downstream substrate, degrading fish habitat quality. The dam and accumulated sediments should be removed under flow conditions that would not create an oxygen demand in the river greater than the river's oxygen reserves or allow substantial sediment accumulation downstream. Revegetation of exposed areas would be required as discussed in section 4.1.5. Dam removal in accordance with substantial planning and erosion control efforts would minimize potential adverse long-term water quality impacts.

To maintain flood control and recreation benefits, and to preserve lakeshore property values, reservoir operations under decommissioning without dam removal would probably be similar to those described under Alternative 2 (section 4.3.3.2). Consequently, long-term water quality impacts would be similar to those described under Alternative 2. Structures and equipment could be stored, disassembled and removed, or demolished. Intakes could be sealed or completely removed. Construction impacts from these activities would cause short-term adverse increases in suspended solids and turbidity.

4.3.6 Lower Lake Cushman Option

Maintaining Lake Cushman at 725 feet, rather than 738 feet, from April through September would affect water quality by increasing suspended solids and turbidity levels in the reservoirs and in the North Fork downstream from Dam No. 2. Lowering Lake Cushman would expose the delta zone, which is composed of fine sediments, to the erosive action of the North Fork as it enters the reservoir. This would cause a long-term, moderate, adverse impact on water quality.

4.3.7 Fish Passage Option

Implementing fish passage facilities would not have any measurable impacts on water quality.

4.3.8 Staff Conclusions

Under Tacoma's Proposal or Alternative 2 or 3, Tacoma would provide and follow a Commission-approved ESCP and adhere to construction scheduling guidelines for all activities in the river including McTaggert Creek diversion removal, powerhouse construction, and structural fish habitat enhancements. Tacoma should continue to follow all pollution control laws and its Oil Spill Prevention, Control, and Countermeasure plan, which would meet WDFW recommendations.

Under Tacoma's Proposal and Alternatives 2 and 3, water temperatures in the lower North Fork would decrease; however, the decreased temperatures would not violate Class AA water quality standards and water quality would not be adversely affected. To avoid cold temperatures in Lake Kokanee and the lower North Fork and associated impacts on aquatic resources, we recommend that Tacoma construct an adjustable or modified intake to withdraw warmer water from Lake Cushman under Alternatives 2 and 3.

WDFW has recommended that Tacoma provide an emergency penstock shut-off valve and monitor dissolved gasses for 1 year at all powerhouse outfalls and spillways during spill events. These measures would be included in Alternatives 2 and 3. Although it is unlikely, because of project design, that penstock rupture and gas supersaturation would occur, the recommended shut-off valve and 1-year gas monitoring are extremely low-cost measures. We do not believe that the recommendations are inconsistent with the purposes and requirements of the FPA. The recommendations would not have a significant negative effect on project purpose, nor would the expense of implementing them have any significant economic effect on the feasibility of the project. We therefore adopt the recommendation that an emergency penstock shut-off valve and dissolved gas monitoring be provided.

WDFW has recommended that Tacoma pave and maintain Staircase Road as a water quality protection measure. As discussed during the agency meeting on Section 10(j) recommendations, we recommend that Tacoma develop and implement, in consultation with FS, a road management plan for project-related roads on FS lands.

4.4 Aquatic Resources

4.4.1 Tacoma's Proposal

4.4.1.1 Minimum, Pulse, and Flushing Flows

Tacoma proposes to increase lower North Fork minimum flow from 30 to 100 cfs. Tacoma would also release 120-cfs "pulse flows" for 6 days in the spring and 5 days in the fall to stimulate juvenile outmigration. Additionally, every 3 years Tacoma would release 300-cfs flows for 3 days to flush fine sediments from the reach below Dam No. 2.

100-cfs Minimum Instream Flow

Tacoma believes that substantial improvements in salmon rearing conditions could be provided by increasing MIF from 30 to 100 cfs. Tacoma studied lower North Fork habitat and flow relationships during 100- and 200-cfs flows released September 5 through 11, 1990. During test flows, Tacoma collected elevation, depth, and velocity data. To augment the data, Tacoma randomly snorkeled habitat types (pools, glides, riffles) in proportion to their study reach occurrence and measured depth, velocity, substrate, and cover at sites where fish were observed. Tacoma used these data to develop fish habitat criteria curves.

To evaluate MIFs proposed by Tacoma, we reviewed three related sub-issues: lower falls (RM 15.6) passage, available fish habitat, and 100-cfs flow temperature effects on the lower North Fork. We assessed potential fish passage at the lower falls under 100-cfs minimum flow, and evaluated Tacoma's analysis of available fish habitat and the flow's consistency with resource agency objectives (section 4.4.3).

For our analysis, we assumed that aquatic resources in the lower North Fork, especially anadromous fish production, have been limited by flow and available habitat for all life stages and that restoration of wild, self-sustaining anadromous runs would require substantially increased flow and habitat for all life stages.

Lower Falls Passage. Currently, the low 30-cfs flow blocks salmon passage of the lower falls (RM 15.6) located 1.7 miles below Dam No. 2. Tacoma evaluated falls passage at 30-, 100-, and 200-cfs flows using Powers and Orsborn's (1985) methodology. Analysis indicated that the falls are passable to steelhead at 100 cfs but impassable to chinook and coho (Tacoma, 1990). At 200-cfs flows, steelhead could readily pass the falls and coho and chinook might be able to achieve passage, but passage is not assured. Sockeye leaping capabilities compare favorably with coho and chinook (table C-3, appendix C), suggesting they also might be able to ascend the falls at 200 cfs.

Tacoma proposes to modify the falls for coho passage. Because chinook and sockeye leaping abilities compare favorable with coho, modifications could also provide chinook and sockeye passage.

With Tacoma's proposed modification of the falls, it is likely that coho, chinook, steelhead, and sockeye would be able to ascend the falls and use the upper canyon reach at flows of 100 cfs or greater. Under this proposal, improving salmon passage of the lower falls would represent a moderate long-term benefit to the river's anadromous fisheries because 20 percent of the length of the lower North Fork is upstream of this falls.

Fish Habitat. Tacoma's IFIM analysis of the existing channel indicates that 30-cfs flow velocities were substantially slower than optimum for fish that currently use the river reach (coho, chinook, chum, and steelhead), and depths were generally more shallow than preferred (Tacoma, 1991a). At 100 cfs, velocities were near optimum and depths were improved based on Tacoma's fish criteria used during snorkeling observations (Tacoma, 1991b).

Tacoma's 100-cfs minimum flows would substantially increase spawning habitat for all species, ranging from a 167 percent increase in rainbow trout spawning habitat to a 626 percent increase in chinook salmon spawning habitat (table 4-2). Fry rearing habitat is reduced at 100 cfs from 15 to 58 percent, however fry rearing habitat would be generally the most abundant habitat type at existing flows, ranging from 4.39 hectares for resident cutthroat to 9.18 hectares for coho. Juvenile rearing habitat would be reduced for coho (18 percent), resident cutthroat (22 percent), and sea-run cutthroat (15 percent) but is also relatively abundant under existing conditions (from about 3 to 4 hectares). Chinook and steelhead juvenile rearing habitat would increase from 188 to 208 percent from 1.48 hectares for chinook and 1.76 hectares for steelhead about 2 to 3.5 hectares, respectively. Juvenile rearing habitat for rainbow trout would increase about 40 percent. Adult holding habitat for chinook salmon would increase 153 percent from 1.24 to about 2 hectares and steelhead adult habitat would increase 810 percent from a low of 0.13 hectare to about 1 hectare with 100 cfs flow. Adult holding habitat for resident and sea-run cutthroat would be reduced about 15 percent from about 4.5 hectares to about 4 hectares for both species.

Substantially increased side-channel flows (that would provide greater juvenile rearing habitat) and a fully-wetted channel width (that would increase benthic macroinvertebrate production) are two resource agency minimum flow objectives (section 4.4.3.1). Aquatic macroinvertebrate production is highly correlated to channel wetted perimeter and is a major component of high fish food production. Tacoma's proposed 100-cfs minimum flow alone would not provide substantially increased side-channel flows nor wet the existing channel's full width.

Table 4-2. Lower North Fork fish habitat changes with minimum flow increase from 30 to 100 cfs.

Species	Lifestage	30 cfs habitat (ha)	100-cfs habitat (ha)	Percent Change
Chinook	Spawning	0.85	5.32	626
	Fry	7.64	5.47	-40
	Juvenile	1.48	2.78	188
	Adult	1.24	1.89	153
Chum	Spawning	3.73	7.47	200
Coho	Spawning	3.27	6.84	209
	Fry	9.18	7.14	-28
	Juvenile	3.50	2.97	-18
Cutthroat	Spawning	2.75	5.38	195
	Fry	4.39	2.87	-53
	Juvenile	6.15	5.04	-22
	Adult	4.61	4.01	-15
Pink	Spawning	2.81	7.04	251
Rainbow	Spawning	1.39	2.32	167
	Fry	8.74	5.50	-59
	Juvenile	2.18	3.66	40
	Adult	2.45	3.99	39
Sea-run Cutthroat	Spawning	1.35	2.26	168
	Fry	8.68	5.46	-59
	Juvenile	4.46	3.88	-15
	Adult	4.45	3.88	-15
Steelhead	Spawning	6.36	9.59	151
	Fry	8.73	5.53	-58
	Juvenile	1.76	3.65	208
	Adult	0.13	1.04	810

Tacoma developed habitat data and fish suitability criteria from observations made at 30 cfs and concluded that 100 cfs is better for salmonid rearing than 200 cfs. Use of Tacoma's habitat analysis to substantiate conclusions about available fish habitat with 200-cfs flows is limited except for the canyon below Dam No. 2 where increased flows would not substantially change the habitat characteristics (such as pool-riffle structure) of the bedrock-confined channel. We also considered that the Instream Flow Incremental Methodology (IFIM) model does not accurately predict nonhorizontal velocity gradients and does not account for crowding effects (predation and competition) when juvenile and adult habitat are in proximity (as the habitats are at lower flows). IFIM results are more limited for predicting fry rearing habitat than they are for other life stages. It is reasonable, however, that 100-cfs flows provide a substantial improvement in rearing habitat over 30-cfs flows.

We conclude that Tacoma's proposed minimum flow would provide substantial salmon and trout spawning habitat increases over the existing conditions and would substantially increase chinook and steelhead juvenile rearing and adult holding habitat. Assuming that, like many Pacific Northwest rivers, juvenile rearing habitat would ultimately limit Skokomish fish production (Everest et al., 1984; Crispin, 1988; Solazzi, 1988) (except for coho and steelhead that are limited by low summer flows) and assuming that no other limiting factors come into play, fish production would increase proportionally to these juvenile rearing habitat increases except for coho and steelhead production that would increase in proportion to increase in summer low flows. This increased fish production estimate does not account, however, for juvenile rearing habitat improvements caused by structural habitat improvements and side-channel excavation.

Temperature Effects. At 100-cfs minimum flow, water would be drawn from Lake Kokanee's warmer upper layer (epilimnion) at a faster rate than currently occurs at 30-cfs flow. Tacoma applied a very basic lake stratification model that predicts the lake would remain stratified with 100-cfs minimum flow. Increasing minimum flows to the lower North Fork could slightly reduce Lake Kokanee's water temperatures during summer because the lake is refilled with relatively cold water from Lake Cushman.

Because aquatic biota have metabolic and behavioral adaptations that allow them to adapt to temperature changes, slightly cooler lake temperature is not anticipated to affect the lake's aquatic resources. The slightly cooler temperatures are not likely to substantially reduce the lake's invertebrate production. Because the fishery is essentially a put-and-take trout fishery (catchable size rainbow trout are stocked), slight reductions in lake productivity would not affect the fishery.

Our approach to evaluating potential water temperature effects on lower North Fork aquatic resources used a FWS method to evaluate temperature effects on fish life stages. We compared 50 percent temperature suitability criteria ("good habitat") (McMahon, 1983; Raleigh et al., 1984; Hale et al., 1985; Raleigh et al., 1986) and other salmonid water temperature criteria (Beschta et al., 1987) to Tacoma's model-predicted 100-cfs temperatures in the lower North Fork.

We anticipate that temperature effects would be minor, because individuals have metabolic and behavioral adaptations to temperature changes, and populations also have behavior responses. We expect the temperature decline to reinforce existing salmon and trout habitat preferences, encouraging habitat separation. Cooler upstream temperatures would influence chinook, steelhead, and coho to occupy habitat upstream of McTaggert Creek, while chum and cutthroat would prefer warmer downstream habitat.

We anticipate that Tacoma's proposed project would have several minor effects on certain salmon and trout life stages, representing changes from existing conditions. The cutthroat trout juvenile rearing period above McTaggert Creek would be reduced from about 12 weeks to about 8 weeks (figure 4-5). The magnitude that the cutthroat rearing season would be shortened decreases in the downstream direction as water temperatures warm. Water temperatures above McTaggert

Creek would range from 7 to 9°C in the summer. Lower North Fork temperatures would be suitable for winter steelhead, chinook, and coho spawning and rearing; however, these temperatures are colder than published criteria for summer-fall chinook upstream migration. These temperature criteria range from 10.6 to 19.4°C (figure 4-6) (Beschta et al., 1987). This information suggests that chinook and chum upstream migration could be stimulated by releasing warmer water (about 10.5°C) in October and November.

We conclude that Tacoma's proposed 100-cfs minimum flow would slightly reduce North Fork water temperatures and could have short-term, minor impacts on aquatic resources.

Additional Pulse Flows

WDFW recommends that Tacoma release additional 20-cfs pulse flows (in addition to the MIF) for 24-hour periods in the spring on May 1, 11, 21, and 30; and June 15 and 30, and 48-hour, 25 percent flow increases in the fall (on August 15 and 25; September 4, 14, and 24; and October 4 and 14). WDFW recommends these levels of pulse flow to augment its recommended 240-cfs interim minimum flows.

Smolt migration and flow data collected by the PNPTC and Tacoma suggest that small flow pulses would stimulate coho smolt outmigration. The Tribe and Tacoma operated a smolt trap in the North Fork just above McTaggert Creek annually from 1987 to 1990 during the coho and steelhead outmigration period (early April through mid-June) (Tacoma, 1990). Flow and temperature monitoring data were available within 0.5 mile of the trap during 1989 and 1990. Flow data indicated that outmigration was stimulated by pulses from rainfall in the watershed (figure 4-7). It appeared that pulses as low as 5 cfs stimulate coho and steelhead outmigration (Tacoma, 1991b).

Considerable scientific literature indicates that slight flow increases could stimulate coho and steelhead outmigration. Additionally, lower North Fork site-specific data indicated that flow pulses stimulate steelhead and coho juveniles. Based on the site-specific data and scientific literature, we conclude that pulse flow releases would represent a moderate, long-term benefit for lower North Fork anadromous fish.

300-cfs Flushing Flows

Tacoma investigated flushing flow effectiveness to remove fine-grained sediment accumulations and organic matter from the canyon below Dam No. 2. Test results showed that a 200-cfs flushing flow would effectively remove fine sediments from most areas. Tacoma proposes 300-cfs flushing flows, however, to ensure a greater level of sediment removal.

With use of agency-recommended ramping rates to minimize fish stranding, moderate, long-term benefits — improved spawning habitat, improved fry intergravel development, and increased macroinvertebrate (fish food) production — would more than compensate for minor, short-term impacts on water quality from flushing flows.

Resource agencies and tribal representatives have expressed concerns regarding fine sediment and organic matter accumulations in the lower North Fork below Dam No. 2. Generally, agencies want more than just surface fines to be removed and recommend that deeper sediment accumulations also be removed.

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We evaluated Tacoma's flushing flow studies and scientific literature to determine appropriate flushing flows for the lower North Fork.

Silt accumulations occur mainly in deep pool habitat upstream of McTaggert Creek. Primarily decomposing organic material and silt-sized mineral grains compose the silt (Tacoma, 1992a). Fine sediment accumulations in pools can reduce pool habitat area, decrease available rearing habitat, and fill in substrate pore spaces thus decreasing winter intergravel habitat (Bjornn et al., 1977). Silt accumulation can reduce substrate surface area, causing reduced invertebrate production (Reiser and Bjornn, 1979).

To flush excess fines, water velocities must exceed critical shear stresses required to erode silt. Tacoma used several methods to estimate flows necessary to erode silt. Flushing flow estimates were based on published silt sheer stress values, local shear stress values estimated from velocity profiles, and estimated maximum velocities at which alluvial silt is stable.

Tacoma performed a silt flushing test at 200 cfs to determine if silt accumulations were effectively removed. Flushing flow estimates, determined from local sheer stress estimates and the 200-cfs flushing test flow, indicated that about 150- to 200-cfs flows effectively remove silt from pools in the upper North Fork. Prior to releasing the 200-cfs flows (pre-flush), composite pool transects contained about 40 percent sand-silt-clay and 14 percent organics; after 200-cfs flows (post-flush), composite pool composition was 7 percent sand-silt-clay and 6 percent organics (Tacoma, 1991c). Tacoma also used "embeddedness" values to measure flushing flow success. Embeddedness is a visual assessment of the degree that dominant particles in the stream bed are surrounded or covered by fine-grained sediments. Pool substrate embeddedness was reduced by 42 percent after the flushing test.

We conclude that the 200-cfs flows would be suitable for most silt accumulation below Dam No. 2 because much of this reach's substrate is bedrock, where surface fines removal is acceptable. We recognize, however, that removing deeper silt accumulations is likely to further benefit habitat by providing more intergravel matrix for invertebrate production and juvenile overwintering. Flushing flows of 300 cfs would remove some of the deeper sediments. Silt removal is also particularly important if accumulations occur after gravel augmentation enhancement of this reach. We agree that Tacoma's proposed 300-cfs flows are suitable flushing flows to remove silt accumulations below Dam No. 2.

Ramping Rates

Site-specific ramping rates and measurement locations for those rates have not been determined for the lower North Fork. Tacoma proposed to ramp increasing and decreasing flows in the lower North Fork at agency-recommended rates. Tacoma tested the Dam No. 2 spillgate mechanism for releasing minimum flows and ramping and does not recommend use of the existing spillgate for "pulse" and "adult attraction" flow releases. The existing spill mechanism's use would be labor-intensive and subject to uncontrollable influences such as Lake Kokanee water level and rainfall (Tacoma, 1992a). The spillgate was not designed for limited releases and is unstable without monitoring and adjustment. Manual gate operation could not be relied upon because inadvertent high flow releases and flow fluctuations would occur. Tacoma proposed to continue to develop a workable release mechanism for required minimum flows and flow ramping. Tacoma has not completed this design because required lower North Fork minimum flows are not yet established.

FWS and American Rivers recommend general ramping rates described in Hunter (1992) for all river flows downstream from Dam No. 2 until a critical flow is defined by Tacoma, resource agencies, and the Tribe.

The Commission is considering a wide range of lower North Fork minimum flows and some of the proposed flows are expected to modify channel shape. We conclude that more site-specific ramping rate determinations are premature. We recommend that Tacoma use agency-recommended general ramping rates until minimum flows are established and critical flows are determined.

Big Creek and Dow Creek

Tacoma proposes fish passage improvements to Big Creek (at Lake Cushman) and Dow Creek (at Lake Kokanee) to improve natural reproduction of lacustrine fish, and lower falls modification to provide anadromous fish passage to the reach below Dam No. 2. Because benefits differ between lake tributary passage improvements (for lacustrine fish) and lower North Fork passage improvements (for anadromous fish), we discuss lake tributary and river passage separately.

High gradients and tributary passage barriers limit upstream spawning and rearing habitat for lacustrine fish in the project reservoirs. Tacoma surveyed lake tributary habitat and investigated enhancement opportunities. Tacoma proposes to remove existing fish passage barriers in Lake Cushman's Big Creek and Lake Kokanee's Dow Creek to enhance reservoir fisheries. Removal of the natural migration barrier on Big Creek would provide 22 miles of upstream spawning and rearing habitat, and removal of a road culvert barrier on Dow Creek would allow access to about 12 miles of tributary habitat.

WDFW recommends that Tacoma modify the fish passage barrier near Big Creek's mouth and remove or modify the impassable culvert 0.8 mile upstream of Lake Kokanee.

We evaluated Tacoma's Proposal by reviewing potential habitat enhancement, determining the level of habitat enhancement that could be achieved, and reviewing published literature concerning potential competition between lacustrine and resident stream fish.

High gradients and fish passage barriers limit tributary rearing and spawning habitat in many Olympic Peninsula rivers (Williams et al., 1975), including the upper North Fork. Because Big and Dry Creeks are Lake Cushman's only major tributaries, they represent the best opportunities for tributary habitat enhancement. The other tributaries have very steep gradients and small drainage areas so they would not provide substantial habitat for lacustrine fish. The Dry Creek tributary to Lake Cushman, for example, has a relatively small habitat area, high gradient (5 to 7 percent), and a predominance of bedrock cascades that limit the stream's rearing and spawning habitat potential (Tacoma, 1990). Big and Dow Creeks have more habitat area and substantial spawning and rearing habitat; however, barriers in their lower reaches cause them to be inaccessible to fish. We agree with Tacoma's assessment that Big Creek and Dow Creek are the only reservoir tributaries suitable for fish passage enhancement.

With Big Creek barrier removal, suitable Lake Cushman tributary habitat would increase about 33 percent from about 62,387 square meters to about 82,774 square meters. Accessible Lake Kokanee tributary habitat, with Dow Creek passage enhancement, would increase about 150 percent from 5,723 square meters to 14,409 square meters.

We conclude that Big Creek and Dow Creek passage improvement would substantially increase spawning and rearing habitat of Lake Cushman and Lake Kokanee's lacustrine fishes. This additional spawning and rearing habitat would improve kokanee and bull, cutthroat, and rainbow trout natural production and recruitment to Lake Cushman, and rainbow and cutthroat natural production in Lake Kokanee. Providing tributary access for lacustrine fish would not substantially increase competition between tributary resident species. Bull trout have co-existed successfully with salmon and steelhead, occupying a different ecological niche than trout and salmon and using young salmon as food (Meehan and Bjornn, 1991). Tacoma's proposed passage improvements are reasonable and suitable designs. Providing fish passage to Big and Dow Creek habitat would enhance natural lake production and represents a moderate, long-term benefit to lacustrine fishes. With Tacoma's proposed use of cofferdams during Dow Creek culvert arch construction, minor, short-term increases in erosion and suspended sediments would be minimized.

Lower Falls

Tacoma also proposes to modify the North Fork's lower falls at RM 15.6 to reduce the falls' height and to improve potential coho salmon passage. Salmon do not currently ascend upstream past the falls. Tacoma evaluated fish passage at the falls using Powers and Orsborn's (1985) methodology. Passage analysis indicated that at 200-cfs the falls is readily passable to steelhead and marginally passable to chinook and coho; however, at 100 cfs, the falls is passable to steelhead but impassable to chinook and coho (Tacoma, 1991b).

As discussed in section 4.4.1.1, with Tacoma's proposed modification of the falls, it is likely that coho, chinook, steelhead, and sockeye would be able to ascend the falls and use the upper canyon reach at flows of 100 cfs or greater. Improving salmon passage of the lower falls would represent a moderate long-term benefit to the river's anadromous fisheries because 20 percent of the length of the lower North Fork is upstream of this falls.

4.4.1.3 Reservoir Trout and Kokanee Stocking

The Cushman Coordinating Committee established a Resident Fish Hatchery Technical Work Group (Work Group), with representatives from WDFW, the Skokomish Tribe, BIA, NPS, FS, and Tacoma, to evaluate Lake Cushman and Lake Kokanee resident fish enhancement (Tacoma, 1993a). FWS and NMFS did not participate in the Work Group, but reviewed documentation of the group's activities (Tacoma, 1993a). The Work Group evaluated numerous factors that can limit lake fisheries (including habitat, lake productivity, harvest pressure, interspecific competition and predation, and dam operations) and developed a resident fishery enhancement program (Tacoma, 1993a).

WDFW recommends and Tacoma has agreed that, within 2 years, Tacoma will fund and establish the resident fish stocking plan developed by the Work Group and provide long-term monitoring of its effectiveness. WDFW also recommends that Tacoma fund a full-time, journey-level fisheries biologist to conduct monitoring and other duties at the project. Tacoma objects to funding this position.

FWS recommends that Tacoma fund fish hatchery facility development, operation, and maintenance sufficiently to recover and mitigate resident and anadromous fish populations affected by project development and continuing operation. NMFS supports FWS recommendations and adds that "any artificial propagation plan should be developed with consultation and approval by NMFS, in accordance with NMFS's policy guidelines."

Tacoma proposes to carry out the resident stocking program developed by the Work Group. Tacoma would stock Lake Cushman with 1.5 million kokanee smolts and 140,000 catchable sea-run cutthroat and stock Lake Kokanee with 12,000 catchable rainbow trout. When the new license is issued, Tacoma proposes to begin developing the Big Creek kokanee broodstock-acclimation facility and to contract with the Seafresh Fish Co. to produce annual stocks for the lakes (Tacoma, 1993a).

Lake Cushman contains mostly kokanee and cutthroat trout (Tacoma, 1990). Some natural production of cutthroat, rainbow, kokanee, bull trout, mountain whitefish, and land-locked chinook is suspected to occur, although hatchery-reared fish probably dominate the cutthroat populations (Tacoma, 1990). The majority of natural kokanee production is believed to originate from shoreline spawning. Natural reproduction is currently limited by reservoir level fluctuations (section 3.4.3.1) and is not producing an abundant kokanee population now. Fish scale analysis indicates that kokanee growth rates are lower than many other lakes (Tacoma, 1990). Cutthroat growth is quite good when compared to other populations in the United States (Tacoma, 1990).

Lake Kokanee primarily contains rainbow trout. Natural production has not been confirmed. The reservoir is small and heavily fished for trout because angler access is easy (Tacoma, 1990). Tacoma proposes to stock Lake Kokanee annually with 12,000 legal-size rainbow trout. The proposed stocking rate has been accepted by WDFW as mitigation for resident fish losses through entrainment. The stocked rainbow trout might compete for resources with existing kokanee, rainbow, and cutthroat populations. No natural production is confirmed in Lake Kokanee, however, so the level of impact would be minimal. Based on historic stocking records, historic angler catch rates, and Bowler and Reiman's CPUE model, we conclude that the proposed stocking rate would increase angler catch and harvest rates.

4.4.1.4 Fish Habitat Improvements

Tacoma proposes fish habitat improvements between the mouth of the North Fork and the base of Dam No. 2. Fish habitat studies identified four different channel types on the lower North Fork (upper canyon, alluvial segments above and below McTaggert Creek, and the lowland plain) with different habitat characteristics and habitat enhancement needs (table 4-3). Tacoma and the JRP established a technical committee to conduct field studies of suitable enhancement sites and develop enhancement recommendations. Tacoma developed several proposed measures to enhance fish habitat in the lower North Fork (table 4-4), based on existing channel and habitat conditions, an assumption of a 100-cfs minimum flow, and consideration of construction access and potential riparian vegetation impacts. The technical committee targeted habitat enhancements to address potential limiting factors of fish production in each reach.

We reviewed habitat study findings, habitat enhancement goals, and the proposed enhancements. We considered the proposed measures' ability to address the potential limiting factors of the lower North Fork and to meet the intent of agency recommendations. We evaluated potential benefits of measures for all species, generally, and the enhancements for their potential to benefit specific life stages of chinook, coho, chum, pink, steelhead, and rainbow and cutthroat trout. We discuss habitat improvements related to increased MIFs (e.g., low flow velocities) in section 4.4.1.1.

Table 4-3. Potential limiting factors of fish production in the lower North Fork.[1]

Channel type	RM	Habitat characteristics	Limiting factors
Upper canyon	15.2-17.3	Deep pools, higher velocity pocketwaters and cascades, spawning gravels rare, cover is boulders, depth, and surface turbulence, abundant woody debris.	Barrier at RM 15.6. Lack of gravel suitable spawning gravel.
Alluvial segment above McTaggert Creek	13.3-15.2	Broad channel dominated by pools and slow glides, common side channels and backwaters, moderately abundant spawning gravel, abundant cover as undercut banks and aquatic and overhanging vegetation.	Some isolated habitat units where habitat heterogeneity creating drift feeding stations is lacking. Low velocities.
Alluvial segment below McTaggert Creek	10.5-13.3	Shallow glides and riffles dominate, excellent spawning gravel, cover deficient, small woody debris.	Lack of instream channel diversity (to create cover, feeding stations, increase habitat diversity, form channel margin habitats, and increase debris-trapping capabilities, limited large woody debris for cover.
Lowland plain	9.0-10.5	Low velocity pools and glides, abundant spawning gravel, good spawning, rearing, and holding habitat.	Low velocities.

1 Source: Tacoma, 1990.

Table 4-4. Structural habitat enhancements proposed by Tacoma for the lower North Fork Skokomish River.[1]

Enhancement	Objective	Proposed Structures
Instream structures	To increase habitat diversity from the mouth to RM 13.3	Six 100- to 2,000-foot-long stream reaches would be enhanced with large floating log and boulder clusters with rock wing deflectors and boulder revetments.
Side-channel excavation	To improve spawning, incubation, and rearing habitat from groundwater seep and surface-water-fed side-channels.	Eight groundwater-fed side channels and four surface-water-fed side channels would be constructed to provide 102,200 (89,200 and 13,000 square feet, respectively) square feet of habitat.
Spawning gravel augmentation	To provide spawning habitat in river's canyon reach (RM 16.0 to RM 17.3)	Gravel suitable for salmon spawning would be added to six sites and anchored with large boulders or through natural river channel hydraulics.
Livestock fencing	To protect bank and riparian vegetation and stream cover	Two of groundwater side channels designated for construction in existing pastures would be fenced.

1 Source: the staff.

Tacoma proposes to augment spawning gravel at several sites in a 1.7-mile reach upstream of the lower falls (RM 15.6). Resource agencies, however, generally recommend gravel augmentation of about 5 river miles from Dam No. 2 downstream to McTaggert Creek (RM 13.3).

NMFS also recommends spawning gravel augmentation in the North Fork reach between McTaggert Creek and the base of Dam No. 2 (letter from Elizabeth R. Mitchell, Deputy Northwest Regional Counsel, NMFS, Seattle, Washington, October 28, 1994).

WDFW's recommendations for habitat improvements to the mainstem and estuary of the Skokomish are also similar to those proposed by Tacoma:

- instream structure enhancements, including large trees, logs, and rootballs to increase habitat diversity;
- boulder cluster placement and floating log cover for structure and pool formation;
- spawning gravel augmentation above McTaggert Creek;
- side-channel habitat development with surface or groundwater flows; and
- livestock fencing for 13 miles of the North Fork where livestock now graze in the riparian zone (letter from Curt Leigh, Mitigation Resolution, WDFW, Olympia, Washington, October 26, 1994).

WDFW justifies the improvements indicating that project operations have created a hydraulically "simplified" channel. Lower flows do not provide the forces needed to move gravel and woody debris that are required to provide the varied habitat suitable for the variety of fish species and life stages occurring in the Skokomish River watershed. WDFW's recommendations generally follow the more specific plans identified in Tacoma's Proposal, but do not provide implementation details. WDFW agrees with Tacoma that fencing the entire riparian segment would be costly and would impede deer and elk movement. WDFW instead recommends fencing pastures in the area.

In general, as aquatic habitat complexity increases, creating areas of different velocities and depths, fish populations increase (Heede and Rine, 1990). Stream complexity creates both low-velocity areas where young fish can incubate and rear and higher velocity areas that provide feeding stations and holding areas for larger fish. The major goal of the proposed enhancements is to increase fish habitat complexity so that the lower North Fork would provide suitable habitat conditions for all species' life stages.

Because the upper canyon reach has habitat types preferred by chinook (large pools, higher-velocity pocketwater, and abundant cover), chinook salmon are likely to benefit from the proposed measures to provide passage above the lower falls (section 4.4.1.1) and spawning gravel augmentation to this upper reach. Large complex pools with abundant cover are preferred by adult chinook (for holding before spawning) and also by rearing juveniles when the cover also provides low velocity areas. Quality adult holding habitat is particularly important to spring chinook (Doyle, 1988), which typically migrate from the ocean during spring, ascend a stream until they find a suitable place to rest, then hold there several weeks while they mature before entering the spawning stage (Royal, 1972). Fall chinook also need holding areas prior to spawning. Fall chinook may enter a river system with an early freshet and have been observed to hold up to a month before spawning (Anderson, 1988). Fall chinook select large deep pools with bedrock ledges or lots of wood or other good cover for holding. Enhanced habitat has been shown to successfully increase chinook spawning (West, 1988). The enhancement or creation of large, deep pools with abundant cover, as proposed, also seems to be one of the best methods for increasing the chinook juvenile rearing potential in larger streams. Deflectors and debris accumulations that create quiet water at stream margins would also be beneficial.

For coho, the proposed instream habitat structures and off-channel enhancements combined with an appropriate instream flow would increase availability of suitable spawning gravel, rearing habitat, and adult staging. Because coho juveniles are susceptible to high currents and must quickly find deep slow-velocity areas during bankfull conditions (Solazzi, 1988), the development of off-channel habitat has the greatest potential to increase production of wild coho salmon smolts in coastal streams (Nickelson et al., 1992). Log and boulder weirs, boulder clusters, series of log and boulder deflectors, or other structures (root wads and large woody accumulations) might be used to deposit gravel. Summer rearing capacity for coho correlates well with total amount of pool and glide habitat, and pools with lots of cover are considered the most productive (Crispin, 1988). Branchy hardwood and cedar trees seem to provide especially good summer instream cover for coho. The lower North Fork has lost winter rearing habitat primarily because low flows prohibit continuous access to side-channel habitat throughout the winter. Any structure that causes the stream to interact with its flood plain as water rises (like the proposed wing deflectors and side-channel excavation) is likely to produce quiet winter rearing habitat for juvenile coho.

Chum habitat in the Skokomish River includes spawning gravel and adult holding areas. Rearing requirements are generally limited to adequate transportation flows for chum salmon fry, because the young chum salmon emigrate to the marine environment shortly after emergence. Chum spawning habitat in the lower North Fork is abundant. The instream habitat improvements would not increase chum salmon rearing habitat.

The habitat available for pink salmon in the Skokomish River includes spawning gravel, rearing habitat, and adult holding areas. The upstream limit of the pink salmon spawning run is thought to be restricted to the lower mainstem. Increased instream flows and installation of artificial habitat structures in the lower North Fork are unlikely to have a direct effect on pink salmon production in the Skokomish River system, because the juveniles migrate seaward soon after hatching.

Steelhead trout have similar habitat requirements as chinook salmon, so the benefit to steelhead from upper canyon enhancements would be similar to those for chinook. Because steelhead juveniles rear in freshwater for up to 2 years, habitat conditions that affect steelhead juvenile rearing habitat are particularly important and are usually primary limiting factors. Severe winters, for example, can limit steelhead reproduction. Proposed instream structure enhancements that create habitat diversity and the creation of groundwater-fed side channels would increase summer and winter rearing habitat for steelhead trout. Increases of eight to ten times the standing crop of yearling steelhead have been observed rearing where branchy oak trees have been secured with cables in large pools (West, 1988).

The proposed instream habitat structures would improve habitat conditions for all rainbow trout life stages. Rainbow trout fry exhibit a marked avoidance of turbulent water (Smith, 1988) suggesting that instream modifications that reduce turbulence might improve fry use. Smith (1988) also found that juvenile rainbow trout prefer instream areas with some form of physical cover.

Production potential of the resident cutthroat trout in the mainstem and lower North Fork under Tacoma's Proposal is good. Cutthroat trout are found throughout the lower North Fork and

McTaggert Creek. Habitat improvements would benefit resident cutthroat trout populations, similarly to resident rainbow trout. Crispin (1988) found that removal of large wood debris and log jams eliminated deep, debris-laden pools and reduced the number of large resident cutthroat trout. The proposed floating log structures and boulder clusters would enhance cutthroat trout habitat.

In summary, based on our species-by-species analysis of Tacoma's proposed instream structure enhancements, side-channel habitat development, and spawning gravel supplementation plans for the North Fork, we conclude that the enhancements would provide a major, long-term benefit to the primary fishery management units of the Skokomish River.

Protection of the riparian zone from grazing livestock is a major issue for a large number of watersheds in the United States. Even though the existing 13-mile reach of the North Fork is currently not greatly affected by grazing, the potential for bank erosion, slumping, and detrimental water quality effects remains. WDFW's recommendation to fence local pastures in this region is reasonable and would provide insurance that the extensive stream habitat enhancements would not be negated by channel braiding and sedimentation caused by livestock grazing in riparian zones. Nevertheless, we do not recommend fencing these private properties because we recommend that the land be purchased by Tacoma as wildlife enhancement lands (section 4.5.4).

4.4.1.5 Reservoir Operations

Tacoma proposes to maintain Lake Cushman at full pool (738 feet) from Memorial Day until Labor Day to enhance recreation opportunities in the summer. Additionally, proposed Dam No. 1 spillway modifications would limit water level fluctuations to about 9 feet during the kokanee spawning and incubation period (between November to March) during a typical year (Tacoma, 1990). Tacoma proposes limiting lake level fluctuations to improve kokanee spawning success and to increase littoral invertebrate production.

We evaluated the effect of Tacoma's Proposal to limit lake fluctuations by evaluating littoral habitat value to the lake's fishery, particularly to invertebrate production, to juvenile fish rearing, and to kokanee reproduction. We estimated exposed shoreline area during critical kokanee spawning period and the magnitude of lake level fluctuation effects and potential effects on fish passage to the tributaries.

Because the location and distribution of kokanee spawning habitat at critical lake levels is not known, it is difficult to quantify kokanee spawning habitat changes caused by lake level fluctuations. As discussed in section 3.4.3.1, however, Tacoma's kokanee spawning habitat survey indicated that the lake has abundant kokanee spawning habitat. The lake continues to be drafted through November, however, dropping water levels during the critical kokanee spawning and egg incubation period. Typically, lake levels drop from about 717 to 712 feet elevation during November, exposing about 88 acres of shoreline. Declining water levels during the critical kokanee reproduction period expose and might desiccate or freeze incubating eggs and alevins in these shoreline areas.

Cutthroat trout usually feed on littoral zone benthic invertebrates and surface insects; juvenile kokanee, bull trout, and cutthroat also rear in the littoral zone. Frequent and dramatic lake level fluctuations reduce the effective area of littoral habitat reducing food production and suitable rearing habitat for young fish.

Effective kokanee spawning habitat varies with season of spawning and lake drawdown. Limiting lake level fluctuations would have an uncertain kokanee benefit for the spawning period, however, egg-to-fry survival would increase because more shoreline would remain wetted during intergravel fry development. Limiting lake level fluctuations during critical kokanee reproductive periods would therefore constitute a moderate, long-term benefit to natural kokanee production.

Reducing lake level fluctuations would also increase littoral food supply and juvenile habitat for other lake species. Maintaining the lake level at 738 feet elevation from Memorial Day to Labor Day would preserve submerged shoreline during the growing season benefiting benthic invertebrate production for bull trout and cutthroat. Increased littoral zone vegetation that acts as aquatic insect and juvenile fish habitat would increase food and habitat for kokanee, cutthroat, and bull trout juveniles in addition to anadromous species that might gain access to the lake through constructed fish passage facilities.

Lake level fluctuations are not expected to affect passage to tributary streams for lacustrine fish that spawn in the lake's tributaries.

4.4.1.6 Replacing Powerhouse No. 2 Turbine Runners

Tacoma proposes to replace the turbine runners at Powerhouse No. 2 to increase hydraulic capacity from 2,700 to 3,000 cfs. Potential impacts on aquatic resources include increased attraction to powerhouse discharges and injury or mortality to fish entering the powerhouse. This is discussed in section 3.4.5. Because fish can only access the turbine runners when the project is shut down during high tides, and because high peripheral velocities near the turbine runners prevent fish from reaching the runners, we conclude that new turbine runners would not substantially increase fish injury and mortality. Because increased lower North flows would cause less flow to be discharged through Powerhouse 2, the potential for false attraction of inmigrating adults would be reduced from current levels.

Under this alternative, Tacoma would re-evaluate fish mortality and injury and false attraction during powerhouse operation after new turbine runners are installed. If false attraction does occur, Tacoma would develop a plan to reduce false attraction by use of chemical odor attractants or repellents, a tailrace barrier, discontinuing power generation at Powerhouse No. 2 during the affected adult immigration periods, or any combination of the above or other methods.

The effect of installing the new turbine runners would range from no adverse effects to minor long-term adverse effects to fisheries, if false attraction occurred at Powerhouse 2. This minor adverse impacts would be offset by the considerable benefits of increases in anadromous fish production in the lower North Fork and the restoration of anadromy to the upper North Fork.

4.4.1.7 New Powerhouse

Tacoma proposes to construct a new powerhouse at the base of Dam No. 2 to release the 100-cfs minimum flow to the North Fork. This flow would increase available habitat upstream of the lower falls (RM 15.6) for steelhead and resident trout. Potential impacts on aquatic resources include entrainment, attraction to powerhouse discharges, and injury or mortality at the powerhouse.

WDFW states that high entrainment mortality of juvenile fish has been documented in Powerhouse No. 2 turbines (Tacoma, 1991c). The Powerhouse No. 2 intake does not have a fish screen, and Tacoma does not propose screening the new powerhouse intake. Tacoma proposes to stock Lake Kokanee annually with 12,000 legal-size rainbow trout, however, as mitigation for resident fish losses through entrainment. WDFW has accepted the proposed stocking rate.

Based on agency acceptance of Tacoma's mitigation proposal and the put-and-take nature of Lake Kokanee's fishery, it is likely that the proposed stocking rate would sufficiently mitigate potential entrainment losses.

Tailrace areas attract fish migrating upstream because powerhouse flows are generally higher than other upstream sources below a dam or natural barrier (Yoshinaka and Ellifrit, 1974). During spawning runs fish often hold (stage) in pools downstream from spawning areas; they may delay migration by staging below tailrace areas or upstream migration barriers, but then return to downstream spawning habitat (EAEST, 1991). Fish may attempt to swim upstream into the powerhouse discharge and be killed or injured in the draft tube or through contact with turbine runners (Fedorenko, 1989). Tacoma does not indicate whether it proposes a tailrace barrier at the new powerhouse to prevent fish access.

The powerhouse should be designed so that tailrace flows do not adversely affect anadromous fish; a tailrace barrier would be required if necessary. Ramping requirements would be as described in section 4.4.1.1.

4.4.1.8 Hatchery Production of Anadromous Fish

Tacoma proposes to continue to support the George Adams Hatchery at current levels (section 4.4.1). We consolidated and considered agency hatchery production recommendations and evaluate the potential for anadromous fish restoration to the lower North Fork in our discussion of Alternative 2 (section 4.4.3.5).

Tacoma's proposed measures to enhance fish production would substantially benefit anadromous fisheries. We estimate that anadromous fish production (of species dominating the fishery now) would increase to about 3 to 5 times the existing production levels. Because existing stocks are at low levels and because some species have relatively long ocean residence periods, however, the increased production might not occur reasonably soon without increased levels of hatchery stocking. Tacoma's proposal is not likely to increase anadromous species diversity without further increased minimum flows and increased levels of hatchery stocking.

4.4.1.9 McTaggert Creek Diversion Removal

Tacoma proposes to remove the McTaggert Creek diversion structure and restore natural flows to the stream to enhance the stream's fishery.

WDFW and FWS recommend that Tacoma remove all diversion structures and restore McTaggert Creek flows. WDFW further recommends that Tacoma replace and upgrade culverts on FS Road 2340 and other points (not specified) to approved bridging structures that do not prevent fish passage.

Because IFIM studies have not been done on McTaggert Creek, we do not know the extent to which increased flows caused by diversion removal would increase habitat for various life stages. We evaluated Tacoma's Proposal by estimating the magnitude of increased flow with diversion removal and qualitatively determining probable effects on the fishery.

Diversion records for 1957-1965, the longest monitoring period, indicate that little or no flow is diverted from McTaggert Creek from June through October (Tacoma, 1993a). The channel is dry around the diversion structure during this period. The average diverted flow ranges from 1.2 cfs in May to 4.7 cfs in December to 11.0 cfs in January and February.

Because no summer flows are diverted from McTaggert Creek, the diversion structure has little direct impact on summer rearing habitat quantity. The diversion of high freshet flows could have influenced the channel configuration, however, and rearing, spawning, and adult habitat quality. Flow diversion also could have inhibited adult access to the upper reaches.

Diversion removal would increase high winter flows in McTaggert Creek. The stream's channel and fish habitat would return to more natural conditions restoring gravel and woody debris recruitment processes; these changes would improve spawning and rearing habitat quality. The greatest increase in discharge and suitable habitat would occur in January and February. Both winter steelhead and coho would benefit. Removing the diversion would increase flows by about 20 to 30 percent in January and February when steelhead migrate and spawn, and intragravel development and juvenile rearing occurs for both species. Winter habitat is especially important for juveniles rearing in the creek. Winter steelhead and coho production could be increased in McTaggert Creek. We anticipate that removing the McTaggert Creek diversion would have a moderate, long-term benefit on the stream's aquatic resources.

4.4.1.10 Construction Impacts

Constructing fish passage and habitat enhancements, removing the McTaggert Creek diversion and excavating the creek's channel, and building a new powerhouse at the base of Dam No. 2, would cause minor sediment deposition in downstream fish habitat. The deposited sediment would be flushed from the river's substrate with higher flows.

Big Creek and Lake Cushman recreation enhancements would cause minor short-term impacts on the lakes's aquatic resources. As water drains from disturbed soil near the lake, some sediments would sink and deposit on near-shore invertebrate habitat, leading to somewhat reduced invertebrate production in the affected area. These effects would be modest and limited to relatively small areas near the recreation sites. Increased parking area runoff and exposed soils runoff would cause minor long-term impacts. Surface runoff would continue to flush some sediments from the improved recreation areas into Lake Cushman's littoral zone over the long term.

Under Tacoma's Proposal, recommended erosion and sediment control and stream protection measures to protect aquatic resources from construction impacts are the same as discussed in section 4.3.1.1. With a Commission-approved ESCP for in-river construction or in sensitive riparian areas near the river and reservoirs, however, impacts should be minor and short term.

4.4.1.11 Terrestrial Vegetation and Wildlife Enhancements

Tacoma's proposed terrestrial vegetation and wildlife enhancements along riparian corridors would have a substantial long-term enhancement benefit to aquatic resources. These enhancements would provide a buffer that protects fish populations and habitat. Logging restrictions and undisturbed riparian areas would prevent erosion that increases turbidity and river sediments that could suffocate incubating eggs. Riparian vegetation would provide fish cover, rearing areas, and supply organic material to support aquatic insect populations that feed fish.

4.4.1.12 Skokomish Estuary

Under Tacoma's Proposal, minimum project-released North Fork flows reaching the Skokomish Estuary would increase to 100 cfs. These flows, however, would still be relatively small in comparison to tidal and total river flows, so they would have only negligible effects on the estuary and delta. The slight increase in freshwater would convert only nearly undetectable amounts of saline marsh and brackish marsh vegetation to brackish and freshwater marsh, respectively. The slightly higher flows would increase channel evolution and sediment transport rates only negligibly, so the delta would continue to recede and aggrade at about the same rates as in the recent past (section 3.4.5 and Hutchinson, 1988). Over 30 years at these rates, delta recession would reduce the estuary's size by about another 1 to 2 percent, which combined with continued shoaling on the inner delta, should further reduce the amount of eelgrass habitat for crab, salmon, herring, smelt, and brant by about 2 to 5 percent. The extent of intertidal mudflats would probably reduce by about 2 to 5 percent also, increasing oyster and gaper clam populations at the outer and inner delta, respectively, while reducing macoma and mya clam populations in these areas.

4.4.2 Alternative 1

Prior to July 1988, when Tacoma began releasing 30 cfs to the lower North Fork in accordance with the Section 401 water quality certificate for the project, low flows reduced habitat and intensified competition between resident and anadromous fish. The 30-cfs minimum flow increased lower North Fork fish habitat and production; however, habitat for many fish species life stages remains substantially suboptimal (Tacoma, 1993b). Under Alternative 1, fish production would continue to be restricted by flow and suitable habitat. Fish production and habitat conditions would continue as described in section 3.4.

Angler success, which has declined in project reservoirs, is not likely to improve under Alternative 1. Limited tributary and lake rearing habitat and lake level fluctuations would continue to restrict kokanee and cutthroat natural reproduction in Lake Cushman. Without stocking or tributary habitat enhancement, Lake Kokanee would have little natural reproduction and angler success in Lake Kokanee would be likely to remain low.

Under Alternative 1, Tacoma would continue to support George Adams Hatchery at current levels and the hatchery would continue salmon production as it has in the recent past (table 4-5). Tacoma's ongoing annual support is tied to an inflation index. During 1989, Tacoma contributed $53,000 to hatchery operation and maintenance.

Table 4-5. George Adams Hatchery annual salmon production.[1]

Species	1983	1984	1985	1986	1987	1988[2]	1989	1990
Fall chinook	3.2[3]	3.7	4.7	6.9	4.8	5.1	12.6	11.0
Chum	16.8	8.0	24.8	11.0	16.1	14.9	15.5	11.8
Coho	2.3	0.6	0.9	1.1	0.9	1.0	1.2	0.4
Annual total	22.3	12.3	30.4	19.0	21.8	21.0	29.3	23.2

1 Source: Tacoma, 1991c.
2 An additional 980,000 pink salmon were produced in 1988.
3 Millions of fish planted.

Under Alternative 1, North Fork flows reaching the Skokomish Estuary would continue to be much less than tidal and total river flows, so the delta would continue to recede and aggrade as described in sections 3.4.6 and 4.4.1.12, thereby reducing the delta's total size by about 1 to 2 percent and reducing the amount of intertidal eelgrass beds and mudflats by about 2 to 5 percent.

4.4.3 Alternative 2

Many resource agency recommendations for aquatic resources have been included under this alternative. The agencies, the Tribe, and American Rivers justify these measures principally as fish habitat enhancement and flood hazard reduction.

4.4.3.1 Return of Full Flows to the Lower North Fork

FWS, NMFS, and the Tribe recommend that Tacoma cease out-of-basin diversions of North Fork waters, except to provide flood protection and comply with required flow releases and agency-recommended ramping. FWS also recommends that Tacoma develop a North Fork flow implementation plan, in consultation with JRP. Further, FWS recommendations advise that Tacoma initiate plans no later than 1 year after license date and fund needed monitoring and data collection to evaluate the effects. The plan should be fully implemented within 5 years, including staged interim and final flows, flow release schedules, hydrography, and long-term monitoring. The plan should include provisions for operation changes during the license term. During the flow implementation process, Tacoma would maintain a 240-cfs interim minimum flow downstream from Dam No. 2. FWS expects full flows would provide suitable flushing flows over time (letter from Willie R. Taylor, Director, Office of Environmental Policy and Compliance, U.S. DOI, Washington, DC, March 29, 1996).

WDFW recommends that Tacoma implement and fund a Stream Flow Resolution Process in which WDFW and other agencies under the Cushman Coordinating Committee would develop a comprehensive plan to restore suitable flows. An Instream Flow Committee (IFC) would convene to develop and implement a flow optimization plan for fish, wildlife, and other resources in the North Fork, mainstem, and estuary. IFC members would include one designated representative of WDFW, WDOE, PNPTC, the Tribe, Tacoma, NMFS, FWS, FS, and NPS. The committee would also include an Administrative Law Judge from FERC to facilitate the process. Concurrently, suitable interim flows would be identified by the IFC, established within 90 days of licensing, and maintained until the flow optimization plan is fully developed. Recommended interim base flows would provide side-channel flow, wet the full width of the existing channel, optimize riffle and pool depth, maintain water quality, and provide main channel velocities consistent with habitat requirements. The flow optimization plan would include:

- annual interim modified full flow regimes for years 2, 3, and 4 of the license;
- a permanent full flow regime beginning in year 5 of the license;
- monitoring of the interim and permanently restored flow effects;
- target habitat values for fish and wildlife; and
- a fish and wildlife impact assessment of Powerhouse No. 2 relocation.

Under WDFW recommendations, Tacoma would also evaluate McTaggert Creek for increased anadromous production.

American Rivers also recommends that Tacoma cease out-of-basin diversion of North Fork waters and begin a full river flow operation that should be modified to the extent necessary to provide flood protection.

We evaluated potential short-term and long-term river channel changes and possible effects of those changes on fish habitat and populations. Analytical techniques typically used to evaluate flow-dependent fish habitat (IFIM) could not be used to estimate this alternative's effects. Anticipated flows are well outside the acceptable extrapolation range and, with anticipated channel morphometry changes, conditions upon which the current models are based would cease to exist. Our assessment of the impacts of this alternative on aquatic resources is therefore necessarily based on our experience and judgment.

Because Lake Cushman would be operated to minimize mainstem flooding, the North Fork's dominant flow (average flood) downstream from Dam No. 2 would be about 2,900 cfs (about half the mainstem flooding trigger). Average flow would be about 784 cfs. Initial response in the lower North Fork's confined portions would be channel deepening and braiding and substrate coarsening as higher flows create new riparian corridor channels to convey increased flow. A series of treed islands would be created that would eventually erode away as North Fork sediment loads lessened. Within the license term, we anticipate that the channel would reclaim much of its original form with several side channels, a few treed islands, deeper pools, and generally coarser substrates.

Greater flow variability would create a much more dynamic aquatic and riparian system; flow magnitude changes could be the driving force causing fishery effects. More diverse instream structure and riparian vegetation would be created. Dynamic natural habitat features could affect available fish habitat and survival. Over time, full flows would provide positive benefits by creating more diverse instream structure and riparian vegetation. Gravel recruitment and scour adjacent to boulders could increase, improving fish habitat. Eroding treed islands and shoreline would increase natural woody debris recruitment to the lower North Fork. It is likely that this will result in long-term benefits; however, short-term effects are difficult to predict.

Flood frequency would increase in the North Fork, creating both short-term and long-term effects. Flooding could flush fry, uproot riparian vegetation, accelerate streambank erosion, and strand fish. Shifting gravel in less stable gravel bars could reduce incubating egg survival through the rainy season. Salmon spawning success would be more severely affected than trout spawning success because salmon eggs incubate and alevins develop during the high-flow winter season. Habitat instability and flood flows would also have a greater adverse effect on salmonids that rear over an extended period (e.g., steelhead and coho). This effect is of particular concern because of the low population levels of the Skokomish River's indigenous fish populations (chinook, pink, sockeye, sea-run cutthroat). Though these risks associated with low population levels are manageable.

Accumulated material, including leaves and fallen trees, would be saturated and flushed from some areas, potentially creating BOD that could reduce DO concentrations. Low DO concentrations could adversely affect fish. Thus, the channel could be affected by increased suspended solids and organic loads for an extended period. Chronic low-level suspended solids and turbidity increases can have greater adverse effects on fish populations than short-term acute increases (Bjornn and Reiser, 1991).

Cooler water temperatures could delay spawning and reduce fry and juvenile growth during summer. To avoid the adverse effects of cooler temperatures, a modified or adjustable intake would have to be constructed at Dam No. 1.

There is considerable uncertainty regarding the short-term effects of full flows on existing fish stocks. Because some of the Skokomish's indigenous fish populations (chinook, pink, sockeye, sea-run cutthroat) are currently at very low levels, temporary habitat disruption caused by increased river flows could further jeopardize these populations. One or more salmon year classes could be lost from adverse effects on eggs, fry, juveniles, and/or smolts. Full flows could also lead to reduced spawning and rearing success for coho and steelhead, two salmon species that currently have fair to good production potential. Consequently, some of the river's important potential for anadromous stock enhancement could be endangered or adversely affected by full flows. Despite these potential adverse effects, the risks of chronic sedimentation or loss of salmon year classes are manageable.

We recognize Alterative 2's intent to release flows in stages. Though there is a considerable body of knowledge on restoration techniques and expectations of success on small streams and rivers, restoration and rehabilitation projects for large river systems are far less common (Regier et al., 1989) and there is little ability to predict success or monitor recovery (Gore and Milner, 1990).

Because it is difficult for us to accurately quantify the North Fork's channel, habitat, and fisheries' response to increased flows, we recognize that an adaptive management strategy is needed. Before full flow benefits can be effectively compared to costs and risks, more reliable information about channel, fish habitat, and fish population response to increased flows is needed. Channel morphometry, fish habitat, and fish population studies should guide substantial flow regime changes. Based on our knowledge and professional judgement, we conclude that restoration of full flows would have more short-term (but manageable) risks is likely to be a major benefit to fishery resources in the long term.

4.4.3.2 Lake Cushman Water Level Management

WDFW recommends that Tacoma maintain the Lake Cushman water level at 738 feet between Memorial Day and Labor Day. The lake would be down no more than 0.5 feet per day to a minimum elevation of 723 feet with drawdown complete by November 15. The Tribe requests that summer pool levels remain at or near current levels. As discussed in section 4.4.1.5, we conclude that maintaining the summer lake level at 738 feet would represent a moderate, long-term benefit to lake fisheries.

4.4.3.3 Powerhouse No. 3 Impacts

Under this alternative, Tacoma would build a new 16-MW underground powerhouse (Powerhouse No. 3) with a 1,300-cfs hydraulic capacity at Dam No. 2's base. The existing powerhouse would be shut down during tunnel connection construction and turbine testing, requiring spillway release to provide discharges to the North Fork. Construction would cause minor sediment deposition in downstream habitat and would increase the risk of fuel, oil, or hydraulic fluid spills in the river. Deposited sediment would be flushed from river substrate with higher flows. Conducting construction in accordance with a Commission-approved ESCP plan would minimize potential adverse impacts on aquatic resources.

4.4.3.4 Fish Habitat Improvements

Tacoma proposed specific actions in its plan that are closely tied to design flow conditions (section 4.4.1.4). Under Alternative 2 design, flows would increase well beyond 100 cfs. Also, flows in the North Fork would be much more seasonally variable than the consistent 100 cfs that was used as the design base. Decisions on specific locations for log and boulder cluster placements and especially on side-channel development, would be very different.

Because full flows would create more diverse instream structure and riparian vegetation and would improve woody debris recruitment to the lower North Fork, structural habitat improvements might not be needed. If needed, the higher range of flows would require structures to be larger (i.e., higher) than proposed by Tacoma in order to function in a higher range of flows. As discussed in section 4.4.1.4, resource agencies generally recommend gravel augmentation of about 5 miles of the lower North Fork from Dam No. 2 downstream to McTaggert Creek (RM 13.3), compared to Tacoma's Proposal to augment several sites in the 1.7-mile reach between Dam No. 2 and the lower falls. Under this alternative, Tacoma would develop a North Fork habitat enhancement plan similar to the plan proposed under its proposal. The plan should be developed in consultation with the agencies and developed around expected seasonal flows for this alternative.

4.4.3.5 Anadromous Fish Restoration and Hatchery Production

Resource agencies have recommended various measures to restore anadromous fish stocks. Some agencies link hatchery production with anadromous fish restoration.

WDFW recommends that Tacoma establish an emergency gene conservation program and renovate the George Adams and Hoodsport Hatcheries. The agency's justification for these recommendations is that the project blocks anadromous fish from the majority of potential North Fork habitat and that sockeye, which once spawned and reared in the original Lake Cushman, were extirpated. Further, the agency states that dewatering the North Fork and disruption of watershed functions adversely affected all anadromous species.

FWS recommends that Tacoma fund and implement sockeye and coho salmon restoration to Cushman reservoir, indicating that a restoration plan should be developed within 1 year of licensing and implemented between years 2 and 9. The agency also recommends that Tacoma fund hatchery development, operation, and maintenance sufficient to recover and mitigate fish populations compromised by the project. The agency's justification is that chinook, coho, sockeye, steelhead, cutthroat, and native char (Dolly Varden and bull trout) have been adversely affected by the project and population restoration would require hatchery stocking.

NMFS supports FWS recommendations and adds that all anadromous salmonid species should be considered for restoration, not just sockeye and coho.

We evaluated anadromous stock restoration potential (poor to excellent) for each stock and estimated anticipated fishery benefits. We also estimated hatchery production costs to restore anadromous stocks.

Chinook Salmon

As discussed in section 3.4.3, the presence of a viable native spring chinook stock in the Skokomish River cannot be completely ruled out. Stock status is currently disputed (WDF et al., 1993) and a stock assessment program may be needed to make a final determination. Too few individuals may remain to re-build spring chinook stock. Impacts that have minor adverse effects on large populations may lead to the demise of small populations. For example, genetic drift is relatively unimportant in large populations but, in small populations, genetic diversity loss directly reduces a species chance to adapt to environmental perturbations. Genetic variation is lost at a rate that is inversely proportional to population size (Allendorf and Ferguson, 1990). Population models suggest that the random nature of dynamic populations, especially with regard to density and capacity for expansion or decline, increases extinction risks for species when breeding adults number about 20 or less (Quinn and Hastings, 1987).

Natural spring chinook stocks from another Puget Sound river system might be available in the future for restoration of a Skokomish River spring chinook stock. There is, however, a well-documented tendency for salmonids to evolve genetically discrete, ecologically specialized populations by natural selection over many generations of adaptations to local environmental conditions (Behnke, 1972; Ricker, 1972; Ryman et al., 1979). Pacific salmon studies have shown that fish in their native environment perform much better than fish derived from other populations (Bams, 1976; Altukhov and Salmenkova, 1987). Any introduced spring chinook stock might suffer from non-adaptive traits that put it at a disadvantage in the Skokomish River system.

Currently, a relatively small fall chinook population (about 50 spawning adults annually) uses the lower North Fork (Tacoma, 1993a). The existing Skokomish River fall chinook is a stock of mixed origin with composite production. A mixed stock is one whose individuals originated from commingled native and non-native parents, and/or by mating between native and non-native fish (hybridization), or a previously native stock that has undergone substantial genetic alteration (WDF et al., 1993). A composite stock is one sustained by both wild and artificial production. The existing stock's composite nature might preclude restoring or establishing a pure native fall chinook stock in the Skokomish River system. As long as the natural stock is managed as a secondary unit, hatchery fish straying would continue to affect the gene pool. Furthermore, genetic risks resulting from inbreeding might increase risks in isolated populations when numbers drop below about 50 breeding adults (Lehmkuhl, 1984; Soule, 1980).

The restoration potential for spring chinook is judged to be poor primarily because of very small numbers (if any) of Skokomish River wild spring chinook. Restoration potential for wild fall chinook is judged to be fair because of increased spawning and rearing habitat, increased upstream passage potential, and increased survival potential for migrating juvenile chinook. Negative impacts between wild and hatchery stocks, however, could preclude restoration of a pure native fall chinook stock.

Coho Salmon

The existing Skokomish River coho stock is of mixed origin with composite production. The natural stock is the primary management unit which could decrease the negative influence of hatchery stocks. Releases of hatchery-origin coho into the Skokomish River system have been minimal, but the magnitude of genetic effects is unknown (WDF et al., 1993). Future releases of hatchery coho stock into the Skokomish River should be avoided to ensure restoration potential for native coho stock.

The restoration potential for native coho is judged to be fair and the North Fork coho stock status is listed as healthy (WDF et al., 1993). Coho production increased when 30-cfs minimum flows were released to the lower North Fork, and coho are an excellent candidate for restoration above the dams via fishways (letter from Willie R. Taylor, Director, Office of Environmental Policy and Compliance, U.S. DOI, Washington, DC, March 29, 1996). Currently, a population of approximately 200 spawning coho adults uses the lower North Fork annually (Tacoma, 1993b).

Chum Salmon

The availability of an early run chum salmon stock for the Skokomish River is unknown. Hood Canal early run chum salmon stocks have suffered chronically low escapement during the past decade. Incidental harvest of early run chum and interactions with hatchery stocks for increasingly limited resources may preclude establishment of a viable early run chum stock.

Early-normal run chum salmon stock is treated as a secondary management unit. Interaction with hatchery stocks may preclude establishment of a viable wild early-normal chum stock. Availability of a viable source of late-normal run chum for the Skokomish River is unknown. Late-normal chum stock in Hood Canal is composed primarily of wild fish. Opportunity to establish a native wild stock, therefore, is higher than for early-normal run chum salmon.

The restoration potential for wild early run chum is poor, primarily because of a chronic decline in escapement to all Hood Canal river systems. The Hood Canal early run chum are native fish that once numbered over 40,000 during the late 1960's. The 1991 escapement estimate for Hood Canal in 1991 for early chum was 936 (WDF et al., 1993).

The restoration potential for wild normal run chum is good. A portion of the normal run chum stock uses the mainstem Skokomish River for spawning, but many of these fish are hatchery-origin chum (mixed stock with composite production). The lower North Fork produces a native normal run chum stock with wild production. Approximately 200-300 wild chum salmon spawn in the lower North Fork annually under current conditions (Tacoma, 1993b). The lower North Fork wild chum stock could be used to establish a viable wild normal run chum stock.

Pink Salmon

The availability of a natural stock of Skokomish River pink salmon is unknown. Historically, the run has not been very abundant. Currently, the Skokomish River pink salmon stock is listed as historically extinct or not currently verifiable in this system (WDF et al., 1993).

There are sustained pink salmon runs in other major Hood Canal tributaries (Dosewallips, Duckabush, and Hamma Rivers) that could serve as sources for reintroduction if a currently viable wild pink salmon stock is not found in the Skokomish River system. Selection of other stocks of pink salmon for Skokomish River population restoration, however, may not succeed (see previous discussion on introduced stocks under spring chinook).

The restoration potential for wild pink salmon is poor and probably independent of factors relating to North Fork flow restoration. Hood Canal pink salmon are primarily native stocks with wild production (WDF et al., 1993). Puget Sound origin pink salmon are managed for natural production escapement requirements for all regions of origin.

Sockeye Salmon

Sockeye are virtually non-existent in the lower North Fork now (two pair might remain). Stock availability is also uncertain. There are only nine sockeye salmon stocks identified in Washington, none of which include a Skokomish River stock (WDF et al., 1993). The possibility exists to introduce a non-Skokomish sockeye stock for potential restoration of this species. The issue of passage to lacustrine habitat would have to be resolved to establish any chance of restoring sockeye. There is also the possibility that out-of-basin sockeye stocks may not adapt well to Skokomish River habitat conditions (see previous discussion on introduced stocks under spring chinook).

Sockeye restoration is not possible without fish passage around the dams because their life history strategy requires a lake system for juvenile rearing. If a suitable broodstock cannot be obtained, restoration potential would be poor.

Steelhead

The potential for restoration of summer and winter steelhead stocks in the Skokomish River is considered fair and good, respectively. Summer steelhead stock is composed of a historically small number of steelhead. Winter steelhead stock status is depressed based on chronically low spawner escapement. Both summer and winter steelhead stocks have declined during the last decade based on harvest information. Existing populations might be depressed, but unless they are being deliberately over harvested, they should be producing at current habitat carrying capacity under prevailing environmental conditions. If habitat is increased through flow restoration, commensurate production increases are probable (letter from Willie R. Taylor, Director, Office of Environmental Policy and Compliance, U.S. DOI, Washington, DC, March 29, 1996)

The summer run and winter run steelhead stocks in the Skokomish River are probably of mixed origin. There could be an adverse influence from hatchery steelhead stocks on genetic integrity of wild steelhead stocks. Hatchery fish may reduce reproductive fitness of the stock they supplement, and may produce offspring that compete with and reduce abundance of native fish (Krueger and Menzel, 1978). Because a goal of supplementation is to increase the number of naturally spawning adults, a supplementation program is successful only if adults resulting from stocked hatchery fish reproduce successfully in the supplemented streams and do not reduce viability of native fish (Smith et al., 1985). Many researchers have found wild fish are more productive than their hatchery counterparts (Miller, 1954; Reisenbichler and McIntyre 1977; Chilcote et al., 1986; Leider et al., 1986). Furthermore, hatchery steelhead may not survive as well in the wild as wild steelhead (Chilcote et al., 1984).

Sea-run Cutthroat Trout

Recent survey information indicates the existence of a sea-run cutthroat trout population in the Skokomish River. Lower North Fork stock is probably self-sustaining and can be maintained and enhanced by implementing measures to preserve required habitat.

The potential for restoration of the anadromous cutthroat trout population of the Skokomish River is judged to be fair. Tacoma conducted population surveys in 1988 and 1989 and found cutthroat trout in all sections of the lower North Fork. Cutthroat trout, assumed to be sea-run based on their larger size, were occasionally observed during September, October, November, and December surveys. The proportion of cutthroat trout sampled in the North Fork that are resident or sea-run stocks is not known. The existence of viable cutthroat trout populations, however, indicates that North Fork habitat conditions are conducive for supporting this species.

Hatchery Production

WDFW recommends that Tacoma establish an emergency gene conservation program and renovate the George Adams and Hoodsport Hatcheries. The agency's justification for these recommendations is that the project blocks anadromous fish from the majority of potential North Fork habitat and that sockeye, which once spawned and reared in the original Lake Cushman, were extirpated. Further, the agency states that dewatering the North Fork and disruption of watershed functions adversely affected all anadromous species.

FWS recommends that Tacoma fund hatchery development, operation, and maintenance sufficient to recover and mitigate fish populations compromised by the project. The agency's justification is that chinook, coho, sockeye, steelhead, cutthroat, and native char (Dolly Varden and bull trout) have been adversely affected by the project and population restoration would require augmentation from fish culture facilities.

DOI indicates that hatchery production should be used to support fish restoration; without hatchery augmentation, habitat restoration benefits may be a long time in realization. Existing hatchery production is generally already fully utilized for other stocking programs (letter from Willie R. Taylor, Director, Office of Environmental Policy and Compliance, U.S. DOI, Washington, DC, March 29, 1996).

We estimated the North Fork's aquatic habitat area and anadromous fish production potential at the instream flow levels considered. Then we appraised the level of hatchery stocking needed to achieve the estimated production potential. Our fish stocking analysis is not meant to suggest which species or life stages should be stocked, actual stocking rates, or a specific stocking schedule, but was undertaken solely to estimate the magnitude of the stocking effort required.

Because several existing stocks are at relatively low levels and some species have relatively long ocean residence periods, we agree that substantial increases in lower North Fork species diversity and production are unlikely to be realized reasonably soon unless existing populations are augmented by hatchery stocking.

Tacoma's IFIM analysis of the existing channel indicated that there is a direct linear relationship between habitat and flow volume (figure 4-8) (Tacoma, 1993b). We assumed that this linear relationship between flows and total habitat would hold for considered minimum flow regimes. In reality, this assumption would probably not hold true when flows exceeded the existing channel capacity (about 240 cfs) because, with increased flows, the channel shape would change. To estimate stocking required to restore anadromous runs to the North Fork and Lake Cushman, however, we used this flow/habitat relationship, North Fork production potential estimates, and current stocking rates as guidelines. Using these assumptions, however, our production estimate (211,991 total adult fish) was reasonably similar to Chaney's (1996) production potential estimate (271,346 total adult fish) under Alternative 2, somewhat corroborating our estimate.

Table 4-6. Lower North Fork anadromous fish production potential (numbers of adult fish).[1]

Species	North Fork Pristine Production Estimates[2]	Lower North Fork Production with Full Flows (784 cfs)	Production with Alternative 2 (549 cfs)
Chinook	30,000 - 60,000	22,500	15,756
Chum	30,000 - 90,000	15,000	10,504
Coho	50,000 - 120,000	42,500	29,761
Pink	30,000 - 100,000	32,500	22,758
Steelhead	4,000 - 20,000	6,000	4,202
Total		118,500	82,981

[1] Source: the staff.
[2] Lichatowich, 1992.
[3] Appendix C.

Lichatowich (1992) reviewed researchers' past attempts to estimate the North Fork's salmon and steelhead production and suggested probable production ranges (table 4-6) based on the earlier estimates. We used the medium value of Lichatowich's ranges and adjusted them to account for loss of upper North Fork riverine habitat and the minimum flow levels being considered. Lichatowich (1992) generally considered 11 to 16 river miles of habitat (upstream to about RM 21 to 26), whereas lower North Fork habitat today is about 8.1 miles, so we reduced riverine habitat to one half of pre-project habitat. We assumed that the current lower North Fork production potential could be achieved with release of the 784-cfs estimated mean annual discharge at Dam No. 2 (no dams). To estimate how many hatchery fish would need to be stocked under the 549-cfs mean flow, we used the direct relationship between flow and total habitat indicated by Tacoma's IFIM analysis (figure 4-8). The 549-cfs minimum flow represents about 70 percent of the estimated mean annual discharge (Chaney, 1996). Thus, we estimated that the lower North Fork's production potential would be about 70 percent of pristine production.

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Table 4-7. Estimated hatchery production needed to increase anadromous species diversity and production in the lower North Fork with 549-cfs average annual flow.[1]

Species	Lifestage[2]	Production Potential[2]	Fish per lb.[2]	% survival[2]	Hatchery Fish (number)	Hatchery Fish (lbs)
Chinook	fingerlings	10,504	70	0.90	1,167,091	16,673
Chinook	yearlings	5,252	9	2.40	218,830	24,314
Chum	fry	10,504	500	1.60	656,489	1,313
Coho	smolts	29,761	17	9.20	323,487	19,029
Pink	fry	22,758	500	0.50	4,551,658	9,103
Steelhead	yearlings	4,202	6	0.01	420,153	70,026
Total		82,981			7,337,708	140,458

1 Source: the staff.
2 Wagner, 1996.

To estimate the number of hatchery fish that would have to be stocked to achieve this production potential we used Wagner's (1996) model to estimate numbers of each fish size and life stage to be released and the production costs (table 4-7). Wagner estimated that capital construction would cost about $50.87 (1991) per pound of fish produced and that annual operation and maintenance costs would cost about $4.30 (1995) per pound of fish produced.

We estimate that capital cost of additional hatchery capacity under Alternative 2 would be about $8,350,000 [1996 $'s] and annual hatchery program operation and maintenance would cost about $616,000 [1996 $'s]. Hatchery stocking under Alternative 2 would provide a major long-term benefit to lower North Fork anadromous fisheries.

4.4.3.6 Terrestrial Vegetation and Wildlife Enhancements

Terrestrial vegetation and wildlife enhancements along riparian corridors would provide a substantial long-term enhancement and positive benefit to aquatic resources (section 4.4.1.11).

Under Alternative 2, the dikes at Nalley Ranch would be removed, allowing pasture and agricultural lands to return to an estuarine environment. Estuaries are productive, unique environments between fresh and saltwater that are very important for salmonids. They provide staging areas for adults during upstream spawning migrations and rearing areas for juveniles and smolts (Meehan, 1991). After emergence, pink salmon fry quickly migrate downstream to the ocean. During early marine life, schools of pink fry, often tens or hundreds of thousands of fish, follow shorelines and spend much time in water a few centimeters deep (LeBrasseur and Parker, 1964). In many areas both pink and chum fry of similar age and size commingle in schools (Groot and Margolis, 1991). We conclude that removing the dikes at Nalley Ranch would provide a substantial benefit to aquatic resources.

Under this alternative, a sill would be built at Lake Cushman's northern end to create a 10-acre subimpoundment for wetland enhancement. Fish passage would be provided. A wetland area would provide additional cover and habitat for stocked cutthroat trout, which generally feed on benthic invertebrates and surface insects in littoral zones. A sill at Lake Cushman's northern end would provide a moderate benefit to aquatic resources.

4.4.3.7 Skokomish Estuary

Because alternative dike-removal and estuary-restoration methods would have similar effects, for the purposes of analysis in this DEIS we assumed that the recommended methods described in appendix D would be used to remove the dikes and restore estuarine conditions at Nalley Ranch under Alternative 2 (figure 4-9).

Removing the dikes would increase suspended and settled sediment levels in the estuary for up to 2 to 10 years. Tidal and river flows eroding barren substrates exposed by dike removal and channel excavations would create a flush of sediments that would taper off after a few weeks but would continue until vegetation colonizes these sites and stabilizes the substrates, which could take several years at some locations. Organic sediment levels would increase and then taper off for several weeks to months after dike removal as upland and wetland plants within the dikes decompose after being killed by altered water levels, salinities, and flow regimes. Sediment levels might then increase again as tidal and river flows erode the devegetated substrates. Erosion rates would begin to decrease as estuarine plants colonize suitable sites within a few weeks to months, and would reach some equilibria when the vegetation has become fully established after a few years. At this point, the natural growth and decomposition of marsh vegetation would increase suspended organic sediments to a level somewhat higher than at present.

We estimate that removing the dikes as described in appendix D would expose about 285 acres within currently diked areas to tidal flows. High brackish or saline marsh vegetation would probably develop on the approximately 29 acres that are located 12 feet or more above MLLW (figure 4-9). Low brackish and saline marsh mixed with mudflat and perhaps some eelgrass associated with deeper distributory channels would probably develop on about 250 acres located between 12 and 8 feet above MLLW. And about 6 acres of land less than 8 feet above MLLW would become mudflat. We expect brackish and saline marsh vegetation would begin establishment on suitable sites within a few weeks or months of dike removal, and would become fully established within 2 to 10 years, depending on specific site characteristics.

The higher river flows released by the project would entrain uncertain amounts of aggraded sediments from the riverbed and transport them to the estuary where they would increase coarse sediment levels. These flows would also convert appreciable amounts of saline marsh and brackish marsh vegetation near the river plume to brackish and freshwater marsh, respectively.

Increasing sediment levels, river flows, and the area affected by tidal flow would immediately alter water flow and sediment deposition patterns. Site-specific changes within the estuary are largely unpredictable, but, based on the average progradation rate (11 inches per year) for similar deltas at the Nisqually and Nanaimo Rivers (Hutchinson, 1988), the delta would prograde an average of about 27 feet and increase in area by almost 3 percent over a 30-year license. We also expect some shoaling, but, based on Hutchinson's (1988) estimated discharge-aggradation relationship for Puget Sound-area rivers, sediment aggradation on the Skokomish Delta would average about 0.004 inch per year, or a total of 0.12 inch over a 30-year license term, and even with increased sediment loads following dike removal would probably not exceed an aggradation rate of 0.01 inch per year. These estimates are, however, averages over the entire delta, and some localized areas would have considerably greater aggradation rates while others would erode.

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Higher suspended and settled sediment levels during the time between dike removal and marsh vegetation establishment would increase turbidity and could therefore reduce the growth rates and distribution of the estuary's eelgrass plants, which are sensitive to light availability (Zimmerman et al., 1991). Because eelgrass has high growth rates (Simenstad, 1983; Phillips, 1984; Kentula and McIntire, 1986) and because intertidal areas suitable for eelgrass growth should increase as the delta advances, we expect that any such reductions would be short-term and that eelgrass beds on the Skokomish Delta would slightly expand their range over a license term.

Likely sediment level increases would probably not be great enough to adversely affect the estuary's clam and other shellfish populations, except in localized areas. Rather, organic sediment level increases caused by the death of vegetation within the currently diked areas would temporarily increase food availability for these shellfish and might enhance their populations. Although organic sediments and shellfish populations might decline somewhat after this increase, they should then slowly and slightly increase again as delta progradation increases the area of intertidal habitat and new marsh vegetation in formerly diked areas develops and contributes additional suspended organic sediments.

Short-term sediment level increases related to dike removal should have only minor effects on salmonids in the estuary because sediment levels should be high enough to negatively affect respiration and feeding behavior only in localized areas and fish would probably seek out protected microhabitats to avoid them. Any reductions in cover provided by eelgrass could be offset by access to cover in formerly diked areas. Furthermore, forage resources for salmon would increase during this time because the organic sediment increase would increase food resources and population sizes of harpacticoid copepods that juvenile salmon prey on in estuaries (Simenstad, 1983; Groot and Margolis, 1991). By increasing cover and forage resources, long-term marsh, eelgrass, and organic sediment increases under Alternative 2 should at least moderately benefit juvenile salmon in the Skokomish Estuary.

Both short- and long-term sedimentation increases should actually improve habitat quality for flounder. Any short-term losses and long-term gains in the size of Skokomish Estuary eelgrass beds would at first temporarily reduce and then ultimately increase spawning and rearing habitat availability for Pacific herrings and surf smelt, and forage for brant. Removing the dikes would temporarily disturb herons, egrets, and seals, but should subsequently benefit these species by reducing public access and therefore disturbance, while increasing the availability of foraging habitat and forage fish populations.

To identify the impacts of increased sedimentation associated with higher river flows, WDFW recommends that Tacoma monitor Dungeness crab, red rock crab, and spot shrimp populations and habitats on the Skokomish Estuary for 3 to 5 years.

WDFW claims that project-caused transport capacity reductions and other factors have reduced the deposition of large woody debris (logs and rootwads) in the lower mainstem and the estuary (letter from Curt Leigh, Fish and Wildlife Scientist, WDFW, Olympia, WA, March 22, 1996). Consequently, WDFW recommends that Tacoma assess the amount of large woody debris that higher river flows would deposit on the estuary and place additional large woody debris on the estuary if the amount deposited by river flows is inadequate. If Tacoma placed additional large woody debris on the estuary, it would provide important additional habitat for invertebrates, shellfish, bottomfish, juvenile salmonids, great blue herons, waterfowl, and bald eagles.

We are unaware of any data to support the claim that there is less large woody debris in the estuary than there was historically, and are concerned that poorly located logs and rootwads could exacerbate flooding or be swept away by river or tidal flows and thus provide no benefits to justify their costs. Nonetheless, we agree that additional logs and rootwads could provide important habitat benefits if there is insufficient large woody debris in the estuary and if they could be placed on sites in the estuary where they would not exacerbate flooding or be swept away by tidal or river flows. We therefore recommend that Tacoma include large woody debris monitoring in its estuary restoration plan and include measures to augment large woody debris in the plan if warranted.

WDFW further recommends the construction of barrier reefs in the outer estuary to protect the delta from erosion, enhance kelp beds, and provide anadromous and marine fish habitat. Because WDFW has not specified the locations, sizes, or materials for these reefs, their effects are largely uncertain. Based on the success of artificial reefs in other marine environments, it is reasonable to assume that such reefs are likely to at least modestly enhance fish habitats and might enhance kelp beds if located at depths suited to kelp growth, but might not because the Skokomish Delta's depth at its margin (6 feet below MLLW) is at the edge of kelp's growth range. Reefs would protect the delta from tidal erosion and when combined with higher sediment inputs, dike removal, and higher river flows would probably cause deltaic aggradation to be greater than indicated above, but we cannot predict actual sediment deposition rates and patterns without more detailed information about the reefs.

WDFW recommends several further measures to enhance Hood Canal shellfisheries outside of the Skokomish estuary. Under these recommendations (letter from Curt Leigh, Fish and Wildlife Scientist, Washington Department of Fish and Wildlife, Olympia, Washington, March 22, 1996), Tacoma would spread additional gravels over 50 acres of clam habitat at Potlatch and East Potlatch along Hood Canal's western shore, and would seed more than 65 acres of oysters, Manila clams, native littleneck clams, or cockles at Potlatch, East Potlatch, Rendsland Creek (eastern shore of Hood Canal), and Twanoh State Park (south shore of Hood Canal, east of Union). Additionally, Tacoma would seed 45,000 geoduck clams at unspecified west-shore Hood Canal or Skokomish estuary beaches and would renovate WDFW's Point Whitney Shellfish facility and fund facility operation and maintenance costs associated with the recommended shellfish seeding measures.

These measures would enhance Hood Canal shellfisheries outside of the Skokomish Delta, but would thus be outside the area of project effects. WDFW claims that increased sediment levels associated with higher flows would cause extraordinary shellfish mortality levels at distances of 3 to 18 miles from the Skokomish River mouth as justification for these recommendations, but provides no scientific evidence to support its claims or refute our conclusion that the project would have no appreciable effects outside the Skokomish Delta.

WDFW also claims that project-caused aggradation in the mainstem has increased Skokomish Valley groundwater levels, thereby increasing septic field and agricultural waste discharges from groundwaters to the Skokomish River's tributaries and mainstem, ultimately increasing bacterial contamination of recreational shelllfisheries in the Skokomish Estuary and Hood Canal. To mitigate such effects, WDFW recommends that Tacoma provide an unspecified level of funding to help implement WDOE's Shellfish Protection Strategy for Hood Canal. We are unaware, however, of any data indicating that bacterial contamination levels in the Skokomish Estuary and Hood Canal have in fact increased because of increased septic field and agricultural waste discharges from groundwaters to the Skokomish River's tributaries and mainstem. Septic system discharges from residential, commercial, and recreational developments along the Hood Canal shoreline have been identified as the primary source of biological contamination in Hood Canal (Yoshinaka and Ellifrit, 1974). Consequently, we do not recommend that Tacoma fund WDOE's shellfish protection strategy.

4.4.4 Alternative 3

4.4.4.1 Increased Minimum Instream Flows

To reduce out-of-basin diversion and to enhance lower North Fork fish habitat, 240-cfs minimum flow would occur for most of the year. In November, 400-cfs flows would be released to enhance and maintain channel form and capacity. The 240-cfs average minimum flow is designed to achieve the following improvements to enhance river fisheries:

- improve flow-related habitat conditions, including flow velocity and depth;
- provide anadromous fish passage upstream of the North Fork's lower falls (RM 15.6);
- increase juvenile rearing habitat by providing substantial increases in side-channel flows;
- provide velocities needed for production of insect species important as fish food;
- increase juvenile intergravel overwintering habitat; and
- increase anadromous fish diversity and production in the lower North Fork.

We reviewed data describing relationships between flows and anadromous fish production and also other guidelines, used before IFIM was available, to evaluate suitable minimum flows. We also compared anticipated habitat area for fish life stages under the 240-cfs minimum flow to existing habitat conditions with 30-cfs flow.

A number of authors have shown a correlation between increased stream flow and increased production of coho and steelhead. Low summer flows have been shown to be positively correlated with coho production (Neave, 1949; Wickett, 1951; Smoker, 1955; Mason, 1976; Mathews and Olson, 1980; Holtby and Hartman, 1982), coho growth rates (Holtby and Hartman, 1982), coho smolts produced (Reeves et al., 1990), and adult run sizes (McKernan et al., 1950).

WDFW estimates returning coho adults to Puget Sound streams based on lowest average daily flows that occurred over a consecutive 60-day period during the summer in the 2 previous years (Zillges, 1977; WDF, 1981). Wickett (1951) reported increased minimum monthly rainfall from 1946 to 1949 increased the number of coho yearlings emigrating the following spring from a stream on Vancouver Island, British Columbia. Smoker (1953, 1955) found combined annual runoff from 21 watersheds in western Washington from 1935 to 1954 was highly correlated with total combined coho commercial catch 2 years later in Puget Sound, Willapa Bay, and Gray's Harbor. Neave (1949) found a "close correlation" when he compared the number of adult coho salmon caught per 100 hours of sport fishing in Cowichan Bay, British Columbia to the minimum summer streamflow in the previous 2 years. By about 1967, summer flows more accurately predicted coho runs than did annual runoff (Mathews and Olson, 1980).

The streamflow and coho production relationship probably also applies to steelhead, because steelhead, like coho, spend at least one year in freshwater before migrating to the sea (Maher and Larkin, 1955). Studies in Fish Creek (Reeves et al., 1990) discovered steelhead smolt production was strongly correlated with the amount of stream habitat available during the previous summer's low-flow period ($r^2 = 0.94$). Beecher (1981) evaluated data from 13 western Washington streams and found steelhead production was significantly correlated to summer flows; higher summer flows resulted in greater production. Rimmer (1985) suggested that reduced discharge indirectly limits age-0 rainbow trout populations by increasing fish densities to a point where density-dependent factors negatively affect growth and production. Nelson (1984) studied a number of Montana streams and determined that naturally occurring low winter stream flows limited trout populations. In those streams with water withdrawals, however, summer flows became limiting.

Baxter (1961) recommended 30 to 50 percent of a river's average annual flow be provided for fish migration. (Pre-project conditions can be used to appraise enhancement potential.) The lower North Fork's estimated mean annual discharge with no dams is 784 cfs; Baxter's method suggests that about 235 to 390 cfs would be suitable minimum flows.

Tacoma's lower falls passage analysis indicated that flows of at least 200 cfs would be required to provide salmon access to the canyon reach below Dam No. 2. Because immigration could occur throughout the year (figure 3-8), continuous year-round passage for chinook, coho, steelhead, and sockeye should be assured at the lower falls. The falls are marginally passable to chinook and coho at 200 cfs, but, at lower flows are impassable to all anadromous fish except steelhead (Tacoma, 1991b). Two hundred forty-cfs flows would probably provide continuous fish passage; this can be confirmed when flows are actually released. If 240-cfs minimum flow does not provide fish passage at the lower falls, we recommend that Tacoma develop and carry out a plan to modify the falls to provide continuous fish passage.

We reviewed Tacoma's IFIM transect water level elevations; in most instances where side-channel flooding was possible, at least 200-cfs flows would be required to achieve side-channel depths of about one foot. Flows greater than 200 cfs are therefore needed to substantially increase side-channel juvenile rearing habitat.

To increase production of aquatic insects, which are important as fish food, wetting the full channel width is desired. Wetted surface area of bottom substrates provides habitat for macroinvertebrates that are important as food for fish. Wetting the existing channel's full width would increase productivity by increasing macroinvertebrate production and providing more juvenile intergravel overwintering habitat. Flows of 240 cfs achieve these bankfull conditions.

We assumed that historic low flows and habitat availability for all life stages have limited North Fork fish production. It is reasonable to conclude that flows greater than 100 cfs would be required to encourage restoration of anadromous species (such as chinook and steelhead) that typically require greater flow velocities and depths than anadromous species that dominate river populations now (chum and coho).

Because flows greater than 200 cfs would alter the channel and specific fish life stage habitat quantities (as measured by IFIM) are not known, we used total habitat area as a predictor of fish production. Tacoma's IFIM study indicated the total area of aquatic habitat with about 250 cfs flow would increase by about 26 percent from about 20 hectares to about 27 hectares.

After habitat surveys, Tacoma identified the canyon reach below Dam No. 2 as a potential chinook and steelhead outplanting site (Tacoma, 1990). Because the reach is bedrock-confined, its substrate, pool-riffle structure, and side-channel habitat potential are not expected to change substantially with increased flows, habitat types would remain much the same under increased flows. We conclude from the IFIM analysis that 240-cfs flows would substantially improve potential steelhead and chinook habitat in the 2.1-mile-long canyon (figure 4-10).

Assuming that, like many Pacific Northwest rivers, available juvenile rearing habitat would ultimately limit Skokomish fish production (except for steelhead and coho that are limited by low summer flows) and assuming that no other limiting factors come into play, fish production would increase proportionally to juvenile habitat increases. We recommend that Tacoma use agency-recommended general ramping rates, when decreasing or increasing flow, until minimum flows are established and critical flows are determined, as discussed in section 4.4.1.1.

4.4.4.2 Fish Habitat Enhancements

Higher flows would create different stream hydrology than 100-cfs flows. Effective spawning, incubation, rearing, and adult holding habitat of a number of salmonid species requires more than minimum flows in the North Fork. Particularly, the lower North Fork reach below McTaggert Creek is deficient in cover and needs structural habitat enhancement to increase suitable habitat. Additionally, resource agencies generally recommend gravel augmentation of about 5 miles of the lower North Fork from Dam No. 2 downstream to McTaggert Creek (RM 13.3) compared to Tacoma's Proposal to augment spawning gravel at several sites in a 1.7-mile reach upstream of the lower falls.

This alternative's instream flow schedule was developed to enhance fish habitat through flow-induced modification of channel morphometry and increases in flow-dependent habitat characteristics. Objectives for the morphometric improvement include channel deepening, maintaining substrates suitable for spawning, and creation of side-channel habitat. Because the channel banks are heavily vegetated with alders, frequent discharge of slightly out-of-bank flows, under this alternative, would tend to cause channel downcutting and side-channel formation rather than widespread channel widening. Fallen trees are important components of some fish habitats, and this flow regime would likely increase the number of fallen trees in the channel.

As discussed in section 4.4.1.4, Tacoma's habitat studies show that spawning gravel is more abundant in the river segment between the lower falls and McTaggert Creek; however, it is unclear whether fish populations could benefit from additional gravel here under the new flow regime.

As in section 4.4.4.4, we recommend that Tacoma, in consultation with the agencies, prepare a plan to monitor fish habitat conditions and fish populations in the lower North Fork. Every five years, Tacoma would prepare a North Fork Skokomish Fishery Report indicating the status of fish habitat and fish populations and indicating what actions are needed to improve the fisheries including an evaluation of whether fish populations would benefit from structural habitat improvements. Additionally, we recommend that Tacoma augment gravel as they proposed and evaluate whether fish populations would benefit gravel augmentation in the reach between the lower falls and McTaggert Creek after the channel reaches equilibrium. If studies indicate that fish populations could further benefit from gravel augmentation of this reach, we recommend that Tacoma develop a plan to augment gravel in this reach also. The plan should also be developed in consultation with the agencies.

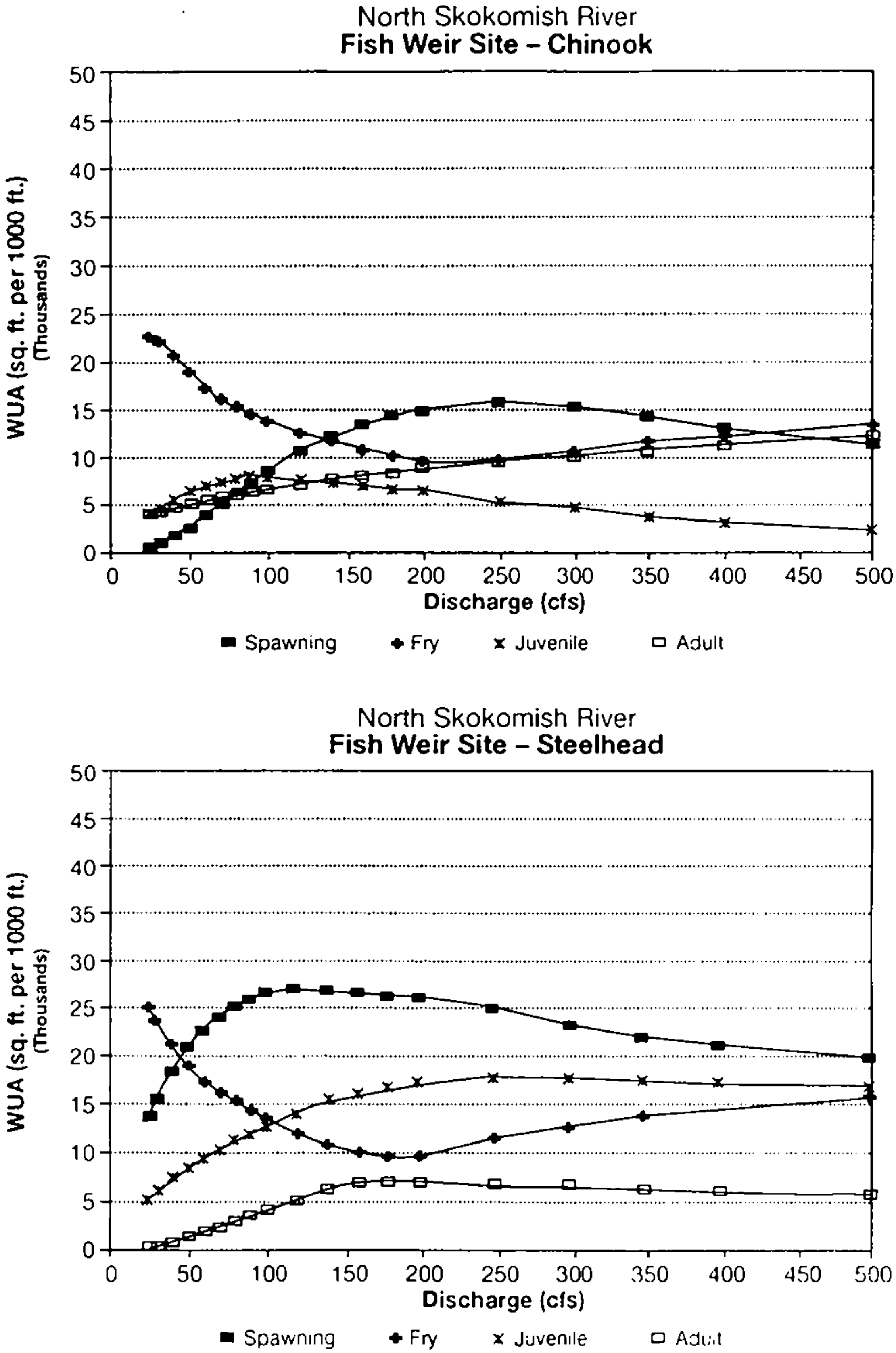

Figure 4-10. Chinook and steelhead habitat relationship to minimum flow in the reach representing canyon habitat. (Source: Tacoma, 1993b.)

We urge Tacoma, the Tribe, and the resource agencies to develop methods to improve the river's fisheries without increasing Tacoma's operating costs. License articles can be changed by Tacoma's request (a license article amendment) or the agencies request by use of the standard license reopener article.

Gravel augmentation of the North Fork between Dam No. 2 and McTaggert Creek represents a moderate long-term benefit to the river's aquatic resources.

4.4.4.3 Hatchery Production

WDFW recommends that Tacoma establish an emergency gene conservation program and renovate the George Adams and Hoodsport Hatcheries. The agency's justification for these recommendations is that the project blocks anadromous fish from the majority of potential North Fork habitat and that sockeye, which once spawned and reared in the original Lake Cushman, were extirpated. Further, the agency states that dewatering the North Fork and disruption of watershed functions adversely affected all anadromous species.

FWS recommends that Tacoma fund hatchery development, operation, and maintenance sufficient to recover and mitigate fish populations compromised by the project. The agency's justification is that chinook, coho, sockeye, steelhead, cutthroat, and native char (Dolly Varden and bull trout) have been adversely affected by the project and population restoration would require augmentation from fish culture facilities.

DOI indicates that hatchery production should be used to support fish restoration; without hatchery augmentation, habitat restoration benefits may be a long time in realization. Existing hatchery production is generally already fully utilized for other stocking programs (letter from Willie R. Taylor, Director, Office of Environmental Policy and Compliance, U.S. DOI, Washington, DC, March 29, 1996).

We reviewed studies estimating the North Fork's production potential and studies estimating hatchery stocking rates that would be required to increase anadromous fish diversity and production in the lower North Fork (Lichatowich, 1992; Chaney, 1996; Wagner, 1996). We estimated the North Fork's aquatic habitat abundance and anadromous fish production potential with this alternative's proposed 240-cfs minimum lower North Fork flows.

Tacoma's IFIM analysis indicated that there is a direct linear relationship between total habitat and flow volume in the existing channel (figure 4-8) (Tacoma, 1993b). As discussed in section 4.4.3.5, we used this flow/habitat relationship, North Fork production potential estimates, and current stocking rates as guidelines to estimate the level of stocking required to increase anadromous fish diversity and production in the lower North Fork. Our fish stocking estimates are not meant to advocate which species or life stages would be stocked, actual stocking rates, or stocking schedule, but were undertaken solely to estimate stocking rates.

Because existing stocks are at low levels and because some species have relatively long ocean residence periods, hatchery stocking is needed, at least initially, to increase anadromous fish diversity and production in the lower North Fork. Without stocking, chum salmon are likely to continue to dominate the anadromous fishery. To determine what funding levels would be required to support hatchery stocking, we estimated stocking rates required to enhance lower North Fork anadromous fisheries under each of the alternatives.

We described the methods that we used to estimate needed hatchery production in section 4.4.3.5. We recognize that these estimated stocking rates might exceed those required to achieve the lower North Fork's actual production potential with 240-cfs average annual flow, because other limiting factors could come into play after habitat is restored. Additional costs to develop the stocking plan, cultivate and handle suitable broodstocks, and monitor populations, however, would tend to offset overestimated production potential. Less hatchery stocking would be needed under this alternative than under Alternative 2 (tables 4-8 and 4-9).

Table 4-8. Estimates of lower North Fork anadromous fish production potential with 240-cfs minimum flows (numbers of adult fish).[1]

Species	North Fork Pristine Production Estimates[2]	Lower North Fork Production With Full Flows (784 cfs)	Production with 240-cfs average flow
Chinook	30,000 - 60,000	22,500	6,888
Chum	30,000 - 90,000	15,000	4,592
Coho	50,000 - 120,000	42,500	13,010
Pink	30,000 - 100,000	32,500	9,949
Steelhead	4,000 - 20,000	6,000	1,837
Total		118,500	36,276

[1] Source: the staff.
[2] Lichatowich, 1992.
[3] Appendix C

Table 4-9. Estimated hatchery production needed to restore anadromous runs to the North Fork Skokomish River.[1]

Species	Life stage[2]	Production Potential[2]	Fish per lb.[2]	% survival[2]	Hatchery Fish (number)	Hatchery Fish (lbs)
Chinook	fingerlings	4,592	70	0.90	510,204	7,289
Chinook	yearlings	2,296	9	2.40	95,663	10,629
Chum	fry	4,592	500	1.60	286,990	574
Coho	smolts	13,010	17	9.20	141,415	8,319
Pink	fry	9,949	500	0.50	1,989,796	3,980
Steelhead	yearlings	1,837	6	0.01	183,673	30,612
Total		36,276			3,207,741	61,402

[1] Source: the staff.
[2] Wagner, 1996.

We recommend that Tacoma develop an anadromous fish stocking plan, in consultation with the fishery resource agencies and the Skokomish Tribe, to increase anadromous fish production and diversity in the lower North Fork. The stocking plan's long-term goal would be to establish naturally reproducing populations without hatchery augmentation whenever possible. During development of the fish stocking plan, Tacoma, the resource agencies, and the Tribe should resolve issues surrounding the species selection for stocking, the magnitude of hatchery production, and the timing and location of fish releases.

As with Alternative 2, to estimate the number of hatchery fish that would have to be stocked to achieve the lower North Fork's production potential (table 4-8), we used Wagner's (1996) model to estimate fish life stages and numbers to be released and the production costs (table 4-9). Wagner estimated that capital construction would cost about $50.87 (1991) per pound of fish produced and that annual operation and maintenance costs would be about $4.30 (1995) per pound of fish produced. Based on our estimates of the stocking program costs, Tacoma's funding of the anadromous fish stocking program shall not exceed $3,600,000 [1996 $'S] capital construction costs. Additionally, Tacoma shall contribute $271,000 [1996 $'S] per year for annual operation and maintenance costs of the hatchery production and stocking program.

An ongoing monitoring plan is needed to evaluate response of North Fork fish populations to recommended fishery mitigation and enhancement measures. Because, in certain instances, hatchery augmentation can adversely affect naturally reproducing fish populations and because the need for hatchery stocking would be reduced as naturally reproducing populations become established, the extent of hatchery stocking should be re-evaluated as monitoring results become available. We recommend that Tacoma, in consultation with the Tribe and the resource agencies, prepare a North Fork Fishery Report every 5 years describing the status of North Fork fisheries and indicate what actions are needed to improve the fisheries. We urge Tacoma, the Tribe, and the resource agencies to develop methods to improve the river's fisheries without substantially increasing Tacoma's operating costs. (For example, if North Fork channel conditions, fish habitat quality, and fish population studies indicate that it is desirable to reduce hatchery stocking and increase minimum instream flows and it can be done in such a way that Tacoma's annual costs do not substantially change, then Tacoma can request a license amendment to change the license articles related to hatchery stocking and minimum flows. License conditions could also be changed by the agencies' use of the standard license reopener article.

Additionally, we recommend stocking Lake Cushman with kokanee and cutthroat and Lake Kokanee with rainbow trout as proposed in the resident fishery enhancement plan developed by the Resident Fish Hatchery Technical Work Group (section 4.4.1.3).

4.4.4.4 Terrestrial Vegetation and Wildlife Enhancements

Terrestrial vegetation and wildlife enhancements along riparian corridors and Nalley Ranch dike removal would provide the same substantial, long-term, aquatic resource benefits as discussed in section 4.4.3.6.

4.4.4.5 Skokomish Estuary

Under Alternative 3, dike removal at Nalley Ranch would produce the same short-term sediment increases and long-term increases in the amount of brackish and saline marsh vegetation as described under Alternative 2 (section 4.4.3.7).

Higher project-released flows reaching the estuary would convert modest amounts of saline and brackish marsh to brackish and freshwater marsh vegetation. These flows would also modestly increase outflows, channel evolution, and sediment transport rates, but would contribute essentially nothing to aggradation on the estuary because they would entrain much less coarse river sediment than flows under Alternative 2 (section 4.4.3.7). By themselves, these flows might not be sufficient to halt or reverse delta recession and steepening; however, removing the dikes at Nalley Ranch is most likely to increase net sediment transport out of the inner delta, which combined with higher river flows should slow delta recession rates to near 0 or perhaps even slightly expand the delta margin overall.

Sediment increases during the time between dike removal and marsh vegetation establishment could temporarily reduce the growth and distribution of eelgrass in the estuary. Because eelgrass has high growth rates (Simenstad, 1983; Phillips, 1984; Kentula and McIntire, 1986), however, and because the intertidal areas occupied by eelgrass beds would be maintained, unless disturbed by some other event, we expect that eelgrass plants would quickly recover and maintain productivity levels and distributions similar to those at present throughout a new license term.

The short-term effects and long-term benefits that dike removal would have on shellfish and salmon under Alternative 3 would be similar to those described under Alternative 2 (section 4.4.3.7), except that there would be no appreciable increase in intertidal habitats related to delta progradation.

Short-term sediment increases and long-term delta maintenance would benefit flounder. Spawning and juvenile rearing habitat availability for herring and smelt and forage availability for brant would vary with eelgrass growth and distribution, temporarily declining but then recovering to near current levels thereafter. As described under Alternative 2 (section 4.4.3.7), dike removal would temporarily disturb herons, egrets, and seals, but would subsequently reduce disturbance while increasing the availability of foraging habitats and prey.

We agree with WDFW's recommendation to have Tacoma assess the amount of large woody debris (logs and rootwads) that higher river flows would deposit on the estuary, and place additional large woody debris on the estuary if the amount deposited by river flows is inadequate (section 4.4.3.8). If Tacoma placed additional woody debris on the estuary, it would provide important additional habitat for invertebrates, shellfish, bottomfish, juvenile salmonids, great blue herons, waterfowl, and bald eagles.

We also agree with WDFW's recommendation to monitor shellfish habitats and populations in the estuary (section 4.4.3.7) and note that other important estuarine functions, habitats, and populations should also be monitored for their responses to estuary changes caused by dike removal and higher flows. We therefore recommend that Tacoma include such monitoring measures as part of the comprehensive estuary restoration plan we recommend for dike removal (appendix D, section 6.0).

4.4.5 Alternative 4 (Decommissioning)

We investigated the effects on aquatic resources of decommissioning the project with complete removal of all project facilities, and the effects on aquatic resources of decommissioning the project while retaining the project dams and the Powerhouse No. 2 flowline to provide flood control benefits.

Decommissioning with dam removal would be accomplished in stages to minimize potential adverse impacts on water quality and consequential downstream impacts on aquatic resources. Of 4,010 acres currently inundated by Lake Cushman, 3,688 acres would be exposed and the entire 100-acre inundated area of Lake Kokanee would be exposed in an unvegetated state. Substantial planning and erosion control efforts would be required to prevent catastrophic erosion effects. Within the project reservoirs, particularly within Lake Cushman, channel reconstruction measures would be necessary to minimize erosion effects and to restore riverine fishery values. Because dam removal's erosion effects would be highly uncertain, the impact could range from minor long-term to major long-term adverse effects.

Dam removal would produce a much smaller Lake Cushman (about 322 acres) and loss of Lake Kokanee. Native and introduced resident fish populations would adjust to this reduction in lacustrine habitat. With the dramatic loss in surface area we anticipate that most resident fish populations would decline. Nonetheless, because anadromous fish use of Lake Cushman and the upper North Fork for spawning and rearing could increase, piscivorous fishes (e.g., bull trout and Dolly Varden) may not decline and could increase in number.

It is uncertain whether anadromous fish were able to pass the falls currently inundated by Lake Kokanee (upper falls) prior to dam construction. In the absence of data to the contrary, we relied on anecdotal information that suggests that passage did occur and assume the chinook, coho, and sockeye salmon, and steelhead trout would be able to pass the falls and use Lake Cushman and accessible portions of the upper North Fork and its tributaries (Wampler, 1980 and James, 1995).

Return of natural flows to the North Fork would substantially affect the river's channel morphometry and sediment transport characteristics. The average annual flood in the lower North Fork would exceed 4,000 cfs with a mean average flow of about 784 cfs.[4] All of the channel characteristics associated with bankfull discharge would adjust to the new flow regime. These channel adjustments would affect the river's fish habitat characteristics. In the short-term, these effects, such as scouring of redds and displacement of fry and juvenile fish downstream, could be detrimental. We anticipate that ultimately the stream would reclaim much of its original channel form and that fish habitat values would increase. Because some of the North Fork's indigenous fish populations are currently at very low levels, the temporary habitat disruption caused by dam removal could further jeopardize these populations. Once habitat characteristics in the lower North Fork stabilized, dam removal would likely provide substantial long-term benefits to fish populations in the river.

Without dam removal, the effects on aquatic resources from this alternative would be very similar to those described for Alternative 2 (section 4.4.3) because both essentially establish full flows with some flood-control spills to Hood Canal.

We did not evaluate the impacts of costly enhancement measures, such as fish passage facility construction, under the decommissioning alternative because it is uncertain whether funds would be available to provide such measures and because the Commission would not require such measures as a condition of project retirement.

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[4] Regression estimates based on 22 years of record from USGS Station No. 12056500.

t4.4.6 Lower Lake Cushman Option

If the proposed land exchange with ONP does not occur, Tacoma could maintain Lake Cushman at or below elevation 725 to prevent park land inundation.

Maintaining Lake Cushman at 725 feet elevation rather than 738 feet elevation in summer would mainly affect the lake's resident fishery. Effects would be similar under each alternative (except decommissioning with dam removal, where it does not apply). Lake lowering would reduce surface area and littoral zone area. We estimated that about 278 surface acres and 23 acres of littoral zone area would be lost. Lost littoral habitat represents about 8 percent of littoral habitat area available at 738 feet lake elevation. Littoral areas are important as juvenile nursery areas and as producers of aquatic insects that are important as fish food. Lake volume reduction would also reduce pelagic habitat. These habitat losses would reduce Lake Cushman's total productivity.

With this lake management requirement, lake level fluctuations would not differ substantially between the alternatives because the lake would be drawn down proportionally further in the fall and winter to provide flood protection (table 2-3).

Maintenance of Lake Cushman surface level at 723 feet during the November through March kokanee reproduction period, a moderate, long-term lake fishery enhancement, would not be possible because, under this lake management requirement, flood control capacity required by the Corps would not be available.

Lowering the summer lake level would not substantially affect the lower North Fork under Tacoma's Proposal or the four alternatives.

4.4.7 Fish Passage Option

Both adult upstream passage to spawning grounds and juvenile downstream passage are needed to provide access to upper North Fork fish habitat. DOI informed the Commission on March 29, 1996, that it was prescribing upstream and downstream fishways for the Cushman Project but did not include a specific fishway prescription. On July 17, 1996, DOI stated it was prescribing collaborative process whereby Tacoma would analyze fishway alternatives and develop and prepare preliminary and final designs in consultation with the resource agencies and the Tribe. In the event that Tacoma did not further develop fishway designs, DOI also included a "default" prescription for trap-and-haul facilities similar to those found at the Baker River Project. DOI would require Tacoma to construct and begin operating fish passage facilities within 24 months of license issuance (letter from Willie R. Taylor, Director, Office of Environmental Policy and Compliance, U.S. DOI, Washington, DC, March 29, 1996).

FWS recommended that Tacoma restore anadromous sockeye and coho salmon to Cushman reservoir, a recommendation that essentially requires fish passage facilities although it is not explicitly stated. FWS indicated that a donor sockeye stock could be obtained by either developing an anadromous sockeye population from any endemic landlocked "kokanee" population in Lake Cushman or by importing a donor stock from one of four sockeye populations in western Washington (Quinault, Ozett, Lake Washington, or Baker Lake). If broodstock is transferred from another management zone, protocol of the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (NIFC, WDF, WDW, and FWS, 1991) would be followed to avoid infection with the virus commonly referred to as IHN (letter from Curt Smitch, Assistant Regional Director, FWS, Olympia, Washington, July 17, 1996).

The Tribe studied fish passage options considering several alternatives for adult upstream passage and juvenile downstream passage (Summit Technology, 1996). The Tribe recommends that Tacoma provide fish passage facilities to convey adult and juvenile salmon around the project dams (Chinook Northwest, 1994).

Although the staff initially indicated that it would accept DOI's prescription, we have concluded, based on further analysis, that DOI's purported prescription is not sufficiently specific to constitute a valid fishway prescription under Section 18 of the FPA. Because DOI has requested a reservation of authority to prescribe upstream and downstream fishways and therefore may do so at some time during the new license term, we examine the environmental impacts of fish passage as an option applied to any of the alternatives.

We reviewed available information describing the historic range of North Fork anadromous fish, evaluated fish passage feasibility (Appendix C), and estimated potential resource benefits of anadromous fish restoration to the upper North Fork watershed.

Table 4-10. Upper North Fork anadromous fish production potential estimates.[1]

Species	Annual Run
Chinook	535
Coho	7,984
Sockeye	120,146
Steelhead	617

[1] Source: the staff, adapted from Appendix C, table C-4.

Although Tacoma indicates that only chinook and steelhead are likely to have ascended the upper falls, we conclude that evidence strongly suggests that other anadromous species historically ranged as far upstream as old Lake Cushman. Lichatowich (1992) reviewed other authors' production estimates of the North Fork Skokomish. Three of these authors estimated sockeye salmon production in old Lake Cushman including Chapman (1981), WDF (1985), and Winter (1988). James (1980) also indicated that chinook, coho, and steelhead migrated past old Lake Cushman. We estimated upper North Fork production potential in our fish passage feasibility analysis. Upper North Fork habitat, including Lake Cushman, would be best suited to sockeye and coho (table 4-10).

Our passage feasibility analysis found that trap-and-haul facilities to collect adult spawners at the base of Dam No. 2 and a "gulper" type smolt collection system in Dam No. 1's forebay (to collect young fish from transport downstream) would be the most practical passage system. Our analysis also assumed, however, that Lake Cushman water level could be maintained at a winter elevation that would protect incubating eggs in the spawning areas. Flood management concerns, however, preclude maintaining the winter lake level (section 4.3). Although, Lake Cushman has abundant kokanee spawning habitat, the lake continues to be drafted through November, dropping water levels during the critical kokanee spawning and egg incubation period. Declining water levels can expose and desiccate or freeze incubating eggs and alevins in shoreline areas (section 4.4.1.5). We are concerned that self-sustaining anadromous fish populations could not be established in Lake Cushman unless the spawning grounds can remain wetted during winter.

Summit Technology (1996) also evaluated several adult upstream passage options including passage via McTaggert Creek, conventional ladder use, and several trap-and-haul options. Generally, use of McTaggert Creek is less desirable because a fish passage barrier would have to be built on the lower North Fork just upstream of McTaggert Creek, effectively blocking anadromous fish from about 4 miles of lower North Fork habitat. Additionally, McTaggert Creek flow would need to be augmented with water from Lake Cushman and the stream's channel would require modification (Summit Technology, 1996). Summit Technology found that the three most effective upstream passage options were a single fish ladder, two ladders, and a trap-and-haul operation based about 2,000 feet downstream from Dam No.2. The single ladder option, however, would likely not be feasible and the double ladder option would require barrier dams and fish collection facilities below both dams (Summit Technology, 1996). Rugged terrain would precipitate high construction costs for any ladder options. Because Lake Kokanee is relatively small, fish ladder construction to provide fish passage from the lower North Fork to Lake Cushman would substantially adversely affect recreation and wildlife resources. Summit Technology's study concluded that trap-and-haul option, with a collection site about 2,000 feet below Dam No. 2, compares favorably in effectiveness to the ladder options and would also allow anadromous fish use of more habitat upstream from McTaggert Creek.

Under Tacoma's proposal, fish passage would be technically feasible and would increase accessible anadromous fish habitat. Flood waters discharged to Hood Canal could cause false attraction of adult fish returning to spawn in the upper North Fork by delaying them in the Powerhouse No. 2 spillway. Because fish would be imprinted to upper North Fork waters fish passage provision would increase potential for false attraction of spawning adults to Powerhouse 2. Entrainment potential to Powerhouse 2 would be highest under Tacoma's Proposal and least under Alternative 2.

With the 30-cfs minimum flows provided by this Alternative 1, steelhead are the only anadromous species that could pass the lower falls (RM 15.6) and reach passage facilities at the base of Dam No. 2. Thus potential fish production would not justify fish passage costs. We estimated that upper North Fork production potential for steelhead trout is a run consisting of about 592 adult fish. Upper North Fork production potential would not vary between alternatives 2 and 3.

Under Alternative 2 fish passage is technically feasible. Because water would be discharged to Hood Canal only to avoid flooding the mainstem Skokomish River, this alternative would have the least potential for attracting spawning adults to Powerhouse 2 .

Upper North Fork anadromous production potential would not vary between alternatives 2 and 3. False attraction potential would be greater under Alternative 3 than under Alternatives 2 because more water would be discharged to Hood Canal.

Fish passage would not be needed with project decommissioning and dam removal. Without dam removal, construction and operation costs of fish passage facilities would probably exceed available resources, because the project would have no revenues. Without power generation, anadromous fish entrainment would not be a concern.

Based on our review of information describing the historic range and production potential of North Fork anadromous fish and our estimation of potential resource benefits of anadromous fish restoration to the upper North Fork, we conclude that restoration of anadromy to the upper North Fork, if biologically successful, could be an appropriate enhancement measure. Trap-and-haul facilities for adult upstream passage and either barge collection or an intake tower collector for juvenile downstream passage are technically feasible and the preferred passage options. We are concerned, however, that self-sustaining anadromous fish populations could not be established in Lake Cushman unless winter lake levels can be maintained to keep spawning areas wetted. Although construction of fish passage facilities is feasible and would derive economic and resource benefits, we conclude, that it is premature to determine if anadromous fish restoration to the upper North Fork could be biologically successful.

Upper North Fork production potential would not vary between Tacoma's Proposal and Alternatives 2 and 3. If biologically successful, fish passage would provide access to upper North Fork habitat with the potential to produce anadromous fish runs totaling about 129,000 adult fish (table 4-8) (appendix C). If fish passage were provided, lake stocking would be required to establish anadromous populations and to realize fishery benefits reasonably soon. We estimate that fish passage facility construction and anadromous fish stocking of Lake Cushman would cost about $9 million (1996) + $1.74 million [1996 $'s] in capital costs and program annual operation and maintenance would cost about $200,000 (1996) + $205,000 [1996 $'s] per year.

4.4.8 Staff Conclusions

Construction impacts would be about the same magnitude under all of the alternatives, except under No Action (there would be no construction impacts) and decommissioning with dam removal (where impacts of removing the dam and revegetating the area now inundated by Lake Cushman could have substantial effects).

Tacoma's Proposal would benefit aquatic resources by increasing lower North Fork flows, providing Lower Falls passage, improving lower North Fork fish habitat with structural enhancements, providing fish access to spawning and rearing habitat in Big and Dow Creek, and protecting aquatic and riparian habitat by the terrestrial vegetation and wildlife enhancements. Benefits from increased flows, however, would be substantially less than those of Alternative 2 or 3. We estimate that fish production in the lower North Fork would increase by about 5 times the current production under Tacoma's Proposal. Because the highest total flow to Hood Canal would be discharged under Tacoma's Proposal, it would likely have the potential for adverse effects caused by false attraction of migrating salmon to Powerhouse No. 2.

Other less substantial benefits of Tacoma's Proposal include flushing flow releases (to prevent lower North Fork sediment accumulation), maintenance of Lake Cushman water levels, increased McTaggert Creek flows, and gravel augmentation to improve spawning habitat in the canyon below Dam No. 2. The benefits of these less substantial improvements are about the same under Tacoma's Proposal and Alternatives 2 and 3.

No action (Alternative 1) would forgo substantial aquatic resources benefits proposed (including increased lower North Fork flows, fish habitat improvements, Lower Falls passage, anadromous fish stocking, accumulated sediment removal, McTaggert Creek diversion removal, etc.) and avoid only the minor, short-term adverse construction impacts.

Restoring 70 percent of lower North Fork flows and providing substantial levels of anadromous fish stocking as proposed by Alternative 2, would provide major long-term benefits to aquatic resources. Though the alternative has manageable short-term risks of adverse impacts from increased turbidity habitat disruption, it is likely to have the greatest long-term benefit to aquatic resources. Fish habitat quality and fish production, in the long-term, would likely be highest under this alternative. We estimate that increased flows and hatchery stocking, with the other aquatic resources enhancements, would increase lower North Fork anadromous production potential by about 15 times current production levels. It would also provide the other less substantial benefits including prevention of sediment accumulations, maintenance of Lake Cushman water levels, and increased McTaggert Creek flows, and increased spawning and rearing habitat in Big and Dow Creeks. The potential of false attraction of migrating adult salmon to Powerhouse No. 2 would be least under this alternative because less flow would be discharged from Powerhouse No. 2 to Hood Canal.

Based on total aquatic habitat, increased minimum flows under the staff-recommended alternative (Alternative 3) would increase anadromous fish production in the lower North Fork by about 9 times current production levels. Fish habitat would likely not be as abundant as under Alternative 2. This alternative also provides the less substantial benefits provided by Tacoma's proposal and Alternative 3 including providing fish access to spawning and rearing habitat in Big and Dow Creek, protection of aquatic and riparian habitat by terrestrial vegetation and wildlife enhancements, prevention of sediment accumulations, maintenance of Lake Cushman water levels and increased McTaggert Creek flows. License amendment by Tacoma's request or license reopening by resource agency request, however, do provide mechanisms to further enhance the fisheries in the future (e.g., by decreasing stocking rates and increasing instream flows) so that, in the long term, the benefits of this alternative might approach those of the Alternative 2. We recommend this alternative because it provides an appropriate level of fishery resource enhancement and balances developmental and non-developmental resources.

4.5 Terrestrial Resources

The effects that each alternative would have on vegetation and wildlife are discussed in the following sections. Appendix E presents the changes in vegetation type acreages and habitat quality and quantity results for HEP species on each of the proposed enhancement parcels.

4.5.1 Tacoma's Proposal

4.5.1.1 Vegetation

Construction Impacts

Replacing Powerhouse No. 2's turbine runners would have no effect on native vegetation because construction would take place within the powerhouse and on its already developed adjacent grounds.

Building a new 1.3-MW powerhouse (Powerhouse No. 3) and substation at Dam No. 2 would displace about 0.5 acre of 30- to 50-year-old conifer and mixed forest vegetation. Depending on how closely it is routed along existing roads, a 2,600-foot-long transmission line from the new substation to the Cushman No. 1 transmission line would require clearing trees on a total of about

1.2 to 3.0 acres. Forest undergrowth on an additional 0.2 to 0.4 acre adjacent to the powerhouse, substation, and transmission line could also be temporarily damaged during construction. The permanent loss of 1.7 to 3.5 acres of second growth conifer and mixed forest would be a relatively minor adverse impact on local vegetation resources.

Excavations and other work associated with removing the McTaggert Creek diversion structure would clear about 0.6 to 1.2 acres of alder-dominated riparian vegetation at this site. If no revegetation measures other than proposed hydroseeding are taken (Tacoma, 1991b), then invasive exotic plants such as scotch broom and Himalayan blackberry mixed with some alders and willows would develop on and dominate the excavated and filled areas within a few years. This temporary vegetation loss and change in composition would have a relatively minor effect on local vegetation resources.

Because the area immediately surrounding the bedrock chute fish passage barrier on Big Creek is mostly bare gravel and sand, drilling and blasting to remove the barrier would have no effect on upland or wetland vegetation. Replacing the culvert that blocks fish passage up Dow Creek would have effects on 0.5 acre of riparian vegetation similar to those effects described for removing the McTaggert Creek diversion structure.

Gravel augmentation in the lower North Fork would have no effect on vegetation because gravels would be transported and deposited by helicopter. Providing access to the lower North Fork for instream structure and side-channel construction to improve fish habitats, however, would damage the vegetation on about 8 acres of land. Most of the affected acreage is old logging roads overgrown by shrubby and herbaceous plants with some 30- to 40-year-old red alder and maple that would be cleared and rough graded to open the roads. Most (70 percent) of the 18 to 30 inch-dbh conifers used to construct fish habitat would be obtained by clearing three 5-acre parcels of upland forest outside the river canyon. Additionally, about 60 similar trees in upland forest stands immediately adjacent to the riparian corridor (typically greater than 200 feet from the river) would be cut and skidded to the river for emplacement as fish habitat. Excavating side channels would displace an additional 5 acres of red alder-maple forest, wetland, and pasture. With Tacoma's (1992a) proposed measures to minimize and mitigate impacts, stream habitat construction would generally have moderate but temporary effects. Because the large trees cut to provide fish habitat structures could not be replaced within the license period, however, their loss would be a moderate long-term adverse impact on local native plant resources.

Proposed recreation facility improvements at the five casual recreation sites along Staircase Road, at LCSP, at the Lake Cushman viewpoint, at Hood Canal Recreation Park, and interpretive exhibits and directional signage in the general project area (section 4.7.1) would have essentially no effect on plant resources because they would be constructed on sites that are already developed or degraded and would not require any clearing. Improvements to the Dry and Copper Creek trails would require clearing about 0.4 acre of C2 forest understory to construct about 0.7 mile of trail, but would probably not require cutting any live standing overstory trees. Mt. Rose trailhead improvements, including excavation and leveling for a parking area, would develop about 0.1 acre of land, but much of this area is already barren from informal parking and turnaround use. Tacoma also proposes to retain any trees greater than 16 inches dbh so little or no vegetation would be cleared. Developing a 30-unit RV campground, five group campsites, and associated facilities at the FS Big Creek Campground would require permanently clearing about 3 to 3.5 acres of disturbed second- and third-growth conifer forest understory on a 6- to 7-acre site, and would probably require the removal of few larger overstory trees. Overall, the proposed recreation improvements would have only minor persistent adverse effects on local native plants.

At least some undeveloped lots on the 3,166 acres of land that are adjacent to the project reservoirs and that the LCDC continues to lease from Tacoma would be developed for residential housing, thereby destroying and degrading native vegetation on these lots. Based on the rate at which lots were developed from 1980 to 1989 (Tacoma, 1990), about 27 new permanent structures and 38 new non-permanent structures per year could be built on the undeveloped lots. If building new permanent and non-permanent structures affects about 0.75 and 0.4 acre of land, respectively, then about 36 acres of native vegetation on currently undeveloped lots would be affected per year, and the area of vegetation affected by structures over the next 30 years would be about 1,053 acres. At that rate of growth, new roads built on LCDC lands over the next 30 years would replace an additional 443 acres of native vegetation. Tacoma's Proposal to help enforce protective covenants could slightly reduce illicit tree cutting on leased LCDC lots.

Operational Impacts

Trees growing within the new transmission line ROW from Powerhouse No. 3 to the Cushman No. 1 transmission line would be cut, and transmission conductor, pole, and access road maintenance would periodically damage vegetation in both this and the existing project transmission line ROWs. Reservoir operations would continue to limit the development of palustrine wetland vegetation along the reservoir shoreline.

Eliminating water diversions from McTaggert Creek would substantially reduce Deer Creek flows to and from the Deer Meadow wetland. With reduced flows, riparian and upland vegetation would encroach slightly on the Deer Creek bed and slightly narrow the creek's riparian vegetation corridor. Reduced water inputs and flow-through rates at Deer Meadow might slightly change the relative proportions of plant species in this wetland. These changes would probably be only slight, however, because this fen wetland developed and was maintained over perhaps thousands of years without water inputs from McTaggert Creek, and an existing concrete block sill dam at the wetland's outlet to lower Deer Creek would retain water within the wetland. Higher flows in McTaggert Creek would kill some riparian plants by scouring them from the creek channel or saturating their root zones, but would also moisten soils on adjacent sites and allow other riparian plants to colonize these sites and replace some existing upland vegetation. Overall, removing the McTaggert Creek diversion structure would have minor effects on riparian and wetland vegetation.

Because Tacoma's proposed 100-cfs MIF and 120-cfs pulse flows would be well-confined within the lower North Fork's existing channel capacity (about 250 cfs), and proposed infrequent short-duration 300-cfs flushing flows would not appreciably affect channel morphology (section 4.1.2), these flows would scour relatively small amounts of riparian vegetation from the stream banks and would increase channel evolution rates only slightly. There would be only minor effects on the lower North Fork's riparian vegetation.

Maintaining fish habitat structures in the lower North Fork would require re-establishing access routes periodically. The impacts on vegetation over the 10- to 20-year maintenance interval that Tacoma (1992a) predicts would be similar to impacts from construction, except that the impacts would be staggered out over the longer time period and access routes would have younger, less established vegetation on them and would require less clearing and grading. If access for habitat structure maintenance has to be re-established more frequently than about once every 5 to 10 years, then the temporary construction-related impacts would become persistent.

If NPS conveys ONP exchange lands to Tacoma, then under the requirements of P.L. 102-436 the existing wetland and mixed forest vegetation on these 30 acres would be managed by Tacoma as they currently are under NPS administration, and would change only as a result of natural maturation and succession. The agencies are concerned that if Tacoma is unable to provide at least the same levels of protection from illicit recreational uses that NPS has provided, then minor vegetation disturbance and the risk of damage by forest fire would increase somewhat. Under ONP management, the mature conifer forest (Soleduck Valley tracts) and C2 (Quileute Valley) vegetation on WDNR lands within ONP that Tacoma proposes to purchase and convey to NPS would also change only because of natural maturation and succession. If the land exchange does not occur, then the vegetation on ONP exchange lands would still mature and would be at no greater risk of disturbance than at present.

Most FS lands within the proposed project boundary are inundated by Lake Cushman and lack vegetation, and there is limited vegetation on FS lands between elevations 738 and 742 feet. Neither Tacoma nor FS proposes any management changes for these lands. Thus, the vegetation on exchange lands that FS proposes to convey to Tacoma would probably change only as a result of natural maturation, succession, and minor continuing disturbance by dispersed recreational use, whether or not the exchange occurs. Vegetation on lands at the Dry Creek mouth that Tacoma currently leases to WSPRC but would convey to FS would probably also change only as a result of natural maturation, succession, and minor continuing disturbance, regardless of whether or not the exchange occurs. WSPRC proposes no management changes for these lands and, under FS management, they would become part of an LSR in a Tier I Key Watershed (USDA and DOI, 1994).

Recreationists collecting firewood and trampling vegetation would likely disturb about 4 acres of forest in and around the new FS campgrounds at Big Creek. Because all other proposed recreation improvement sites are already used formally or informally, vegetation disturbance at these sites would likely increase only as much as visitation increases.

Enhancement Measures and Parcels

Tacoma (1990) proposes several measures to reduce continuing impacts on vegetation within the existing project transmission line ROW and to improve wildlife habitats there. Along 15 to 30 miles of the ROW, Tacoma would continue to cut all conifers and deciduous trees greater than 6 inches dbh in the 25- to 50-foot-wide areas between the ROW's borders and the central wire zone (the area directly beneath the conductors), but would allow tall shrubs (greater than 4 feet tall) to grow in the outer areas. On 38 acres dominated by cultivated Christmas trees or other C1 trees and shrubs, Tacoma would clear the sites, seed them with native grasses and forbs, and then fertilize, monitor, and maintain this vegetation. To restrict public access into three palustrine wetlands crossed by the ROW and thereby protect them, Tacoma proposes to plant and maintain 1, 2, and 4 acres of deciduous scrub-shrub plants in buffer zones around the wetlands. At three dump sites covering a total of 1.35 acres within the ROW, Tacoma would remove the trash, prepare the sites, and then seed them with grasses and forbs. At 19 locations along the ROW, Tacoma would protect ROW vegetation from damage by gating roads to reduce public access. Tacoma would use herbicides to maintain the ROW only when mechanical methods cannot be used, and would use only cut surface and basal herbicide application techniques on individual trees and shrubs. Overall, these measures would substantially enhance native plant resources in the ROW.

Fish stocking, osprey nesting structure construction, and Lake Kokanee boating restrictions are not expected to noticeably affect the reservoirs' limited wetland vegetation.

In addition to the Westside, Dow Mountain, Lake Standstill, Deer Meadow, and Potlatch parcel lands that it has already acquired, Tacoma would acquire title or development rights to 335 acres at LCSP, 40 acres adjacent to Deer Meadow, 1,469 acres in the Northern Lower North Fork, and 187 acres at Purdy Creek. Tacoma would prohibit commercial logging on these lands, and would enhance forest maturation by maintaining at least two snags no less than 18 inches dbh per acre in C2 and C3 stands. With these measures, trees in forest stands on these enhancement parcels would continue to grow, and mature forest would dominate the Westside, LCSP, Dow Mountain, Deer Meadow, Potlatch, and Northern Lower North Fork enhancement parcels within 30 years (table E-2). By promoting forest maturation on these parcels, Tacoma's Proposal would substantially benefit plant resources on these parcels.

Though Tacoma would prohibit commercial logging, fifteen 2-acre patches of C2 (5 acres) and C3 (25 acres) would be clearcut, seeded with grasses and forbs, and maintained to create permanent forage plots for elk at Deer Meadow. On Northern Lower North Fork lands, Tacoma would similarly clearcut, seed, and maintain 4 acres of patches in C2 stands and 20 acres of patches in C3 stands and would additionally prepare, grass and forb seed, and fertilize 75 acres of recent clearcuts to create permanent elk forage plots there as well. Tacoma's Proposal to gate four roads at each of these two parcels would reduce public access and therefore also reduce vegetation disturbance.

To maintain and enhance wetland vegetation, Tacoma proposes to install or improve water control structures at Lake Standstill (Tacoma, 1990) and to plant 13 acres of palustrine scrub-shrub vegetation at Purdy Creek. These measures would be a modest long-term benefit to local wetland resources.

Vegetation changes on Southern Lower North Fork, Nalley Ranch, Belfair Wetlands, and Lilliwaup Swamp lands would be the same as described under Alternative 1 (section 4.5.2.1).

4.5.1.2 Wildlife

Construction Impacts

Because Powerhouse No. 2 is an already developed site, replacing its turbine runners would not adversely affect wildlife. Building Powerhouse No. 3 and its transmission line would eliminate 1.7 to 3.5 acres of semi-disturbed conifer forest that provides suitable habitat primarily for common disturbance-tolerant forest species. Powerhouse No. 3 construction activities could also temporarily disturb sensitive species in the area, including ospreys that nest at the upper end of Lake Kokanee.

Removing the McTaggert Creek diversion structure and the Big Creek and Dow Creek fish passage barriers would convert 1.1 to 1.7 acres of alder-maple riparian forest to herbaceous vegetation and invasive exotic shrubs, and would temporarily disturb local wildlife during construction. Augmenting gravel in the lower North Fork would also temporarily disturb riparian wildlife, including ospreys, but would not alter any vegetation that provides habitat for wildlife.

Cutting 60 conifers between 18 and 30 inches dbh within the lower North Fork Valley to provide fish habitat structure would reduce the availability of large trees that raptors prefer for perching.

Proposed recreation improvements would clear only about 3.5 to 4.0 acres of disturbed conifer forest habitat. Because recreation facility construction would not be intensive or long-term and would generally take place on already semi-disturbed sites with tolerant wildlife, disturbance by these construction activities would be only minor.

Overall, disturbance caused by proposed construction activities would have moderate but short-term adverse impacts on wildlife, while most long-term habitat losses would be concentrated in already somewhat disturbed areas and would thus have relatively minor adverse impacts. If developed at the same rate as recent years, mature conifer forest habitat and wildlife losses on about 1,496 acres of LCDC lands over the next 30 years would, however, represent a more substantial long-term adverse impact on local wildlife habitat and populations.

Operational Impacts

Because Lake Kokanee water levels are generally stable and there is little wetland vegetation around Lake Cushman, water level fluctuations would continue to have negligible effects on any waterfowl nesting on the project reservoirs.

If the land exchange between Tacoma and ONP is completed and Tacoma is able to manage the 30 acres of wetland and mixed forest habitats on ONP exchange lands as NPS has, then wildlife on these lands would be unaffected by the proposed land exchange. If Tacoma is unable to provide at least the same levels of protection that NPS has provided, then the ONP-resident and Lilliwaup Swamp-migratory elk subherds that use this area could be adversely affected by increased poaching and disturbance (NPS, 1994). With the land exchange, conifer forest wildlife populations occupying exchange lands currently managed by WDNR would face no risks of displacement or habitat loss to logging and would thus benefit. Without the land exchange, elk and other wildlife on ONP exchange lands would continue to be disturbed at current levels, and wildlife on WDNR exchange lands would continue to face a small risk of displacement and habitat loss to logging. Wildlife would probably be unaffected by the land exchange between Tacoma and FS, whether or not it occurs, because none of the involved parties proposes any substantial management changes for exchange lands (section 4.5.1.1).

Deer Creek flow reductions caused by removing the McTaggert Creek diversion structure might slightly reduce the availability of stream habitat for American dippers and open water foraging and rearing habitat for ducks, but would probably not alter vegetation communities along Deer Creek or in Deer Meadow enough to affect other wildlife species. Higher water flows in McTaggert Creek and the lower North Fork might temporarily wash out some beaver structures, but would ultimately benefit beavers, river otters, and dippers by providing additional aquatic habitat. Because North Fork flows would not be high enough to substantially alter the riparian vegetation (section 4.5.1.1) or restrict wildlife movements, proposed flows would probably not appreciably affect other wildlife. Maintaining fish habitat enhancement structures in the lower North Fork would temporarily disturb wildlife and the grass-forb-shrub vegetation that provides forage for deer on the access routes.

Increasing use of existing and proposed recreation facilities would correspondingly increase disturbance of wildlife in habitats around these sites. Nonetheless, operational impacts on wildlife would be relatively minor under Tacoma's Proposal.

Enhancement Measures and Parcels

The 11 osprey nesting structures that Tacoma proposes to build along the transmission line ROW where it crosses high quality osprey habitat at the Skokomish Estuary (7 structures), Henderson Bay (2 structures), and North Bay (2 structures) have a high likelihood of being successfully used and providing substantial benefits to ospreys. Allowing a tall shrub zone to develop, planting deciduous scrub-shrub buffers around wetlands, and creating grass-forb areas would substantially increase the availability of forage for black-tailed deer. By retaining non-hazardous snags and topping trees to create snags within the ROW rather than removing them, Tacoma would enhance ROW habitats for cavity nesters such as American kestrels, pileated woodpeckers, and tree swallows. Gating 19 roads would reduce disturbance of species that currently inhabit the ROW, and could increase ROW use by sensitive species such as pileated woodpeckers.

As indicated by the HEP results (table E-7), Tacoma's Proposal to build six nesting and eight perching structures for ospreys at the project reservoirs, while closing the upper third of Lake Kokanee to motorized boating to reduce disturbance, would also enhance reservoir habitats for osprey. In fact, when combined with increases in fish prey populations that should accompany fish stocking in the reservoirs and fish habitat enhancements in Big Creek, Dow Creek, McTaggert Creek, and the lower North Fork, local osprey habitats and populations could increase more than indicated by the HEP results. And because high quality estuarine habitats were not evaluated in the HEP, the number of HUs for ospreys at Nalley Ranch and Belfair Wetlands (table E-7) should be considerably higher than estimated (appendix E).

Although proposed forest treatments might temporarily disturb wildlife on affected sites, protecting and enhancing the Westside, LCSP, Dow Mountain, Deer Meadow, Potlatch, and Northern Lower North Fork parcels would generally benefit mature forest wildlife species on these parcels as indicated by the HEP results (table E-7). Though the total number of HUs for fishers on these parcels would decline by about 1 percent between TY0 and TY30, the total number of HUs for hairy woodpeckers, Douglas squirrels, and Roosevelt elk would increase by 10, 9, and 4 percent, respectively. These results suggest that habitats and populations of other mature forest species such as northern goshawks, band-tailed pigeons, Vaux's swifts, pileated woodpeckers, and pine martens would also be maintained or would increase slightly. In addition to HU increases associated with forest cover protection, elk HUs at the Deer Meadow and Northern Lower North Fork parcels would also increase because Tacoma would increase forage by creating 30 and 99 acres of grass-forb habitat, respectively, and would reduce disturbance by gating four roads at each of these parcels. Protecting the LCSP and Northern Lower North Fork parcels would reduce disturbance along small portions of the Lilliwaup and Skokomish elk herds' migration routes, and would protect them from habitat destruction. Because Lake Standstill, Purdy Creek, Nalley Ranch, and Belfair Wetlands do not provide suitable habitat for fishers (appendix D), fisher habitat values for these parcels in appendix D should be 0 rather than the calculated values.

As further indicated by the HEP results (table E-7), wetland habitat protection at the LCSP, Deer Meadow, and the Northern Lower North Fork parcels would maintain current habitat for great blue herons and dabbling ducks such as mallards. At these same parcels, maturing palustrine scrub-shrub habitats would be primarily responsible for increasing yellow warbler and mink habitats by about 60 and 3 percent, respectively. In contrast to the HEP results, the number of HUs for great blue herons at Lake Standstill should be 0.0 because of already high disturbance levels there and this parcel's habitat value for mink should probably also be lower than estimated (appendix D). At Purdy Creek, protection and wetland vegetation maturation and enhancements would maintain the current number of dabbling duck HUs while increasing HUs for great blue herons, yellow warblers, and mink by 15, 187, and 17 percent, respectively. Presumably, these habitat protection and enhancement measures would similarly maintain or increase habitat for other wetland wildlife species including Cope's giant salamander and red-legged frogs.

Under Tacoma's Proposal, wildlife habitat and population changes in the Southern Lower North Fork, Nalley Ranch, Belfair Wetlands, and Lilliwaup Swamp parcels would be the same as described under Alternative 1 (section 4.5.2.2).

4.5.1.3 Threatened and Endangered Species

Because peregrine falcons are not known to nest in the project vicinity and because there is no suitable peregrine nesting habitat on project lands, other Tacoma-owned lands, or the enhancement parcels, Tacoma's Proposal would have no effect on breeding falcons. Because waterfowl, shorebird, and other avian prey populations would continue to provide abundant forage resources, Tacoma's Proposal would also have no effect on peregrine falcons that occur in the project vicinity as migrants or during winter.

No potential habitat for marbled murrelets or northern spotted owls would be affected by developing new recreation facilities at Dry and Copper Creeks, Staircase Road, the FS Big Creek Campground, LCSP, Lake Cushman viewpoint, or Hood Canal Recreation Park because these sites lack suitable habitat for murrelets and owls. Suitable habitat does exist at the Mt. Rose trailhead, but less than 0.1 acre of vegetation would be disturbed and Tacoma would not remove any trees greater than 16 inches dbh on this site, so no potential habitat would be lost. Because improvements at the Big Creek Campground, LCSP, Lake Cushman viewpoint, and Hood Canal Park would all be at least 1.5 miles from any murrelet or spotted owl observations (Tacoma, 1991b, 1993b), construction activities would not likely disturb murrelets or owls. Spotted owls potentially nesting on FS lands in the Dry Creek drainage probably would not be disturbed by trail and recreation facility construction at Dry and Copper Creeks because these activities would occur at least 1.25 miles from the nearest spotted owl observation. Because marbled murrelets might be nesting on nearby FS lands in the Dry Creek, Timber Mountain, and Copper Creek drainages, however, these trail and facility improvements could temporarily disturb murrelets. Similarly, there is a slight chance that murrelets potentially nesting on FS lands in Bear Gulch and on Mt. Rose might be temporarily disturbed by recreation facility construction along Staircase Road and at the Mt. Rose trailhead. Surveys of suitable habitat on project and enhancement parcel lands found no other marbled murrelet or northern spotted owl nest trees (Tacoma, 1991b, 1993b) that could be affected by project construction or operation.

Acquisition and protection of the Westside parcel would protect murrelets and spotted owls from disturbance by logging or development on this parcel that could occur under Alternative 1, and would provide a buffer from continuing residential development on adjacent LCDC lands. Acquiring and enhancing the Westside, LCSP, Dow Mountain, Deer Meadow, and Northern Lower North Fork parcels would speed the development of mature forests on these parcels and increase the future availability of suitable habitat for murrelets and spotted owls in the project vicinity. If recreation facility improvements at Dry and Copper Creeks, along Staircase Road, and at the Mt. Rose trailhead are constructed outside of their breeding seasons, then Tacoma's Proposal would have no adverse effects on murrelet or spotted owls and would have moderate long-term benefits for these species.

Because bald eagles regularly occur in the project vicinity only along the lower North Fork during winter, they could only be affected by disturbance and a reduction in the availability of perch and roost sites and forage along the lower river. Proposed fish habitat construction and maintenance activities, including instream structure placement, side-channel excavation, and gravel augmentation, in addition to Powerhouse No. 3 construction activities, could all temporarily disturb bald eagles along the lower North Fork during construction. The regular concentrations of bald eagles at Richert Farm during winter suggests that the eagles are habituated to current agricultural operations and would not be disturbed by them, but proposed gravel mining or recreation facilities (section 4.5.2.1) would increase disturbance levels if developed and operated. Although forest management regulations (Forest Practices Board, 1992) would probably protect most perching and roosting trees along the river, timber harvest in the Southern Lower North Fork parcel could eliminate some of these trees, reducing the availability of suitable perching and roosting sites, and could temporarily disturb roosting eagles. Additionally, some perch or roost trees in the Southern Lower North Fork parcel could be inadvertently cut to provide materials for instream fish habitat structures.

Conversely, Tacoma's Proposal would protect perch and roost trees in the Northern Lower North Fork parcel, and proposed North Fork fish habitat enhancements, combined with higher instream flows, should eventually benefit eagles by increasing forage fish populations in the project vicinity. Fish stocking in the project reservoirs would also increase the local availability of prey, and bald eagles might use and benefit from perch and nest structures built for ospreys. Thus Tacoma's Proposal might have some minor short-term adverse effects, but would probably have moderate long-term net benefits for bald eagles overall.

4.5.2 Alternative 1 (No Action)

4.5.2.1 Vegetation

Under Alternative 1, residential development on LCDC lands would have the same substantial adverse impacts on vegetation as described under Tacoma's Proposal (section 4.5.1.1) except that Tacoma would not help enforce protective covenants so illicit tree cutting on lots could continue at the higher recent rates.

As assumed in the HEP, upland forest stands on all of the proposed enhancement parcels would be clearcut at the rate of 2 percent per year. Over the 30-year HEP analysis period, these logging rates would consistently reduce the amount of Class 3 and 4 forest stands while increasing the amount of C1 on these parcels (table E-2).

In contrast to the HEP assumptions, upland forest stands in LCSP would almost certainly not be logged, and their acreages would not change from current conditions (TY0), although projected recreation increases for the park and region (section 3.7.3) indicate that minor vegetation disturbance by recreationists would correspondingly increase at LCSP and other recreation-use areas in the vicinity. Although the 863 acres of private inholdings at Lilliwaup Swamp could be logged and developed for residential housing at rates exceeding 2 percent per year, WDNR would probably continue to protect about 2,000 acres at the parcel's core from logging and rates of mature forest conversion to C1 indicated for Lilliwaup Swamp in table E-2 should probably be reduced by about 15 percent (appendix D).

Agricultural production would continue on crop and pasture lands on Richert Farm lands within the Southern Lower North Fork parcel, at Purdy Creek, within diked areas at Nalley Ranch, and at Belfair Wetlands. Estuarine vegetation would develop in areas where the 1994 flood breached the dikes at Nalley Ranch and could develop in other areas because Tacoma does not intend to maintain the dikes (letter from Michael A. Swiger, Counsel for the City of Tacoma, Van Ness Feldman, Attorneys at Law, Seattle, Washington, March 29, 1996, volume 3). Richert Farm has plans to develop 1,000 feet of river side-channel and a 1-acre pond that would enhance wetland vegetation, but also has plans to develop a gravel mining operation, recreational vehicle park, cabins, and equestrian riding and boarding facilities that could destroy or degrade unknown amounts and types of native vegetation on the farm (letters from Gerald Richert, Manager, Skokomish Farm, Inc., Shelton, Washington, March 15, 1996 Marley Young, P.E., P.L.S, Skokomish Farm, Inc., Shelton, Washington, October 20, 1994).

4.5.2.2 Wildlife

Under Alternative 1, residential development on about 1,496 acres (section 4.5.1.1) and illicit tree cutting would substantially reduce habitat and increase disturbance of forest wildlife on LCDC lands over the next 30 years. Christmas tree cultivation along with maintenance activities and public use that disturb the vegetation — allowing invasive exotics with low forage value such as scotch broom to dominate — would continue to limit transmission line ROW forage availability and habitat quality for black-tailed deer. Reservoir operations and land exchanges with ONP and FS would have the same limited effects on wildlife as described under Tacoma's Proposal (section 4.5.1.2).

Clearing upland forest stands for timber production or residential development on the proposed wildlife habitat enhancement parcels would continue to affect many wildlife species. Increases in open grassy and shrubby vegetation would increase forage habitat availability for elk and other species. Even so, these forage increases would generally be offset by the losses of mature forest habitat needed for winter and other cover as indicated by HU decreases for elk (table E-5). Because forest cutting would probably be about 15 percent less than estimated, habitat losses for elk, hairy woodpeckers, Douglas squirrels, and fishers at Lilliwaup Swamp should be similarly lower. Still, private-inholding development and continuing unregulated harvest could disturb the migration corridor and winter habitats of elk in the Lilliwaup Swamp-migratory and -resident subherds' enough, when combined with other habitat losses, to substantially slow subherd population increases that should result from hunting season suspensions, winter road closures, and protection of the Lilliwaup Swamp Special Management Zone.

Mature forest losses would also reduce nesting habitat for band-tailed pigeons and both foraging and nesting habitat for northern goshawks. By cutting trees before they can mature into snags, while also cutting existing snags, forest harvest would reduce available habitat for primary cavity nesters such as pileated woodpeckers, and for secondary cavity nesters such as Vaux's swifts. HU decreases for hairy woodpeckers (table E-6) indicate that enhancement parcel habitats for these cavity nesters would generally decrease by about 29 percent over 30 years under Alternative 1's assumed timber harvest rates. Timber-harvest-caused habitat losses for pine martens and other species that depend on the proposed enhancement parcels' mature forest habitats would be similar to HU losses predicted for Douglas squirrels and fishers, which average about 32 and 41 percent, respectively (table E-6). Woodpecker, squirrel, fisher, and elk habitat losses at LCSP would probably be less than estimated because this parcel would not be logged.

State forest management guidelines (Forest Practices Board, 1992) would restrict timber harvests within buffer zones around palustrine, lacustrine, and riverine wetlands. As indicated by the HEP results (table E-6), these guidelines would also generally maintain existing habitats for mallards and other dabbling ducks, mink, and other wetland species. In fact, HEP results indicate that as palustrine scrub-shrub habitats on the enhancement parcels mature, HSIs and therefore the number of HUs for yellow warblers would actually increase with no action as compared to current conditions (table E-6). Also, wetland habitats and wildlife populations at Lilliwaup Swamp could improve more than indicated by the HEP results, because the additional protection of wetlands within the Special Management Zone was not considered in the HEP.

Even though the HEP assumed that wetlands would be protected, logging or development and disturbance in adjacent areas could degrade habitat quality for species such as red-legged frogs. Nesting habitat losses combined with increased disturbance caused by recreationists and other activities on all enhancement parcels would drive HSIs and therefore the number of HUs for great blue herons to 0.0 within 10 years (table E-6). Estuarine habitats at Nalley Ranch and Belfair Wetlands would provide more habitat for ospreys than indicated by the HEP results (appendix D), but continued full access to the project lakes and increases in recreational boating and fishing would increase disturbance and reduce osprey HSIs and HUs by 25 to 50 percent over 30 years.

4.5.2.3 Threatened and Endangered Species

Alternative 1 would have no effect on peregrine falcons because they are not known to nest in the project vicinity; because there is no suitable peregrine nesting habitat on project lands, other Tacoma-owned lands, or the enhancement parcels; and because avian prey populations would continue to provide abundant forage resources for peregrine falcons that occur in the project vicinity as migrants or during winter.

Surveys of suitable habitat on project and enhancement parcel lands found no marbled murrelet or northern spotted owl nest trees (Tacoma 1991b, 1993b) that could be destroyed by logging or continuing project operations under Alternative 1. This alternative's effects on marbled murrelets and spotted owls would range from no effect to minor adverse effects.

Continued agricultural activities at Richert Farm would not adversely affect eagles but gravel mining and recreational facility development and operation (section 4.5.2.1) would increase disturbance of eagles in the Southern Lower North Fork parcel if undertaken. As described under Tacoma's Proposal, forest management regulations (Forest Practices Board, 1992) would probably protect most perching and roosting trees along the river, but timber harvest in both the Northern and Southern Lower North Fork parcels could eliminate some of these trees, reducing the availability of suitable perching and roosting sites, and could temporarily disturb roosting eagles. Existing fish populations that are the primary food source for bald eagles on the North Fork would not change substantially under Alternative 1 (section 4.4.2). Overall, Alternative 1 would probably have a slightly adverse effect on bald eagles.

4.5.3 Alternative 2

4.5.3.1 Vegetation

Construction Impacts

Building a new 16-MW underground powerhouse (Powerhouse No. 3) at Dam No. 2 would require clearing approximately 0.3 acre of 30- to 50-year-old conifer and mixed forest vegetation. As under Tacoma's Proposal (section 4.5.1.1), a new 2,600-foot-long transmission line from the new substation to the Cushman No. 1 transmission line would require clearing trees on a total of about 1.2 to 3.0 acres, and forest undergrowth on an additional 0.2 to 0.4 acre adjacent to the powerhouse access-substation site and transmission line could also be temporarily damaged during construction. The permanent loss of 1.5 to 3.3 acres of second growth conifer and mixed forest would be a relatively minor adverse impact on local vegetation resources.

The relatively minor effects of removing the McTaggert Creek diversion structure and fish passage barriers on Big and Dow Creeks, and the effects of gravel augmentation and fish habitat structure construction in the lower North Fork would be the same as those discussed under Tacoma's Proposal (section 4.5.1.1)

Likely measures to enhance mainstem flow capacity and conveyance, including gravel and overbank vegetation removal, side-channel enhancement, and river bank stabilization (Mason County, 1993) would probably clear or disturb dozens of acres of riparian vegetation. Additional measures to prevent and mitigate effects on vegetation would probably be required to obtain the necessary permits for flow capacity and conveyance improvements, however, and some measures such as side-channel enhancements would probably enhance riparian vegetation and wetlands. Thus, this measure would likely have moderate short-term adverse impacts but long-term benefits for these plant resources.

All of the recreation facilities that Tacoma proposes to construct would also be built under Alternative 2, and would have the same impacts on vegetation as described in section 4.5.1.1. Under Alternative 2, however, developing new agency-recommended camp sites at LCSP would require clearing or disturbing C3 conifer forest understory vegetation on up to 8 acres of land and might require removal of some overstory trees. The boat ramp extension and mooring float would be built within Lake Cushman where no vegetation would be affected. Expanding and improving existing WDFW public access parking areas on the mainstem Skokomish River would require clearing and disturbing less than 1 acre of riparian forest vegetation. Overall, recreation improvements under Alternative 2 would have minor long-term adverse impacts on native plants.

Although WDFW recommends that Tacoma pave Staircase Road without significantly widening the road bed (letter from Curt Leigh, Mitigation Resolution, Washington Department of Fish and Wildlife, Olympia, Washington, October 26, 1994), some roadbed widening would be required. Widening the bed along the 4-mile section of road to be paved would probably require clearing disturbed C2, C3, and C4 vegetation on as much as 2 to 4 acres distributed along the roadway.

Because the lower North Fork and mainstem would have substantially higher flows under this alternative, Tacoma would build two bridges on Richert Farm property in the Southern Lower North Fork parcel to maintain access across the rivers for land management activities. Because these bridges would be built on disturbed agricultural lands, the effects on native vegetation would be negligible.

Residential development on LCDC lands would have the same substantial adverse effects on vegetation as described under Tacoma's Proposal (section 4.5.1.1) except that illicit tree cutting on lots would be reduced by WDFW's recommendation that Tacoma take measures to rigorously enforce protective covenants.

Operational Impacts

Under Alternative 2, transmission line ROW maintenance and changes in McTaggert Creek, Deer Creek, and Deer Meadow water flows would have the same minor effects on native plant resources as discussed under Tacoma's Proposal (section 4.5.1.1). Water level fluctuations at Lake Cushman would continue to exceed the tolerance limits of most wetland plants even with a reduced winter draw-down to elevation 723 feet, so reservoir operations under Alternative 2 would also have the same minor effects on wetland vegetation around the lake as described for Tacoma's Proposal.

Increasing average flows in the North Fork and mainstem to 757 and 1,876 cfs, respectively, would have profound but somewhat uncertain effects on vegetation along the river. Higher North Fork flows (section 4.1.3) would kill plants by saturating their root zones, inundating them, or by scouring them from the existing river banks, reclaimed meander channels, and newly established channels. If the increase in lower North Fork riverine area (currently 31 acres) is proportional to the increase in mean river flow (757 cfs) over current channel capacity (240 cfs), then about 98 acres of 30- to 40-year old red alder-bigleaf maple forest mixed with western red cedar, Douglas fir, western hemlock, black cottonwood, and understory shrubs along the lower North Fork would be killed by higher flows. The higher flows would also kill perhaps an equal amount of upland forest vegetation by raising groundwater levels and increasing the width of the flood plain. To mitigate the adverse impacts on riparian vegetation, the agencies recommend that Tacoma develop a riparian vegetation protection and restoration plan. No such plan has been developed and the agencies have not described any specific measures to be included in the plan. For the purposes of analysis, we assume that such a plan would include planting trees and shrubs in a 15-foot-wide area on both banks from Dam No. 2 to the South Fork, a total area of about 31 acres. To plant these trees and shrubs, Tacoma would have to clear and revegetate at least 8 acres of access road to the river as they would for instream fish habitat structure enhancements (section 4.5.1.1) if not more, or would have to use helicopters. Although this plan would speed the re-establishment of riparian vegetation, the new riparian vegetation community would not be as mature as the existing community until after a 30-year license term.

Higher flows in the mainstem would have similar types of effects on riparian vegetation as higher flows in the lower North Fork, but should affect only a few acres at most because the project would be operated to prevent overbank mainstem flows.

Maintaining fish habitat structure enhancements in the lower North Fork would have the same minor impacts on vegetation as described under Tacoma's Proposal (section 4.5.1.1). Resident fish stocking in the project reservoirs, shellfish enhancements, and fish hatchery renovations would not affect vegetated areas. The impacts of building new fish hatchery facilities cannot be determined because the agencies have not identified the type, size, or location of such facilities. Under Alternative 2, the minor effects of completing or not completing the proposed land exchanges with ONP and FS would be the same as described under Tacoma's Proposal (section

4.5.1.1). In addition to the minor adverse effects that recreationists would have on vegetation under Tacoma's Proposal (section 4.5.1.1), firewood collecting and vegetation trampling by campers at new LCSP camp sites would disturb about 2 to 4 acres of C3 plants.

Enhancement Measures and Parcels

Under this alternative, Tacoma would eliminate or control the invasive exotic reed canary grass currently growing in wetlands on ONP exchange lands, as recommended by DOI (letter from Willie R. Taylor, Acting Director, Office of Environmental Policy and Compliance, Department of the Interior, Washington, D.C., October 31, 1994), which would slightly benefit native wetland plants by allowing them to colonize the site.

The agencies originally recommended that Tacoma implement its proposed enhancements for the existing transmission line ROW, in which case the benefits to native plant resources within ROW the would be the same under Alternative 2 as they would be under Tacoma's Proposal (section 4.5.1.1). During the Section 10(j) resolution process for this project, WDFW stated that increasing urbanization had reduced habitat values in the 15-mile ROW section between the Vaughn Tap and Tacoma, and suggested that enhancement measures proposed for this section could be omitted from the ROW enhancement plan (letter from Curt Leigh, Fish and Wildlife Scientist, Washington Department of Fish and Wildlife, Olympia, Washington, April 22, 1996). Native vegetation enhancement benefits would be slightly less if this section of ROW were omitted from the plan because Tacoma would not rehabilitate the 3 dump sites, install 13 of the 19 gates, or clear and seed 9 of the 38 acres that it proposes to.

To mitigate reservoir-fluctuation effects on palustrine wetland vegetation around the lake, the agencies recommend that Tacoma stabilize water levels at the head of Lake Cushman by constructing a subimpoundment, with water control and fish passage structures, and then planting wetland vegetation to create 10 acres of lacustrine wetland and 5 acres of palustrine emergent wetland in this area. Impoundment construction activities might temporarily disturb small amounts of existing wetland or upland vegetation, but this measure would modestly enhance wetland vegetation resources in the project area if fully successful.

In addition to the Westside, Dow Mountain, Deer Meadow, Northern Lower North Fork, and Purdy Creek lands that Tacoma proposes to manage for terrestrial resources, under Alternative 2 Tacoma would also manage the Southern Lower North Fork, Nalley Ranch, Belfair Wetlands, and Lilliwaup Swamp parcels and 64 additional acres at Purdy Creek for terrestrial resources. In addition to the vegetation protection and enhancement measures that Tacoma proposes (section 4.5.1.1), the agencies recommend that Tacoma also plant understory trees and shrubs on a total of 100 acres and create additional snags at the Westside, Dow Mountain, and Deer Meadow parcels. At the Northern Lower North Fork parcel, the agencies recommend that Tacoma create additional snags, plant about 48 acres of understory trees and shrubs, and thin about 38 acres of conifer forest in addition to Tacoma's proposed measures, while clearing, preparing, and seeding 50 acres of C2 and 25 acres of D3 forest to create grass-forb foraging habitat for elk (table E-4).

On Southern Lower North Fork lands, the agencies recommend snag enhancements, thinning 62 acres of forest, planting 52 acres of understory trees and shrubs, clearing 150 acres of C2 and 25 acres of D3 forest, and converting 146 acres of agricultural cropland to pasture (table E-4). At Purdy Creek and Belfair Wetlands, the agencies recommend that Tacoma plant 29 and 32 acres of palustrine scrub-shrub vegetation, and 24 and 34 acres of agricultural grain crops, respectively.

Table E-4 describes vegetation changes at Nalley Ranch if the dikes were selectively breached as JRP suggested when the HEP analyses were first done. Vegetation changes under the recommended dike removal plan (appendix D) are described in section 4.4.3.7. Finally, at Lilliwaup Swamp, the agencies recommend that Tacoma thin 2,000 acres of forest, plant 14 acres of understory trees and shrubs, clear and seed a total of 570 acres of forest to create grass-forb habitat, and scarify and seed unnecessary roads. Vegetation changes on the LCSP, Lake Standstill, and Potlatch parcels would be the same as described under Alternative 1 (section 4.5.2.1).

Although creating elk forage areas would have an adverse impact on forest development, other protection and enhancement measures would allow the majority of forest stands to mature and dominate the enhancement parcels within 30 years (table E-4). Agency and Tribal recommendations to acquire additional lands along the mainstem and re-establish riparian vegetation on cleared lands would enhance unknown amounts and types of native vegetation. Overall, the agencies' recommended protection and enhancement measures would significantly benefit native upland and wetland plant resources in the project vicinity.

4.5.3.2 Wildlife

Construction Impacts

Under Alternative 2, the minor effects of building Powerhouse No. 3 and its associated transmission line, removing the McTaggert Creek diversion and Big Creek and Dow Creek fish passage barriers, augmenting gravel in the lower North Fork, and constructing lower North Fork fish habitat structure enhancements would all be the same as described under Tacoma's Proposal (section 4.5.1.2).

Though mitigation to prevent permanent wildlife habitat losses would probably be required, implementing and maintaining likely measures to enhance mainstem capacity and conveyance would probably temporarily disturb wetland wildlife and habitats throughout much of a license term. The short-term disturbance impacts and long-term benefits that Nalley Ranch dike removal would have on wildlife are described in section 4.4.3.7. Subimpoundment construction at the head of Lake Cushman would temporarily disturb sensitive wildlife that use this area, including Lilliwaup herd elk. Constructing bridges on Richert Farm lands would not affect native habitats but might temporarily disturb wildlife, including resident Skokomish herd elk that use this area. Paving Staircase Road would eliminate up to 4 acres of degraded conifer forest habitat used mostly by common disturbance-tolerant species, could disturb Lilliwaup Herd elk resident in ONP or migrating between ONP and Lilliwaup Swamp, and could lead to increased vehicle speeds and wildlife road-kills.

The effects that recreation facility construction would have on wildlife would be similar to those described under Tacoma's Proposal except that building new campsites at LCSP would make an additional 8 acres of mature conifer forest habitat unsuitable for disturbance-sensitive species such as pileated woodpeckers. Expanding and improving public access parking areas on the mainstem Skokomish River would displace negligible amounts of riparian forest habitat and would disturb local wildlife for relatively short periods of time.

The adverse effects that residential development on LCDC land could have on wildlife would be similar to those described under Tacoma's Proposal (section 4.5.1.2), except that strictly enforcing land use covenants would reduce wildlife habitat loss and disturbance caused by tree cutting and other illicit activities.

Operational Impacts

Reservoir operations, changing McTaggert Creek, Deer Creek, and Deer Meadow water flows, and maintaining lower North Fork fish habitat structures would have the same impacts on wildlife as described under Tacoma's Proposal (section 4.5.1.2). Higher instream flow releases could restrict the movements of some wildlife, including young elk, trying to cross the river. These flows would also wash out most active beaver lodges on the lower North Fork and would eliminate about 98 acres of riparian forest habitat that provides forage for beavers and important habitat for many other species. Eventually, however, when the river channel begins to stabilize, the higher flows would benefit beavers, river otters, and dippers by providing additional aquatic habitat.

In addition to reservoir fish-stocking-related increases in forage for ospreys under Tacoma's Proposal (section 4.5.1.2), agency-recommended hatchery renovations and enhancements could also increase local salmonid fish populations that provide forage for mergansers, belted kingfishers, river otters, and black bears as well as ospreys. Wildlife would be disturbed by recreationists at minor levels similar to those described under Tacoma's Proposal, except that disturbance would increase slightly more if the new agency-recommended campsites at LCSP and improved mainstem accesses increase visitation at these sites. Under Alternative 2, land exchanges with ONP and FS would have the same small effects on wildlife as described under Tacoma's Proposal (section 4.5.1.2).

Enhancement Measures and Parcels

If transmission line ROW enhancement measures were the same, Alternative 2 would provide the same substantial benefits to wildlife as described under Tacoma's Proposal (section 4.5.1.2). If the 15-mile section from the Vaughn Tap to Tacoma were eliminated from the ROW management plan, the benefits would be slightly less because Tacoma would not then build 2 osprey nests at Henderson Bay as it proposes.

In addition to the benefits of reservoir and fishery enhancements described for Tacoma's Proposal (section 4.5.1.2), ospreys under Alternative 2 would also benefit from subimpoundment construction at upper Lake Cushman and — probably more so than indicated by the HEP results — from estuary restoration at Nalley Ranch (table E-8). As indicated by the HEP results, subimpoundment construction at Lake Cushman would also increase habitat for great blue herons, dabbling ducks, and mink (table E-8), while wetland habitats for these species on other parcels would be maintained at current levels or increased (by about 6 percent for mink). By enhancing and protecting palustrine scrub-shrub vegetation, Alternative 2 would improve habitats for yellow warblers by about 94 percent.

Even though proposed forest treatments might temporarily disturb wildlife on affected sites, forest habitat protection and enhancement measures (section 4.5.3.1) at the Westside, Dow Mountain, Deer Meadow, Northern and Southern Lower North Fork, and Lilliwaup Swamp parcels would have significant long-term benefits for mature forest wildlife species as indicated by 25, 35, 39, and 36 percent HU increases over current conditions for hairy woodpeckers, Douglas squirrels, fishers, and Roosevelt elk, respectively. By including the Northern and Southern Lower North Fork and Lilliwaup Swamp parcels, Alternative 2 would further benefit local elk by protecting and enhancing virtually all of the important winter habitat and large portions of the migration routes currently used by the Skokomish and Lilliwaup herds.

Agency and Tribal recommendations to acquire unspecified lands along the mainstem and to re-establish riparian vegetation on cleared lands are likely to further benefit great blue herons, yellow warblers, and mink to an unknown degree.

4.5.3.3 Threatened and Endangered Species

For the same reasons as discussed under Tacoma's Proposal (section 4.5.1.3), Alternative 2 would have no effect on peregrine falcons.

In addition to the potential effects of constructing recreation improvements as described under Tacoma's Proposal (section 4.5.1.3), construction activities associated with building a subimpoundment at the head of Lake Cushman and paving Staircase Road could similarly and temporarily disturb marbled murrelets on nearby FS lands, if the road or subimpoundment were constructed during murrelet breeding seasons. The benefits of protecting potential habitat by acquiring and enhancing the Westside, Dow Mountain, Deer Meadow, and Northern Lower North Fork parcels would be the same as described under Tacoma's Proposal (section 4.5.1.3). Acquiring and enhancing the Southern Lower North Fork and Lilliwaup Swamp parcels would provide additional similar benefits over a substantially greater area. Thus, Alternative 2 would have substantial, long-term potential benefits for marbled murrelets and northern spotted owls, but this alternative's construction activities could have temporary adverse impacts on murrelets and spotted owls unless conducted outside of breeding seasons.

Although bald eagle perch and roost trees along the entire lower North Fork would be protected from commercial logging under Alternative 2, some of these trees could be inadvertently cut to provide materials for instream fish habitat enhancements or could be killed by higher river flows. Additionally, Powerhouse No. 3 construction, instream and side-channel fish habitat construction and maintenance activities, and gravel augmentation could all temporarily disturb eagles. Furthermore, if higher North Fork flows initially decrease anadromous fish populations, then forage resources for bald eagles would be reduced. Even so, because lower North Fork lands would be protected from logging or development, and because anadromous fish populations could ultimately increase substantially, Alternative 2 could provide substantial long-term benefits to bald eagles wintering along the lower North Fork.

4.5.4 Alternative 3

4.5.4.1 Vegetation

Construction Impacts

Replacing Powerhouse No. 2 turbine runners, building a new 3-MW powerhouse (Powerhouse No. 3) and associated transmission line at Dam No. 2, removing the Big Creek fish passage barrier, and augmenting gravel in the lower North Fork under Alternative 3 would have minor effects on vegetation similar to those described under Tacoma's Proposal (section 4.5.1.1). Removing the McTaggert Creek diversion structure and Dow Creek fish passage barrier would also have effects similar to those described under Tacoma's Proposal. To enhance native vegetation development on the McTaggert and Dow Creek sites, we recommend that Tacoma develop, in consultation with the landowners (Simpson Timber Company and WDNR), a plan to restrict the development of invasive exotic plants and to enhance the development of native trees and shrubs.

Enhancing mainstem flow capacity and conveyance under Alternative 3 would have moderate short-term adverse impacts but long-term benefits for plant resources on dozens of acres as described under Alternative 2 (section 4.5.3.1). If studies of lower North Fork fish habitat responses to higher flows indicate that instream fish habitat enhancement measures are warranted, then constructing these structures would have moderate short-term adverse effects on riparian and upland forest vegetation similar to those effects described under Tacoma's Proposal; however, our recommendation to not cut suitable osprey and bald eagle perch, roost, and nesting trees (section 4.5.4.3) should reduce the number of large river valley trees cut to provide instream habitat materials.

Constructing the recreation improvements included in Alternative 3 would have all of the same minor persistent adverse effects on 3.5 to 4.0 acres of vegetation as described under Tacoma's Proposal (section 4.5.1.1), and would also require clearing 8 acres of mature conifer forest understory at LCSP as described under Alternative 2 (section 4.5.3.1). If Tacoma paves Staircase Road as an outcome of the road management plan that we recommend and that the FS requires (section 6.4), then 2 to 4 acres of disturbed C2, C3, and C4 vegetation along the roadway would be cleared as described in section 4.5.3.1. To realize the benefits of minimizing potential adverse impacts on an estimated 1,496 acres of mature forest and other vegetation resources on LCDC lands (section 4.5.3.1), we adopt the agencies' recommendation that Tacoma take measures to strictly enforce the covenants on these lands.

Operational Impacts

Transmission line maintenance, reservoir fluctuations, and altered McTaggert Creek, Deer Creek, and Deer Meadow water flows would all have the same minor effects on vegetation as described under Tacoma's Proposal (section 4.5.1.1).

Alternative 3's 240-cfs instream and 400-cfs flushing flows would generally be confined to the lower North Fork's existing channel and would tend to deepen it more than widen it (section 4.1.4). We expect that virtually no riparian forest vegetation would be inundated and killed, and that at most only a few acres of 30- to 40-year old red alder-bigleaf maple forest vegetation would be killed by saturating root zones and scouring plants from the river banks, reclaimed side channels, and newly developed side channels. These losses would be very small in comparison to the current amount of riparian vegetation along the river and would not be substantial enough to warrant a riparian vegetation restoration plan that would have its own set of adverse impacts on vegetation, such as the agencies' recommended flows. Additionally, because they nearly maximize channel evolution rates, such bankfull flows should create enough new sites suitable for wetland plant colonization that the total amount of riparian vegetation along the lower North Fork would remain fairly stable even though the rate at which riparian plant community composition and distribution change would accelerate. Because these 240-cfs and 400-cfs North Fork flows would not normally create bankfull or overbank flows on the mainstem, they would only slightly accelerate riparian vegetation change rates along the mainstem and would not substantially affect the amount of riparian vegetation there.

If instream fish habitat structures are constructed in the lower North Fork, maintaining them would have minor adverse effects on 8 acres of vegetation similar to those described under

Tacoma's Proposal (section 4.5.1.1). Completing or not completing the proposed land exchanges with ONP and FS under Alternative 3 would have the same minor effects on vegetation as described in section 4.5.1.1.

Enhancement Measures and Parcels

Because we believe that it is required to meet the strictures of P.L. 102-436 and NPS management policies, we adopt DOI's recommendation (letter from Willie R. Taylor, Acting Director, Office of Environmental Policy and Compliance, Department of the Interior, Washington, D.C., October 31, 1994) to eliminate or control reed canary grass on ONP exchange lands. This measure would slightly benefit native wetland plants by allowing them to colonize the site.

We agree with WDFW that increasing urbanization would limit the value of transmission line ROW enhancements between the Vaughn Tap and Tacoma (section 4.5.3.1). We therefore recommend that Tacoma submit a final transmission line ROW enhancement plan after reviewing its current plan and consulting with the agencies. Native plant resources in the existing transmission line ROW would be enhanced as described under Tacoma's Proposal if the current plan is retained (section 4.5.1.1), and benefits would be slightly reduced as described under Alternative 2 if the Vaughn Tap to Tacoma section of ROW were removed from the plan (section 4.5.3.1).

No measures would be taken to enhance the limited palustrine vegetation around Lakes Cushman and Kokanee, so project reservoir wetlands would not change substantially (table E-5).

In addition to the Westside, Dow Mountain, Deer Meadow, and Nalley Ranch parcels that it already owns, Tacoma would acquire title or development rights to 40 acres of Simpson Timber Co. land adjacent to Deer Meadow and the JRP-proposed Northern and Southern Lower North Fork and Purdy Creek parcels (appendix D). Vegetation changes on the Westside, Dow Mountain, Deer Meadow, and Northern and Southern Lower North Fork parcels (table E-4) would be somewhat similar to those described for Alternative 2 (section 4.5.3.1), but smaller less extensive patch cuts and thinning in Class 1 and 2 stands only (appendix D) would further increase the estimated amounts and development of mature forest on the Deer Meadow and Northern and Southern Lower North Fork parcels, while reducing estimated increases in grassed habitats.

Vegetation changes at Purdy Creek (table E-4) would be the same as those described under Alternative 2. Alternative 3's short-term impacts and long-term benefits for native wetland plants at Nalley Ranch, described in section 4.4.4.5, would increase estuarine vegetation more than estimated in table E-4 because the dikes would be removed rather than selectively breached as assumed in the HEP.

Protecting and enhancing these parcels would significantly enhance native upland and wetland vegetation resources in the project vicinity. Vegetation changes on the LCSP, Lake Standstill, Potlatch, Belfair Wetlands, and Lilliwaup Swamp parcels would be the same as described under Alternative 1 (section 4.5.2.1).

4.5.4.2 *Wildlife*

Construction Impacts

Under Alternative 3, the effects that replacing Powerhouse No. 2 turbine runners, building Powerhouse No. 3 and its transmission line, removing the Big Creek fish passage barrier, and augmenting gravel in the lower North Fork would have on wildlife would be the same as described under Tacoma's Proposal (section 4.5.1.2). Removing the McTaggert Creek diversion structure and Dow Creek passage barrier would also have minor effects similar to those described under Tacoma's Proposal, but our recommendation to enhance the development of native shrubs and trees (section 4.5.4.1) would speed the development of forage for deer.

Enhancing mainstem capacity and conveyance would temporarily disturb wetland wildlife and habitats throughout much of the license term as described under Alternative 2 (section 4.5.3.2). If studies of lower North Fork fish habitat responses to higher flows indicate that instream fish habitat enhancement measures are warranted, then the effects that constructing these structures would have on wildlife would also be similar to those described under Tacoma's Proposal (section 4.5.1.2) except that suitable osprey and bald eagle perch, roost, and nesting trees along the lower North Fork would not be cut to provide instream habitat materials.

The effects that recreation facility construction would have on wildlife would be similar to those described under Tacoma's Proposal (4.5.1.2) except that building new campsites at LCSP would make an additional 8 acres of mature conifer forest habitat unsuitable for disturbance-sensitive species such as elk. If Tacoma paves Staircase Road as an outcome of the road management plan that we recommend and that the FS requires (section 6.4), the temporary disturbance effects, minor habitat losses, and potential for road-kills would be the same as described in section 4.5.3.2. Building bridges at Richert Farm would also temporarily disturb resident elk and other species as described in section 4.5.3.2. Residential development on LCDC lands would have the same substantial impacts on wildlife habitat as described under Tacoma's Proposal (section 4.5.1.2).

Operational Impacts

Reservoir operations and altered McTaggert Creek, Deer Creek, and Deer Meadow water flows would have the same minor impacts on wildlife as described under Tacoma's Proposal (section 4.5.1.2), as would maintaining lower North Fork fish habitat structures if studies demonstrate that these structures are warranted. Higher instream flows for the lower North Fork might wash out some beaver lodges, but would ultimately benefit beavers, river otters, and American dippers by providing additional aquatic habitat.

Fish stocking and perhaps fish habitat enhancements would increase forage resources for ospreys, mergansers, belted kingfishers, river otters, and black bears. Wildlife would be disturbed by recreationists at minor levels similar to those described under Tacoma's Proposal, except that disturbance would increase slightly more at LCSP if the new campsites increase visitation. Under Alternative 3, land exchanges with ONP and FS would have the same small effects on wildlife as described under Tacoma's Proposal (section 4.5.1.2). Because Tacoma does not currently have the capability to ensure that elk using exchange lands would be protected as they are under NPS administration, or to monitor and enforce the protective covenants on LCDC lands and land use restrictions that would be included in a final management plan for the recommended habitat enhancement parcels, we recommend that Tacoma develop a plan to provide for such monitoring and enforcement.

Enhancement Measures and Parcels

Alternative 3 would include the same transmission line enhancement measures and provide the same substantial benefits to wildlife as described under Tacoma's Proposal (section 4.5.1.2).

Constructing Tacoma's proposed osprey perching and nesting structures under Alternative 3, in combination with fish stocking would probably increase reservoir HUs for ospreys somewhat more than the 11 percent increase estimated in the HEP analyses (table E-9). Although dike removal might temporarily disturb ospreys, great blue herons, and dabbling ducks, restoring estuarine conditions at Nalley Ranch would also improve habitats for these species more than indicated by the HEP estimates. Protecting and enhancing these parcels, along with wetlands in the Deer Meadow, Northern and Southern Lower North Fork, and Purdy Creek parcels, would maintain existing habitat levels for great blue herons, dabbling ducks, and ospreys, and would improve habitats for yellow warblers and mink by 78 and 5 percent, respectively (table E-9).

Implementing our recommended forest treatments (thinning, small patch cuts, snag enhancements, and road removal and closure; appendix D) might temporarily disturb wildlife at affected sites within the Westside, Dow Mountain, Deer Meadow, and Northern and Southern Lower North Fork parcels. These effects would be inconsequential, however, and the benefits of habitat protection and enhancement would increase the number of HUs for hairy woodpeckers, Douglas squirrels, fishers, and elk on these parcels by estimated averages of about 23, 32, 29, and 31 percent, respectively (table E-9). Protecting and enhancing the Northern and Southern Lower North Fork parcels would provide further substantial benefits to elk because most of the Skokomish herd's winter range and much of its migration route would be protected from disturbance and habitat loss.

4.5.4.3 Threatened and Endangered Species

Alternative 3 would have no effect on peregrine falcons for the same reasons as discussed under Tacoma's Proposal (section 4.5.1.3).

The effects that recreation facility improvements would have on marbled murrelets and northern spotted owls would be similar to those that would occur under Tacoma's Proposal. As with Tacoma's Proposal and Alternative 2, acquisition and protection of the Westside parcel would protect murrelets and spotted owls from disturbance by future logging or development on this parcel, and would provide a buffer from continuing residential development on adjacent LCDC lands. Acquiring and enhancing the Westside, Dow Mountain, Deer Meadow, and Northern and Southern Lower North Fork parcels would speed the development of mature forests on these parcels and increase the future availability of suitable habitat for murrelets and spotted owls in the project vicinity. If potential Staircase Road paving and recreation facility improvements at Dry and Copper Creeks, along Staircase Road, and at the Mt. Rose trailhead are constructed outside of their breeding seasons, then Alternative 3 would have no adverse effects on murrelet or spotted owls and would have substantial long-term potential benefits for these species.

Recommended instream flows under Alternative 3 would not be likely to affect trees large enough to be used by bald eagles for perches or roosts along the lower North Fork. To prevent such trees from being destroyed by logging or inadvertent cutting for instream fish habitat structures, we recommend that Tacoma include measures to identify and protect potential bald eagle perch and roost trees along the lower North Fork in its final wildlife management plans. Though bald eagles might be disturbed by construction at Powerhouse No. 3 and by gravel augmentation, they would be protected from increased disturbance at Richert Farm (part of the Southern Lower North Fork parcel). Carrion food sources would be maintained or enhanced, and fisheries enhancements would substantially increase fish forage resources for bald eagles. Even though Alternative 3 might have some minor short-term disturbance effects, overall it would have substantial long-term net benefits for bald eagles.

4.5.5 Alternative 4 (Decommissioning)

4.5.5.1 Vegetation

If the project were decommissioned without dam removal, then the project transmission line would be dismantled from Powerhouse No. 1 to the Vaughn Tap and mid-successional shrubs and trees would dominate the former ROW for several years before second-growth Douglas fir forest became the dominant species — if the ROW vegetation were allowed to develop naturally and were not developed or managed for some other purpose. Because the project would still be operated for flood storage and recreation, fluctuating water levels would continue to limit the development of wetland vegetation around the lakeshore as described for Tacoma's Proposal (section 4.5.1.1). Project-regulated flows in the lower North Fork would be similar to Alternative 2 flows that would initially kill perhaps 98 acres each of riparian and upland forest (section 4.5.3.1). New wetland and riparian forest plants would begin to replace the killed vegetation within a few years, but would then take at least 40 years to attain the existing vegetation's characteristics. Because of these higher flows, some entity or entities might choose to undertake the mainstem capacity and conveyance enhancement measures. If so, these measures would have moderate short-term adverse impacts and long-term benefits for riparian vegetation resources on dozens of acres as described under Alternative 2 (section 4.5.3.1).

Residential development on LCDC lands would probably continue with the same substantial adverse effects on native forest vegetation as described under Tacoma's Proposal (section 4.5.1.1). The proposed land exchanges with ONP and FS could still be completed, and the minor effects of completing or not completing the exchanges would be similar to the effects described in section 4.5.1.1. The substantial adverse effects of logging and residential development on proposed enhancement parcels would be the same as described under Alternative 1.

Decommissioning the project with dam removal would have the same effects as without dam removal except there would not be any reservoir fluctuations, residential development on LCDC lands might slow, and the land exchanges probably would not occur because the lake would no longer encroach on ONP or FS lands. Removing the project dams might require clearing or disturbing vegetation on several acres around the dams in order to provide access, staging areas, and spoil storage sites. To remove the dams, Lake Cushman and Lake Kokanee would be drawn down over a couple of years, eventually exposing almost all 100 acres of Lake Kokanee's bottom and about 3,736 acres of current Lake Cushman bottom, thereby restoring Lake Cushman to its historic 322-acre size. Herbaceous ground cover would be seeded on the exposed lands and construction sites to prevent catastrophic erosion, but could develop poorly because many of these areas are likely to have poor soils. Pioneering willows and red alder would probably be the first woody species to colonize newly exposed areas, with bigleaf maple and black cottonwood beginning to develop within a few more years. After 30 years, these tree species would probably form a moderately-developed but young riparian corridor along the restored stream reaches and around the remaining Lake Cushman shoreline. On upland areas, however, these trees, along with some young Douglas fir, would probably be heterogeneously distributed and poorly developed on many sites. If plant succession were allowed to continue, it would probably take at least 200 years to develop conifer forest stands similar to those occupying inundated lands before the project was built.

4.5.5.2 Wildlife

Removing the transmission line and either allowing vegetation to grow in the ROW or developing it for some other use would eliminate open foraging habitat for raptors and deer, and would also eliminate osprey nests on transmission towers. Without dam removal, reservoir level fluctuations would have the same minor impacts on waterfowl and other wetland wildlife as described under Tacoma's Proposal (section 4.5.1.2). Higher project-regulated flows in the lower North Fork and mainstem capacity and conveyance measures would have the same moderate short-term adverse impacts and long-term benefits for riparian wildlife as described under Alternative 2 (section 4.5.3.2).

Logging and residential development on proposed enhancement parcels and LCDC lands would substantially and adversely affect wildlife much as described under Alternative 1. Completing or not completing the ONP and FS land exchanges would have the same minor effects on elk and other wildlife using exchange lands as described in section 4.5.1.2. Increasing recreation in the project vicinity would correspondingly increase minor disturbance of ospreys and other sensitive wildlife as described under Alternative 1.

Decommissioning with dam removal would also have all of these effects on wildlife except that there would be no reservoir fluctuation impacts, the land exchanges probably would not occur, and disturbance from recreational activities and residential development impacts on LCDC lands would probably be somewhat less. Dam demolition would damage or destroy several acres of second growth forest habitat and would disturb all but the most tolerant species near these sites during the 2 years it would take to demolish each dam. Eliminating Lake Kokanee and reducing Lake Cushman's surface area by 3,736 acres would substantially decrease the local availability of optimal foraging habitats for ospreys, but might ultimately increase some prey populations if anadromous and resident salmonid fisheries in the restored river and remaining lake increase. Increases in riverine area would also eventually provide additional habitat for American dippers, beavers, and river otters, and the development of palustrine scrub-shrub willows along the restored river reaches would increase habitat availability for yellow warblers and mink. Herbaceous ground cover established on the exposed lake beds would provide additional elk forage similar to the bottomlands that existed before the project, but elk and other animals foraging on these areas or travelling across them to drink water at the river would be at greater risks of disturbance and elk might not use these areas extensively until additional cover develops.

4.5.5.3 Threatened and Endangered Species

Alternative 4 would have no effect on peregrine falcons for the same reasons as discussed under Tacoma's Proposal (section 4.5.1.3).

Without dam removal, conditions for marbled murrelets and northern spotted owls would be similar to those described under Alternative 1, so Alternative 4 would have minimal effects on these species. Removing the dams would also not affect any suitable habitat for murrelets and spotted owls, and neither of these species are known to occur near the dams. Thus, sediment stabilization and revegetation of the former lake bottom near the upper end of Lake Cushman are the only activities that might disturb murrelets and spotted owls nesting on adjacent FS lands, so Alternative 4 would have no to minor adverse effects on marbled murrelets and spotted owls over a 30-year period.

Under Alternative 4, regardless of whether or not the dams are removed, bald eagle perching and roosting trees along the lower North Fork would be at risk of loss to logging or removal by higher river flows, and forage resources would be reduced if anadromous fish populations decline in response to river habitat changes. Conversely, higher river flows could enhance the number of perches along the river if killed trees remain standing as snags, and could enhance forage resources if fish populations increase.

If the project dams were removed, then demolition activities might disturb eagles along the lower North Fork's upper reaches. Dam removal would also reduce the local availability of lake foraging habitat, and could degrade downstream fish habitats enough to reduce fish populations and therefore forage availability in the river. If anadromous fish populations eventually increased with increasing spawning habitat availability, however, forage resources for bald eagles could be substantially enhanced. Thus, Alternative 4 could have moderate short- or long-term adverse impacts on substantial long-term benefits for bald eagles wintering in the project vicinity.

4.5.6 Lower Lake Cushman Option

If Lake Cushman were lowered to elevation 725 feet, then seeding on exposed lands to prevent erosion would increase the local abundance of herbaceous grassy vegetation by about 278 acres. The limited wetland vegetation around the lakeshore would quickly die off where there is not some other water source such as a creek, but similar amounts and types of wetland plants would probably become established along the new lakeshore within a few years. If exposed lake bottom lands are not maintained as grassed areas or planted with trees and shrubs, then willows, red alder, bigleaf maple, black cottonwoods, and conifers would naturally colonize these areas. Because the water table would not be far below ground surface on many exposed sites, trees would have enough available water to form young but moderately well-developed stands similar to those that would probably form in restored riparian areas under decommissioning with dam removal.

Lowering the lake would reduce its surface area and the availability of foraging habitat for ospreys by about 6 percent, but would create an additional 0.2 mile of riverine habitat for dippers and other wildlife. Herbaceous ground cover established to prevent erosion would provide additional forage for elk, but without any cover, elk and other animals foraging on these areas or travelling across them to drink water at the river would be at greater risks of disturbance. Likely measures to remove stumps, including blasting, would also temporarily disturb wildlife.

Lowering the lake would have no effect on peregrine falcons (section 4.5.1.3). As under decommissioning with dam removal, measures to stabilize sediments and revegetate the former lake bottom near the upper end of Lake Cushman would be the only actions that might disturb marbled murrelets and northern spotted owls nesting on adjacent FS lands. If measures to remove tree stumps from the exposed lake bottom were taken during their breeding seasons, then murrelets and spotted owls nesting or potentially nesting on adjacent lands might be temporarily disturbed. Reducing the lake's surface area would also slightly reduce potential foraging habitat used by bald eagles. Because eagles rarely forage on the reservoir, however, this reduction in foraging habitat would not have any adverse impacts on bald eagles.

4.5.7 Fish Passage Option

Because gulpers would be situated within Lake Cushman, and their associated fish-collection hoppers and truck-transfer facilities would probably be on developed project lands adjacent to the dam, constructing and operating these downstream migrant passage facilities would almost certainly not affect any vegetation. Even though the exact size and location of upstream migrant trap and haul facilities at the base of Dam No. 2 are somewhat uncertain, they are unlikely to occupy more than 0.5 acre and would displace even less vegetation because much of the canyon floor near the dam base has unvegetated rocky substrates.

Fish passage facility construction activities could disturb local wildlife, perhaps including ospreys nesting at the upper end of Lake Kokanee. Because these facilities would probably be constructed at the same time as Powerhouse No. 3, however, the additional disturbance of fish passage construction would be minor and temporary. Fish passage facility operations would persistently increase human activity near the dams, but because only a couple of people would be needed for operations these disturbance impacts on wildlife would be inconsequential. Because providing fish passage would likely increase fish populations in the project reservoirs, upper and lower North Fork, and mainstem, this measure's minor disturbance impacts would probably be more than compensated for by increasing the availability of forage resources for wildlife, including great blue herons, ospreys, black bears, and river otters.

Providing fish passage would have no effect on peregrine falcons, marbled murrelets, or northern spotted owls, but is likely to benefit bald eagles by increasing the availability of forage resources.

4.5.8 Staff Conclusions

Under Alternative 1, logging and residential and other development could destroy or degrade forest and wetland vegetation on the proposed parcels and LCDC lands, thereby displacing elk migration corridors and winter range, reducing available habitats for species such as hairy woodpeckers, Douglas squirrels, fishers, ospreys, and great blue herons by 25 to 50 percent or more, and increasing disturbance and habitat loss for bald eagles and perhaps marbled murrelets and spotted owls. With or without dam removal, Alternative 4 would have similar effects on terrestrial resources, except that dam removal would ultimately enhance some vegetation and wildlife after substantially disturbing them during demolition and rehabilitation. Because Alternatives 1 and 4 would, overall, have substantial adverse effects on terrestrial resources in the project vicinity, we do not recommend that they be implemented.

Tacoma's Proposal would benefit terrestrial resources by protecting 7,617 acres of land and water from the forest, wetland, and riparian habitat and wildlife losses that would occur under Alternative 1. Although Tacoma's Proposal does protect and enhance some valuable vegetation and wildlife resources, including the margins of elk migration corridors, as further discussed in appendix D, we do not recommend Tacoma's Proposal because it would not include elk winter range or habitats frequently used by threatened and endangered species.

Alternative 2 would significantly benefit terrestrial resources by managing 19,689 acres of land and water to protect and enhance virtually all elk migration corridors and winter range in the project vicinity, large amounts of mature and old growth forests and riparian habitat, a diverse array of wetlands including estuaries, and habitats used by threatened and endangered species. Nevertheless, as further discussed in appendix D, we do not recommend Alternative 2 because it does not represent the best balance of developmental and non-developmental resources.

Alternative 3 would substantially benefit terrestrial resources by protecting and enhancing 9,999 acres of mature and old growth forest, riparian areas, important wetlands including the Skokomish Estuary, elk winter range and migration corridors, and habitats used by threatened and endangered species. Because it would protect and enhance all of the priority wildlife species and habitats in the project vicinity and provides the best balance of developmental and non-developmental resources, we recommend implementing Alternative 3.

Because lowering Lake Cushman would temporarily reduce wetland coverage and increase wildlife disturbance around the lake without providing any substantial long-term benefits to terrestrial resources, we would not recommend it. If fish passage facilities increased fish populations, then it would enhance forage resources for several wildlife species while only negligibly increasing wildlife disturbance and not affecting vegetation.

4.6 Land Use

4.6.1 Tacoma's Proposal

4.6.1.1 Construction Impacts

Construction of day-use sites, campgrounds, and boat ramps would cause minor, short-term impacts on land use in the project area. The construction of recreation facilities at Lake Cushman, Big Creek Campground, and the Hood Canal Recreation Park would disrupt some use in the short-term and might temporarily require closure of parts of these areas.

Construction of the new Powerhouse No. 3 at the base of Dam No. 2 would cause a moderate change in land use. Some trees would have to be removed; however, the area is inaccessible to the public and not visible from most public locations in the vicinity. Hence, the change should not have any significant effect on other area land use.

Construction traffic associated with the development of the powerhouse and recreation facilities in the Staircase Road Recreation Area would increase traffic volumes on Lake Cushman Road and Staircase Road. Traffic impacts, however, would occur primarily for short periods of time in the morning and afternoon as workers enter and exit the site. In addition, intermittent deliveries of construction supplies and equipment may cause minor slowdowns during the day. These delays should be a short-term inconvenience to area residents for the duration of construction.

4.6.1.2 Long-term Impacts

Tacoma's Proposal to construct a new 1.3-MW powerhouse at the base of Dam No. 2 and a new transmission line would increase the area devoted to generation facilities by up to 3.5 acres.

By removing the McTaggert Creek diversion structure, Tacoma would convert a small area devoted to project uses into more natural forest and riparian areas.

The Richert Farm has several wet crossings for livestock, vehicular, and equipment access between fields separated by the river. One crossing is on the lower North Fork and another is on the mainstem. Although the river is passable at the two wet crossings under the current MIF of 30 cfs, the river would be impassable at elevated flows of 100 cfs (letter from J. Richert, JR Co., Shelton, Washington, January 22, 1992). Increasing the minimum flow to 100 cfs would require bridge construction or drastic alterations in farm practices.

Tacoma's Proposal to dedicate 3,599 acres of timber and other lands, along with the project reservoirs, for wildlife habitat preservation and enhancement would maintain these lands in an undeveloped state. Increasing the amount of lands dedicated to wildlife habitat and converting the management focus of some lands to wildlife would reduce the amount of area available for residential and recreation development. Proposed restrictions on logging would limit forestry uses in the area.

As discussed in section 3.9.1.2, the forest products industry has historically been a dominant force in the economy of Mason County and, although the economic base of the county has diversified somewhat in recent years, continues to play a substantial role. With the recent federal protection of the northern spotted owl and consequent removal of substantial tracts of timber producing land for habitat preservation, there is increasing concern within the state over the reduction in available timber supply. The 1,407 acres of private land that would be converted from forest production to wildlife preservation under Tacoma's Proposal represents less than 1 percent of the total timber producing land in the county. When viewed in the context of Mason County, the impact of this change in land use should not be significant. From a larger, statewide perspective, though not a significant portion of total acreage, it is one more encroachment on a dwindling timber supply.

Although some lands would be removed from future recreation development, recreation opportunities at existing developed recreation facilities would generally be improved (section 4.7.1). Some dispersed recreational uses of lands along the Staircase Road Recreation Area, including camping, would be eliminated to improve public safety, reduce the fire hazard, and reduce site degradation from overuse.

The FS-Tacoma land exchange (section 3.6.4) would benefit FS by ensuring that Lake Cushman would not inundate ONF lands and would allow FS full management of local ONF lands and some adjoining lands on Staircase Road. Tacoma would benefit from the land exchange by gaining ownership and full control over lands needed for reservoir operations. To protect FS lands, FS and Tacoma have worked together to develop draft plans for recreation and resource management.

The NPS-Tacoma land exchange would prevent reservoir encroachment on ONP (section 1.2). DOI has recommended that Tacoma comply with the following conditions on the property to be taken over by Tacoma as part of the exchange.

- Hunting or disturbing wildlife on ONP lands to be transferred to Tacoma shall be prohibited.

- Harvesting plants except for small quantities of fungi and berries shall be prohibited on these lands.
- The lands shall not be developed.
- Reed canary-grass on these lands shall be controlled or eliminated through an approved Integrated Pest Management Program.
- Tacoma shall provide ranger patrols to enforce use restrictions on these lands.
- The Skokomish Tribe shall, for ceremonial, religious, and other traditional uses, continue to have unchanged access to these lands.
- The management agreement between the Secretary of the Interior and Tacoma that is required by P.L. 102-436 shall be included as a license article.

Compliance with these conditions would ensure that the appropriate use and management of the transferred lands would continue to occur.

ONP has several plans and legislative authorities that guide park management. In addition to the general national park guidance found in federal legislation such as the Organic Act of 1916 (39 Stat. 535 et seq.) and Redwoods Act of 1978 (P.L. 95-250), the park is guided by the original legislation that established the park (June 28, 1938), the Olympic National Park Master Plan (1974), the Olympic National Park Land Protection Plan (1983), and the Resources Management Plan (1991).

The management objectives for national park lands include the directive to maintain, restore, and perpetuate the inherent integrity of NPS natural resources. The land exchange would support these goals. Although outside of the ONP boundary, the establishment of wildlife habitat areas with hunting restrictions and quality habitat under Tacoma's Proposal would also help to protect the Roosevelt elk populations, another ONP management goal.

4.6.2 Alternative 1 (No Action)

Under Alternative 1, no action, hydropower generation, residential development, and recreation would continue to be dominant land uses in the North Fork River Basin.

Because the project reservoirs would continue to be operated as they are today, the types of land uses that occur along the shoreline today would remain. Lands would not be acquired and dedicated for wildlife enhancement by Tacoma, and could continue to be developed and used for recreational, residential, and forestry uses. LCDC lands could be further developed for residential purposes, thereby increasing the density of the development, adding vehicular trips to the area roadways, and increasing recreation demand and use of area facilities.

Use of project recreation facilities would continue, and misuse of the Staircase Road area could continue to be a problem. No additional recreation facilities would be constructed by Tacoma to meet the anticipated increases in recreational use.

Under Alternative 1, the land exchange between NPS and Tacoma and FS and Tacoma could still occur. The land exchanges would prevent Lake Cushman from inundating ONP land and FS land. Additionally, the land exchange with NPS would transfer ownership of park inholdings (lands within the ONP boundary that are not owned by NPS) to NPS. Because Tacoma would have to manage its newly acquired lands at the same level as NPS and FS would, there would be no change in land use.

4.6.3 Alternative 2

4.6.3.1 Construction Impacts

In addition to the construction impacts on land use described under Tacoma's Proposal (section 4.6.1.1), the construction of a new underground powerhouse at Dam No. 2 would cause a moderate change in land use. A 70-by-120-foot area of privately owned, forested land would be cleared for excavation and construction of the new substation. It is likely that Tacoma would have to purchase and remove one house on the hill above the substation site because construction could destabilize its foundation. This action would remove that property from residential land use. Noise and dust from construction activities could also provide a short-term nuisance to the remaining residents on the hill above the site.

Approximately 200 feet of access road would be constructed along the east bank of the lower North Fork, and traffic would increase slightly during the 24- to 36-month construction period. This traffic would occur sporadically throughout the day, with primary effects occurring during the morning and afternoon hours when the construction workers enter and exit the site. Delivery and movement of construction equipment and supplies would have intermittent, minor, adverse effects on traffic flow and movement throughout the day for the duration of the construction period.

The new 2,600-foot-long transmission line between Powerhouse No. 3 and the existing transmission lines at Powerhouse No.1 will go through an existing residential area. Construction of the transmission line is likely to create a short-term nuisance to neighboring residents as it would require tree removal and clearing of high growth vegetation along the corridor as well as the use of heavy equipment to install transmission towers and string new lines.

4.6.3.2 Long-term Impacts

Lake Cushman would operate at the same typical level (elevation 738 feet) as under existing conditions from May through August; therefore, there would be no change in shoreline uses. From October to March, Lake Cushman would be from 3 to 12 feet higher than existing levels. This measure would benefit land uses that are better suited to higher reservoir levels. The minimum reservoir elevation would be 723 feet, 33 feet above the existing minimum of 690 feet.

Returning near full flows to the North Fork should eliminate many sandbars and low-lying riparian lands. The fish habitat enhancement measures, additional support of fish hatcheries, and estuary habitat enhancements could cause a minor increase in vehicular activity on area roads but would also increase the amount of land devoted to natural resource preservation and management in the area.

The combined effects of estuary channel development, increased sediment transport capacity, and South Fork watershed recovery efforts could cause long-term increases in flood channel capacity (section 4.1.3). Subsequent reductions in nuisance flooding along the North Fork and mainstem would be a long-term benefit to shoreline land uses (agricultural, forestry, and residential).

Segments of the lower North Fork within the valley near the mainstem could reclaim old meander channels or cut new channels in response to the higher river flows (section 4.1.3) and could disrupt existing land uses such as ranching, farming, and residences in the area.

Terrestrial vegetation and wildlife enhancements would generally have the same types of effects as described under Tacoma's Proposal (section 4.6.1.2); however, more than four times the acreage (15, 742 acres) would be managed for wildlife under Alternative 2. Under this alternative, more than 11,600 acres of public or private land (about 2 percent of all county land used for forest production) would undergo a conversion of use from forestry management with a timber production emphasis to wildlife habitat with a preservation emphasis. This would have about the same type of effect as Tacoma's Proposal (section 4.6.1.2) except on a larger scale.

The new transmission line between Powerhouse No. 3 and the existing transmission lines at Powerhouse No. 1 could affect the way in which residents use and develop their property. Long-term access will be required within the ROW for maintenance and, therefore, the corridor will have to be kept free of trees and large shrubs. This would convert the land from forest land to open space-utility use for the duration of the license.

The effects of recreation improvements on land use would be the same as under Tacoma's Proposal (section 4.6.1.2). Additional recreation accesses and facilities would be built under this alternative. These include new boating access to the southern portion of Lake Cushman, improved boating access at the LCSP and WDFW boat launches, and improvements at Hood Canal Recreation Park. Each of these improvements would increase the amount of lands devoted to recreational use. In addition, about a 4-mile section of Staircase Road that is currently not paved will be paved and widened. Agencies have also recommended that Tacoma develop a plan to enforce existing management covenants on LCDC lands. The effects of the land exchanges between Tacoma and FS and Tacoma and NPS would be the same as under Tacoma's Proposal (section 4.6.1.2).

Removing dikes on Nalley Ranch would expose about 285 acres of land within the currently diked areas to tidal flows. This action would convert active agricultural land into estuarine habitat unsuitable for agricultural use.

4.6.4 Alternative 3

4.6.4.1 Construction Impacts

Construction would have the same impacts on land use as described under Tacoma's Proposal (section 4.6.1.1).

Although worker vehicles and construction vehicles would increase volume on Lake Cushman Road and Staircase Road, the increase is not expected to create any significant traffic problems. Traffic associated with construction workers will occur for short periods of time in the morning and afternoon as workers commute to and from the construction area. Other construction vehicles will access the area at intermittent times during the day and should not be more than a minor inconvenience to residents or visitors to the area.

4.6.4.2 Long-term Impacts

Lake Cushman reservoir operations would have the same land use impacts as described in section 4.6.3.2.

Terrestrial vegetation and wildlife enhancements would generally have the same types of effects as described under Tacoma's Proposal (section 4.6.1.2) and Alternative 2 (section 4.6.3.2); however, 5,981 acres would be managed for wildlife under Alternative 3.

Under this alternative, about 2,940 acres of private land would be converted from forest production to preservation. This represents less than 1 percent of the county land currently dedicated to forest production and would have the same effect as described under Tacoma's Proposal (section 4.6.1.2). Much of the agricultural land included within the boundaries of the wildlife management parcels (particularly Richert farm land) would continue under agricultural use.

The effects of the land exchanges between Tacoma and FS, and Tacoma and NPS would be the same as described under Tacoma's Proposal (section 4.6.1.2).

By improving sediment transport and by ceasing and reversing channel aggradation in the North Fork and the mainstem, the flood hazard for low volume, high frequency floods would be reduced thereby benefiting residential, agricultural, and forestry uses along the shoreline and low lying areas of the valley.

The recreation improvements would have the same effects on land use as described for Alternative 2 (section 4.6.3.2). Under Alternative 3, however, Tacoma would develop, in consultation with the FS, a road management plan for project-related roads on FS lands. Tacoma would be required to implement any measures included in the plan.

4.6.5 Alternative 4 (Decommissioning)

Decommissioning without dam removal would have no effect on shoreline recreation or residential uses and increases in large flood events would probably not occur.

Decommissioning with dam removal could exacerbate flooding impacts along the North Fork and the mainstem (section 4.2.5). Until the river's flood capacity increased as higher flows created a new channel, the flood potential would be higher than it is currently. Flooding effects would be felt in more residential areas, agricultural areas, and other land areas along the lower river valley.

If the dams were removed, the reservoirs would no longer exist and these river valleys could return to the natural lake and river recreation setting of pre-project conditions. The popular reservoir recreational uses (lake boating, lake angling, swimming, and water skiing) would cease and be replaced by small lake (remnant Lake Cushman) and river-based recreational uses.

There are approximately 3,000 residential lots along Lake Cushman with about 2,500 owners. About 250 lots are waterfront lots, and in 1991 there were about 180 bulkheads or docks on these lots. Although lands and waters below elevation 742 are within the project boundary and technically under hydropower generation and public water-based recreational uses, Lake Cushman shoreline lots have, in effect, been under private residential and water-based recreational uses because of limited public access to the shore. Because lowering Lake Cushman would render most existing docks unusable and increase the distance between homes and the waterfront, the lower 725-foot elevation would have major negative impacts on current lakeshore residents and residential land uses and values. Furthermore, under the lease agreements with Tacoma, all lessee's property boundaries end at the 742-foot elevation contour. As a result, it is not certain that property owners would be able to move or construct new facilities in the exposed areas.

Four private residential parks are located along Lake Cushman. Two of the parks are multi-purpose with facilities including boat launch and moorage, playgrounds, basketball courts, badminton courts, horseshoe pits, picnic areas, and restrooms. The other two parks were specifically built to serve boaters and have boat ramps and temporary toilet facilities. When the lake drops 8 to 20 feet from the 738-foot level, boat launch ramps cannot be used and shorefront swimming beaches become less desirable. Overall, the parks would become less attractive for general recreational use if the dams were removed.

4.6.6 Lower Lake Cushman Option

If all conditions of P.L. 102-436 (section 1.2) are not met, the NPS-Tacoma land exchange would not occur. Consequently, the only action that could be taken to prevent Lake Cushman from inundating NPS lands would be to lower the lake level to elevation 725 feet.

This action would have a severe long-term negative impact on existing residential and recreational land uses. Although Lake Cushman is typically operated below 725 feet from October to March, the reservoir is operated at about 738 feet from June through August to enhance enjoyment of the shoreline during the peak season for recreationists and seasonal residents. Many homes and recreation facilities have been built to take advantage of the lake's aesthetics and sheltered recreation areas at 738 feet. If the reservoir was lowered, the existing residential improvements and recreation facilities (boat ramps, two boater destination parks, and swimming beaches) would be less enjoyable or even unusable. The impacts would be similar though less severe than Alternative 4 with dam removal (section 4.6.5).

Lowering Lake Cushman on a permanent basis would eliminate the project reservoir occupation of ONP lands, but would also eliminate current shoreline uses at existing accesses and facilities. Although Tacoma could develop recreation accesses and facilities to serve the lower reservoir elevation, because of the prevalence of steep shorelines, there is no guarantee that suitable swimming and wading areas and boating accesses could be constructed to replace all existing facilities.

4.6.7 Fish Passage Option

For a trap-and-haul fish passage facility, access to the North Fork below Dam No. 2 and to Lake Cushman would be essential and could require the construction of new boat ramps and access roads. It is possible, however, that existing facilities could be used and that no new construction of land-based facilities would be required. Because details on the need for, or possible location of, fish passage facilities have not yet been developed, the actual extent of change is indeterminate at this time. We anticipate that any adverse effects, such as traffic slow downs or disruption of existing recreation activities, that might result from construction of new land-based access facilities would be minor.

4.6.8 Staff Conclusions

Decommissioning with dam removal (Alternative 4) or adopting the lower Lake Cushman option for Tacoma's Proposal or Alternative 2 or 3 would cause severe negative long-term impacts on shorefront residential lands and recreational facilities. If the land exchanges between Tacoma and NPS and Tacoma and FS occur, the lower lake elevation would not be necessary. Thus, Tacoma should continue to undertake all efforts necessary to finalize these agreements.

Under each alternative, lands in the project vicinity could continue to be developed and used for recreation, residences, timber production, and agriculture. Under Tacoma's Proposal and Alternatives 2 and 3, large parcels of land in the project vicinity would be converted from current uses to wildlife protection areas. Although there would be significant benefits from preserving the proposed parcels in a natural state, there would also be negative effects from this action. Alternative 2 would have the most significant adverse effect because it would convert the largest amount of land from productive commercial timber and agricultural use to wildlife habitat. Although it would have only minor effects on agricultural and timber production lands, Tacoma's Proposal would provide the least amount of wildlife habitat. Alternative 3 would provide the most significant benefits by protecting a large amount of land as wildlife habitat with only minor effects on agricultural and timber production lands. Under Alternative 4 it is uncertain whether lands would be preserved for wildlife.

Richert Farm has requested that Tacoma build bridges at the existing wet crossings for transporting vehicles and livestock across the North Fork and the mainstem at higher flows (letter from J. Richert, JR Co., Shelton, Washington, January 22, 1992). Under Tacoma's proposed development scenario these bridges would be required. Under the preferred alternative, we are recommending that Tacoma consult with FWS and WDFW concerning bridge design and location and then construct the appropriate structure(s).

4.7 Recreation Resources

4.7.1 Tacoma's Proposal

4.7.1.1 Construction Impacts

The movement of heavy equipment, dust, and increased traffic associated with construction of new facilities could adversely affect recreation experiences in the project vicinity. Although most of the project modifications (such as construction of Powerhouse No. 3) would not be visible to the public, people fishing, boating, and hiking in the project area might hear construction equipment noise. Construction of the recreation facilities proposed for Lake Cushman, Hood Canal Recreation Park, and Big Creek would temporarily disrupt access to the developed areas of those facilities and could temporarily degrade the recreational experiences of visitors to those areas.

Staircase Road is the only road that serves the ONP Staircase Campground and Ranger Station. If construction in the Staircase Road Recreation Area was not completed during the off-season, then construction vehicles would share the road with sightseers and other visitors going to the national park and would slightly increase the levels of congestion, noise, and dust along the road.

Although construction-related activities might degrade the experience of visitors to the project area and the Staircase area of ONP, these impacts would be temporary and of short duration.

4.7.1.2 Long-term Impacts

Because the summertime reservoir operation would be the same as under existing conditions, recreation opportunities along the reservoirs would remain the same as described in section 3.7.2.

The provision of a 100-cfs MIF could enhance fish production, especially downstream from the lower falls (section 4.4.1.1) and could improve sportfishing catch rates.

Fish habitat enhancement measures in the lower North Fork, McTaggert Creek, Big Creek, and Dow Creek would increase trout and salmon habitats (sections 4.4.1.2, 4.4.1.4, and 4.4.1.9). If fish populations respond to these habitat increases, sportfishing opportunities could be substantially enhanced in the river basin. Reservoir stocking of trout and kokanee, as proposed by Tacoma (section 4.4.1.3), would also increase catch rates.

Enhanced angling opportunities could attract more anglers to public access sites and place greater demand on these existing sites along the reservoirs, river, and delta. Tacoma's Proposal to expand and improve access to these areas would help meet the increased demand.

Wildlife habitat improvements along Lake Cushman, the lower North Fork, and at the Purdy Creek parcel would benefit wildlife populations (section 4.5.1) and could improve opportunities for observing wildlife and for hunting on adjacent lands.

Tacoma's Proposal to gate roads (as a wildlife habitat protection measure) would reduce public vehicular access to some areas. The impact of this action would be minor because many recreationists could access gated lands on foot and other roads are available in the area for off-road vehicle use.

If the FS-Tacoma land exchange occurs, Tacoma would gain lands currently within ONF on the northern edge of Lake Cushman. FS has requested that the following conditions be included in the exchanges.

- Tacoma should, within 1 year of license issuance and in consultation with NPS, FS, WSPRC, WDFW, and ICOR, prepare and begin to implement a project recreation plan.

- Tacoma should acquire lands adjacent to the project reservoir in order to assure the development of additional recreation facilities within the project boundary.

- Tacoma should fund the construction, operation, and maintenance of recreational facilities within project boundaries.

Compliance with these conditions would ensure that the property and surrounding area would be maintained to FS standards.

Recreation Plan

Implementation of Tacoma's proposed recreation plan would provide improved public access to Lake Cushman, Hood Canal, and Big Creek. Because Tacoma has proposed no new facilities for Lake Kokanee in its recreation plan, public access and recreation opportunities there would remain limited.

The new facilities and improvements to existing facilities proposed by Tacoma would enhance recreation opportunities in the following areas (table 4-11).

- Staircase Road Recreation Area;
- LCSP;
- Lake Cushman viewpoint;
- two FS hiking trails;
- FS Big Creek Campground; and
- Hood Canal Recreation Park.

Staircase Road Recreation Area. Tacoma would develop five day-use sites and monitor, maintain, and regulate the area. The development of picnic tables, toilets, and parking areas would substantially improve recreation facilities and enhance recreation experiences in this area. Tacoma's Proposal to pay FS to operate and maintain this area would ensure adequate management. Under FS management, the Staircase Road Recreation Area would be monitored to discourage overuse and misuse, to reduce existing fire hazards, and to control litter and sanitation problems. This arrangement notwithstanding, Tacoma would be responsible for operating and maintaining these facilities.

The proposed facilities for the five day-use sites include a total of 18 picnic sites, 3 toilets, and 22 parking spaces. To provide adequate access to developed facilities and to discourage dispersed uses at the day-use sites, FS has recommended that Tacoma tie the number of parking spaces at each day-use site to the number of picnic tables at each access. Tacoma has not done this. At Site 1, six parking spaces are proposed to serve the three picnic tables proposed for the site. The provision of three excess parking spaces at Site 1 might encourage undesirable dispersed recreational use at the site. At Site 2, the three parking spaces proposed would not adequately serve the public's use of the four picnic tables proposed.

Developing facilities and improving recreation access along Staircase Road would not increase recreation capacity. Many people currently use the area inappropriately and without facilities (section 3.7.3). Bringing the inappropriate use under control would displace some users that are accustomed to the unregulated, largely undeveloped shoreline. Although some current users would be displaced, the new facilities and improved access could attract a number of new users.

Tacoma's Proposal to provide barrier-free toilets and one designated barrier-free picnic table in the Staircase Road area would improve facilities for the disabled.

Table 4-11. Tacoma's proposed recreation improvements.[1]

Staircase Road Recreation Area

Improve 5 casual shoreline access sites adjacent to Staircase Road. Informal campsites would be converted to day use only. Proposed improvements, which would be constructed to meet FS standards, are as follows.

Site 1 Cushman Falls
- gravel parking for 6 vehicles
- 3 picnic sites (table, elevated grill, site hardening)
- a sign stating "Picnic Only, 3 sites available"
- a barrier-free toilet and bollards
- 1 information kiosk
- 2 sets of stairs

Site 2 Mt. Rose Area
- gravel parking for 3 vehicles
- 4 picnic sites (table, elevated grill, site hardening)
- a sign stating "Picnic Only, 4 sites available"
- a sign indicating toilet location at Mt. Rose Trailhead
- 1 information kiosk
- stairs

Site 3 Mt. Rose Area
- gravel parking for 4 vehicles
- 4 picnic sites (table, elevated grill, site hardening)
- a sign stating "Picnic Only, 4 sites available"
- a sign indicating toilet location at Mt. Rose Trailhead
- 200 feet of new trail to the Mt. Rose Trailhead
- 1 information kiosk
- 2 sets of stairs

Site 4 Mt. Rose Area
- gravel parking for 4 vehicles
- 3 picnic sites (table, elevated grill, site hardening)
- a sign stating "Picnic Only, 3 sites available"
- a toilet and bollards
- 1 information kiosk
- stairs

Site 5 Cushman Cliffs
- gravel parking for 5 vehicles (including one barrier-free space)
- 4 picnic sites (table, elevated grill, site hardening)
- a sign stating "Picnic Only, 4 sites available, 1 site accessible"
- a barrier-free toilet and bollards
- 1 information kiosk
- stairs
- barriers and revegetation to discourage misuse

Lake Cushman Viewpoint

Develop the existing viewpoint to accommodate picnicking and improve accessibility of the site.
- gravel parking for 20 vehicles
- 4 barrier-free picnic sites
- a barrier-free toilet and bollards

FS Dry Creek Trail

Relocate Dry Creek Trailhead to a location near Copper Creek and close the portion of Dry Creek Trail that is adjacent to Lake Cushman residences. Proposed improvements include the following.
- a trailhead sign
- an information kiosk
- about 0.1 mile of Copper Creek Trail improvements
- about 0.57 mile of new trail constructed from Copper Creek Trail to existing Dry Creek Trail
- gravel parking for 6 vehicles
- a barrier-free toilet

FS Mt. Rose Trailhead

Proposed improvements include the following.
- a trailhead sign
- an information kiosk
- gravel parking and turnaround area for 8 vehicles
- a barrier-free toilet with bollards
- excavation and leveling for vehicular turnaround and parking for 8 vehicles

WDFW Lake Kokanee Boat Launch Fund Annual Operation and Maintenance of Boat Launch
WSPRC Lake Cushman State Park
Improve Lake Cushman State Park for day use and organized large group day-use facilities. Modify existing large day-use building to incorporate Skokomish Tribal longhouse function and building architecture. The improved building would be a covered, open area with concrete pavement. The following improvements are proposed. • grills, cooking counter, sinks, central fire pit(s) • picnic tables and perimeter seating • barrier-free restrooms including flush toilets and sinks • roof ventilation and enclosure panels for winter use • a salmon barbecue pit adjacent to the building • modifications to building to incorporate Native American design • design consultation with the Tribe • WSPRC construction standards • 50 gravel day-use parking spaces (with at least 2 barrier-free spaces) to be used as overflow parking Remove existing comfort station at day-use and swim beach area and replace with a barrier-free bath house. Proposed improvements include the following. • changing areas with benches and stalls • showers • sinks • flush toilets Improve boating access to include the following. • 48 additional gravel parking spaces in the boat launch area that can also be used as overflow parking for groups using the longhouse/day-use building
FS Big Creek Campground
Improve and develop the undeveloped portion of Big Creek Campground to accommodate overnight camping, overnight group facilities and general day use. Proposed improvements, which would be constructed to meet FS standards, include the following. One group site for RVs (30-units) • 30 drive-through RV parking spaces • 2 covered community kitchen shelters with stoves, fireplaces, and 15 tables to accommodate 120 people • 10 additional tables separate from community kitchens to accommodate 80 people • 1 group fire circle with benches • a barrier-free toilet Other facilities (all barrier-free) • 2 informational kiosks • 1 fee station • 1 hand pump well and well house • 12 trash receptacles • 6 wastewater disposal sumps • 1 entrance sign • 12 directional and facility identification signs

Five group sites for tents (3-5 units each)

- gravel parking for 25 spaces
- 15 overnight campsites with tent spaces
- 10 tables
- 5 group fire circles with benches
- a barrier-free toilet

Hood Canal Recreation Park

Improve the facility to decrease boat launching and retrieval time and otherwise reduce problems associated with overcrowding at the site.

- extend boat ramp to below low tide
- construct floating dock for 10 boats
- stabilize 500 to 1000 feet of bank
- construct stairway-ramp between beach and picnic area
- hire two full time traffic control persons during peak shrimping times

Build an additional concrete boat launch lane at some unspecified time in the future if the above improvements are not sufficient to meet year-round demand.

General Project Area

Build interpretive exhibits in areas to be specified in the future.

- Tribe interpretive exhibits
- 8 other interpretive exhibits

Construct directional and informational signs for the following areas.

- Dam No. 1 and Dam No. 2 overlook
- Lake Kokanee and WDW boat ramp
- Lake Cushman State Park
- Lake Cushman viewpoint
- Big Creek Campground
- Staircase Road day-use sites

Construct traffic control and safety signs for the project area regarding the following.

- road conditions
- parking areas
- speed limits
- road hazards
- warnings

[1] Source: Tacoma, 1993a.

Lake Cushman State Park. By converting an existing toilet facility at LCSP into a barrier-free bath house, Tacoma would improve universal access to public facilities at this location.

Lake Cushman Viewpoint. The Lake Cushman viewpoint is currently an unimproved pull-out off Lake Cushman Road on the east side of the reservoir between Powerhouse No. 1 and LCSP. Tacoma's Proposal to develop four day-use picnic sites and a toilet at the Lake Cushman viewpoint would be a significant improvement because there are currently no facilities to support use at this site. Because all site facilities would be barrier-free, Tacoma would significantly improve universal access at this site.

Forest Service Trails. The primary change to FS trails in the project area would be relocating the Dry Creek Trailhead to a location near Copper Creek to join with the Cooper Creek Trail. By relocating the Dry Creek Trailhead and rerouting the initial segment of the trail to avoid a residential area, Tacoma would reduce the potential for conflict between shoreline residents and hikers. In addition, public access to Dry Creek could be ensured by moving the initial portion of the trail off private land. Although the rerouted trail could be longer and could cover more difficult terrain, the new trail would allow hikers to traverse a more natural environment, as is typically sought on FS hiking trails.

Proposed general improvements, including kiosks, signs, toilets, and parking areas, near the Dry Creek, Copper Creek, and Mt. Rose Trails would enhance the recreational experience of users. Should the proposed land exchange with the FS not occur, Tacoma would be required to grant a trail right-of-way to the FS for applicable sections of the Mt. Rose Trail.

Forest Service Big Creek Campground. The camping units proposed for Big Creek Campground would help offset the loss of camping opportunities along Lake Cushman in the Staircase Road Recreation Area. Tacoma's proposed interpretive signage and kiosks at the picnic sites should enhance visitors' enjoyment of the area.

Hood Canal Recreation Park. Tacoma's Proposal for Hood Canal Recreation Park would improve public access and allow for speedier boat launching and retrieving. The proposal to build stairs or ramps between the beach and picnic area would facilitate public access. An extended boat ramp, a floating dock, and traffic control would help reduce problems related to overuse of the boating access. Although the most effective means to meet existing and future demand at the launch would be to provide an additional launch ramp, Tacoma proposes to build a second boat ramp only if the proposed measures do not satisfy demand.

General Recreation Enhancements. Tacoma's plan to provide interpretive exhibits at the Hood Canal Recreation Park, LCSP, the Lake Cushman viewpoint, and other sites chosen by Tacoma and the Tribe, would enhance visitors' experience of the project area and would help meet the growing public demand for interpretive facilities. The exhibits, which would include Native American cultural history interpretation and information about the hydroelectric project, would provide a regional and historical perspective.

Access for the Disabled

Tacoma proposes to build the following barrier-free facilities:

- two toilets, one parking space, and one picnic site in the Staircase Road Recreation Area;

- two toilets, two kiosks, a fee station, a hand pump, trash receptacles, and six wastewater disposal sumps at the FS Big Creek Campground;
- toilets at Mt. Rose Trailhead and the new Dry Creek Trailhead;
- a bathhouse (including changing areas, benches, showers, sinks, and flush toilets) at the proposed longhouse/day-use building at LCSP;
- four picnic sites and a toilet at the proposed Lake Cushman viewpoint; and
- a ramp at Hood Canal Recreation Park to provide access between the picnic area and the beach.

Tacoma received no comments from the public or agencies about disabled access to the project, but is ultimately responsible for complying with the Americans with Disabilities Act of 1990. Although Tacoma's Proposal would greatly improve universal access, additional barrier-free facilities (including boating and fishing areas, restrooms, and picnic facilities) would be needed to adequately meet the access needs of the disabled at Big Creek Campground, Lake Cushman, and Lake Kokanee.

4.7.2 Alternative 1 (No Action)

Under Alternative 1 the project reservoirs would be operated as they are under existing conditions, and the reservoirs and existing recreation facilities would continue to provide the opportunities described in section 3.7.2.

The Staircase Road Recreation Area would continue to receive heavy use during the summer recreation season (section 3.7.3). Current problems with sanitation, litter, fire hazards, and other safety hazards may persist because of overuse and misuse in this area. These problems could intensify under Alternative 1 because use is expected to increase and there is no formal agreement with FS regarding recreation management of these lands.

Boater put-in to the southern portions of Lake Cushman would be limited because there is no nearby public access. Access to Lake Cushman at low water levels would continue to be limited because no public launches serve reservoir elevations lower than about 730 feet.

The platted shorelines of both Lake Cushman and Lake Kokanee could be developed as residents continue to purchase and develop lots under the LCDC for residential use. Increasing numbers of residents would benefit from private shoreline access.

Because FS does not own, or have an easement for, the initial segment of Dry Creek Trail, there is no guarantee that this trail would be available for public use in the future. If the trailhead and initial portion of the trail are not relocated away from shoreline residences along Lake Cushman, conflicts between trail users and residents may occur.

At Hood Canal Recreation Park, crowding and waiting time at the boat launch could increase, especially during shrimp season when use is highest. Conflicts between park users would continue as the number of park users increase. Because no improvements are anticipated other than maintenance under Alternative 1, problems at the park would probably persist.

Fishing success in Lake Cushman, which has declined since the early 1970's, would continue to be depressed because of lake level fluctuations and substantial reductions in kokanee and cutthroat stocking. Without fish habitat enhancements, increased flows in the North Fork, or reservoir stocking, the Skokomish River and reservoir fisheries would continue to provide only a marginal sport fishery.

4.7.3 Alternative 2

4.7.3.1 Construction Impacts

Construction of Powerhouse No. 3 and recreation facilities would have the same general impacts as described under Tacoma's Proposal (section 4.7.1.1).

4.7.3.2 Long-term Impacts

Lake Cushman reservoir operations from April to September would be similar to those under existing conditions, therefore, reservoir-based recreation opportunities would remain the same as described in section 3.7.2. The minimum year-round elevation of Lake Cushman would be 723 feet (section 4.6.3.2), which would benefit recreational land uses that are better suited to higher reservoir levels (boat launching, shoreline angling).

Returning full flows to the North Fork could eventually increase trout and salmon habitats in some places (section 4.4.3.1). Removing dikes on Nalley Ranch would increase the intertidal area and could increase and improve shellfish habitat. If gamefish populations respond to these habitat increases, angling opportunities could be greatly enhanced in the river basin within the life of the license. Full flows might enhance shellfish production at the Skokomish Delta and subsequently improve recreational shellfish catch rates. Marine catch rates could also improve with full flows.

Returning full flows to the North Fork could also provide a new resource for white water kayaking and canoeing. Although public access is limited, the river bed contains the characteristics to make it a desirable resource if higher flows were provided. Due to its limited access, however, this would not be anticipated to be a major recreation activity in the area.

Managing 15,742 acres of land for wildlife in the project vicinity would benefit wildlife populations (section 4.5.3.2) and could improve opportunities for observing wildlife. If game animals respond to these habitat enhancements, hunter success rates could improve in adjacent areas where hunting is permitted. Managing these lands for wildlife could also benefit dispersed recreational uses.

If fish passage improves natural fish production, angling opportunities could be enhanced in the Skokomish River, reservoirs, and Hood Canal. Improvements in fish production, however, would take time. A discussion of the benefits and liabilities of stocking versus restoring fish populations is included in section 4.4.

Recreation Plan

Tacoma would provide recreation improvements in addition to those described under its recreation plan (table 4-11). WDFW and DOI have requested that Tacoma acquire and develop unspecified lands near Dam No. 1 to provide direct public boating access to the southern portion of

Lake Cushman. Providing public access near Dam No. 1 would be a significant improvement because direct access to the southern portion of the reservoir is limited.

Additionally, Tacoma would construct a barrier-free mooring float at LCSP and would extend one ramp to facilitate boat launching and retrieving at the park's boating access. The mooring float would improve access for the disabled. Because no evidence exists to indicate that crowding is a problem at the LCSP boat launch, the mooring float would not significantly benefit most boaters. Because the longest boat ramp at LCSP extends only to 725 feet (where the bank drops off steeply), the extension of the ramp would allow boating access to the reservoir when it drops below 725 feet (typically in the autumn and winter). The construction of additional camping units at LCSP and Big Creek Campground would help meet the growing demand for camping facilities and would help offset the loss of camping opportunities at the Staircase Campground in ONP.

Because Lake Kokanee's only public access is a boating access, Tacoma would acquire shoreline lands along Lake Kokanee to improve public recreation access and opportunities at the lake.

Tacoma would construct an additional boat ramp at Hood Canal Recreation Park to allow for greater ease and less waiting time in boat launching and retrieval. By reducing the waiting time at the ramp, problems with crowding and conflicts among anglers could be reduced. This would be a major benefit during shrimp season when use and conflicts are highest.

4.7.4 Alternative 3

4.7.4.1 Construction Impacts

Construction of Powerhouse No. 3 and recreation facilities would have the same general impacts as described under Tacoma's Proposal (section 4.7.1.1).

4.7.4.2 Long-term Impacts

Between April and September, Lake Cushman reservoir operations would be similar to those under existing conditions (section 3.7.2). Between October and March, reservoir operations would have the same recreation impacts as described in section 4.7.3.2.

Increasing the average North Fork flows to 240 cfs would substantially increase trout and salmon habitat (section 4.4.4.1). If gamefish populations respond to the habitat increases, river and marine catch rates could increase substantially. Improving hatchery production could also increase sport catch rates.

Managing 5,981 acres for wildlife in the project region would preserve that land from development, which would benefit dispersed recreational uses. Managing these lands for wildlife would benefit wildlife populations (section 4.5.4.2) and could improve opportunities for observing wildlife. If game animals respond to the habitat enhancements, hunting opportunities could also be improved in adjacent areas where hunting would be permitted.

Recreation Plan

Under this alternative, we would include the following improvements in addition to the recreation improvements included in Tacoma's recreation plan. At Site No. 1 at the Staircase Road Recreation Area (where Tacoma proposes six parking spaces for three picnic tables), Tacoma would develop three parking spaces to serve the three picnic tables proposed. By downsizing the parking area at Site 1, there may be room for a barrier-free parking space and a barrier-free picnic site. This would greatly improve universal access at the site.

Tacoma would also provide 15 dual purpose picnic and camping units, 3 tent camping units, 1 large barbecue pit, centrally located barrier-free vault restrooms, and a level parking area for up to 20 vehicles at the Bear Gulch access to help to support the use and reduce misuse at this popular informal access (Tacoma, 1990).

Until permanent recreation facilities could be constructed at the Staircase Road Recreation Area and Bear Gulch access, Tacoma would provide temporary toilets and provide for site management and monitoring in consultation with FS.

When combined with the 50-plus campsites that would be developed at the Big Creek Campground, construction of 50 camping units and supporting facilities at LCSP would relieve some of the excess demand for camping spaces at the Staircase area of ONP. Boating access at LCSP would be improved by construction of a boat launch ramp that would allow for boat launching at lower lake elevations and would provide boat access to the lake for a majority of the year under typical conditions. In addition, the 48 parking spaces to be added in the boat launch area would increase opportunities for public use of the boating facilities.

A reservation system for the proposed LCSP longhouse/day-use building would avoid potential user conflicts. Within 3 years of building completion, Tacoma should assess the adequacy of the building in meeting recreation needs in cooperation with WSPRC. If the day-use building does not adequately serve both Native Americans and the general public, a second day-use building should be constructed.

The most effective means to reduce crowding and waiting times at the marine boat launch at Hood Canal Recreation Park would be to construct an additional boat ramp to accommodate another lane of traffic. An additional ramp would significantly reduce the serious crowding problems that occur during the shrimping season and would help to meet anticipated growth in the use of this facility.

4.7.5 Alternative 4 (Decommissioning)

4.7.5.1 Construction Impacts

Because a range of decommissioning methods are possible under this alternative, a range of impacts on recreation is possible.

Assuming that the reservoirs would remain intact, decommissioning without removal of project facilities would not affect area recreation opportunities. Decommissioning with facility removal would require extensive construction activities. The movement of heavy equipment, dust, and traffic congestion could degrade the experience of recreationists visiting the project area, the ONP Staircase Campground and Ranger Station, and the Staircase Road Recreation Area.

4.7.5.2 Long-term Impacts

If the Lake Cushman water surface elevation were maintained at 738 feet and Lake Kokanee maintained at 478 feet under this alternative, the recreation value of the reservoir and the existing recreation facilities could be maintained. The benefits to the fishery and anglers would be the same as those described in Alternative 2. It is unclear, however, what entity would assume maintenance of the existing recreation facilities. These facilities could deteriorate or be expanded under new management.

The lands around Lake Cushman and Lake Kokanee have been designated as shorelines of state-wide significance under the Washington Shoreline Management Act (section 3.6.3) and are considered to be major resources for all people in the state. As part of the Mason County Shorelines Protection Policy Project, the county developed a goal for managing shorelines of state-wide significance that gives preferences to uses that increase public access to publicly owned areas of the shoreline and increase recreational opportunities for the public on the shoreline (Mason County, 1994). Through the designation and development of policies for use, the state and county have recognized the project reservoirs as resources of significance to the public. Although decommissioning with dam removal would ultimately provide some recreation resources in the area, it would mean the permanent destruction of the reservoir's recreation resources.

If the dams were removed, the reservoirs would no longer exist and the area would be returned to a river setting where future recreation may be possible. Recreationists accustomed to recreating on the reservoirs would be displaced. The valley would take decades to acquire the natural appearance that is sought by many recreationists who come to this area. The existing shoreline recreation facilities that serve the existing water levels would become much less attractive to recreationists and water-oriented facilities would be rendered inoperable. Because Lake Cushman is one of the largest lakes on the Olympic Peninsula, it would be difficult for recreationists to find similar recreation opportunities in the area. The displaced recreationists would probably go to other regional lakes, which could lead to crowding problems.

4.7.6 Lower Lake Cushman Option

If reservoir levels were maintained at or below 725 feet year-round, it would cause a significant negative impact for recreationists. Most existing recreation facilities such as boat launches, bath houses, docks, and shoreline parks would be unusable or less attractive if water levels were lowered year-round. Other structures such as bulkheads would be rendered useless and would become a year-round eyesore. Many structures would have to be relocated, removed, or rebuilt. Several boat launches are located in small bays that are protected from wind, and because existing launches would have to be extended out into less protected areas, boat launching could become more difficult at lower water levels. During public meetings held in Hoodsport (January 31, 1996) and Olympia, Washington (February 1, 1996), lessees of Lake Cushman properties stated that under the lease agreement with Tacoma, all lessees' property boundaries end at elevation 742 feet. As a result, it is unclear whether or not new facilities would be feasible or permitted in the exposed area.

The three public recreation facilities along Lake Cushman (LCSP, Dry Creek Boater Destination Park, and Deer Meadow Boater Destination Park) (figure 4-11) have amenities that would be unusable at the 725-foot reservoir elevation. Deer Meadow Park "...constructed in conjunction with the spillway project was intended to serve as a sheltered day use area for boaters to supplement the rather limited public beach opportunities for boaters around the lake. Since high boating activity and the need for day-use sites is primarily in the summer, we constructed it to serve full or very close to full lake conditions. Draw-downs of as little as four feet render the west harbor area inaccessible and draw-downs over ten feet restrict usage of the east harbor. We did not feel there was any need to make the park usable during winter draw-downs which must be at least 14 feet because of spillway capacity. Maximum usage is only possible with near full lake conditions" (letter from Steven Fischer, Senior Special Projects Engineer, Tacoma, Tacoma, Washington, September 29, 1993).

Dry Creek Boater Destination Park, a boat landing and dispersed camping area, was built to accommodate the 738-foot lake level. LCSP's boat launch, beaches, picnic sites, camping sites, swimming, and wading areas were also built to serve the 738-foot level (figure 4-12).

The four private recreation parks (figure 4-11) were built for the residents of the Lake Cushman development. The concept of private residential parks along a hydroelectric project reservoir is contrary to the Commission's and Tacoma's own recreation policies. These private parks, however, provide an important function by satisfying the recreation demand of numerous reservoir users (Lake Cushman residents and guests). These parks would not be suitable for general public use because they were not built to handle the level of traffic the public would generate. When the lake level is at 738 feet, the boat launches, docks, shoreline picnic sites, and other facilities are usable and help meet recreation demand. If the level were lowered, these parks would no longer provide the sheltered shoreline amenities that help meet demand at Lake Cushman.

Because much of the lake shoreline below elevation 730 feet is steeply sloping, grading would probably be necessary to provide safe wading beaches at the lower elevation. Also, stumps were cleared out of some beach and launch areas several years ago for safety purposes. Because stumps are also valued for fish habitat, it might be difficult to remove additional stumps from the reservoir. Recreationists, especially boaters, therefore would have greater obstacles at lower lake levels.

4.7.7 Fish Passage Option

Fish passage facilities can provide an interpretive opportunity for visitors. With a trap-and-haul system, interpretive programs would be limited to descriptive signs that could be incorporated into other project interpretive displays.

4.7.8 Staff Conclusions

Because the NPS-Tacoma and FS-Tacoma land exchanges would eliminate inundation of federal lands at normal operating levels, there would be no need to lower the reservoir level to 725 feet (section 4.7.6). We recommend that Lake Cushman be operated no lower than 738 feet during the peak recreation season (Memorial Day weekend to Labor Day weekend). This measure, a continuation of typical existing operations and included in Tacoma's Proposal and Alternatives 2 and 3, would ensure that the public recreation facilities that were built to serve Lake Cushman at 738 feet would remain usable and attractive.

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CEII

PLEASE REFER TO THE "CEII" VERSION

Tacoma's Proposal and Alternatives 2 and 3 would improve recreation facilities and increase recreation opportunities in the project vicinity. Alternative 3, however, would be the most beneficial. It includes all recreation enhancements proposed by the resource agencies as well as additional recommendations developed by the staff and would provide the largest amount of enhanced facilities and opportunities. Alternative 3 would also require more barrier-free facilities than Tacoma's Proposal or Alternative 2. Under Alternatives 1 and 4, no new or improved recreation facilities would be provided.

Decommissioning the project with dam removal would have a significant impact on both local and regional recreation opportunities and would conflict with county-developed goals for preserving shorelines within the county (section 4.7.5.2). Hence, from the perspective of recreation resources, this is the least desirable of the alternatives considered.

4.8 Aesthetic Resources

4.8.1 Tacoma's Proposal

4.8.1.1 Construction Impacts

Construction related to the new powerhouse at the base of Dam No. 2 would occur in an area that is not easily accessible or visible to the public. The noise from construction activities would be audible to people at Lake Kokanee. Construction of the substation and transmission lines required to serve the new powerhouse would be visible from Lake Kokanee and the Dam No. 1 overlook. Although the construction activities would reduce the aesthetic quality of the area, the impact would be temporary. Several residences that are near the top of the bluff overlooking the lower North Fork Canyon would experience most of the noise impacts.

Removing the McTaggert Creek diversion would temporarily create a small disturbed site (about 2 acres) directly adjacent to FS Road 2340. Because McTaggert Creek is difficult to access and does not have many viewers, the impacts are considered very minor.

Construction related to fish habitat enhancement measures in the lower North Fork, McTaggert Creek, Big Creek, and Dow Creek could increase noise levels in these areas. Instream construction would release sediments that would temporarily cloud the water.

Proposed recreation facility construction at LCSP, Big Creek, Staircase Road Recreation Area, and Hood Canal Recreation Park and the associated noise, fumes, and traffic could temporarily detract from the aesthetic quality of these areas. These impacts could affect people at several key viewing areas including: Dry Creek Boater Destination Park, Bear Gulch Recreation Area, Staircase Road Recreation Area, LCSP, Lake Cushman viewpoint, and Hood Canal Recreation Park.

4.8.1.2 Long-term Impacts

The new powerhouse (Powerhouse No. 3) would not be visible to the public; however, the 70-by-120-foot substation (to be located on the left abutment) and the 2,600-foot-long transmission line would be visible to recreationists on Lake Kokanee, visitors to the WDFW boating access, and area residents. Because the area is already developed, the impact would be only moderate.

Because reservoir operations would be unchanged, there would be no aesthetic impacts relative to existing conditions (section 3.8.3.1). Tacoma would maintain Lake Cushman at elevation 738 feet from Memorial Day to Labor Day, thereby maintaining the visual quality of the shoreline during the peak recreation season.

By removing the McTaggert Creek diversion, the small impoundment would eventually convert back into a natural flowing creek. We anticipate that, with revegetation of disturbed areas as proposed by Tacoma, the creek would regain its natural character within a few years.

Tacoma did not evaluate the aesthetics of the North Fork at flows more than 57 cfs, therefore, no specific conclusions can be made regarding aesthetics and increased flows in the bypass reach or mainstem. Views of the North Fork are extremely limited (because of difficult access in the steep-walled canyon and the lack of public lands). Increasing minimum flows in the bypass reach from 30 cfs to 100 cfs, therefore, would have little effect on aesthetic values for the general public.

Increased flows in the North Fork could affect the aesthetic character of the mainstem during the summer when mainstem flows are typically lowest. Because there would be increased sound, motion, and energy created by higher North Fork flows, visitors to the area who prefer higher flows would experience an improvement in the aesthetic quality at that time.

Tacoma's Proposal to manage 3,599 acres of land for wildlife habitat would help protect vegetation and wildlife diversity and thus preserve the natural aesthetic character of these lands. Restrictions on logging would also help to preserve natural aesthetic character.

The recreation facilities and regulations proposed for Staircase Road Recreation Area could reduce the negative aesthetic impacts from overuse and misuse of the shoreline area. Regulating and monitoring use of the area could reduce the existing fire hazard and subsequently reduce the risk of forest fire damage.

Tacoma's provision of universally accessible recreation facilities at the Lake Cushman viewpoint would provide new views of the area for the disabled and others at this key viewing location.

Tacoma proposes no enhancements for Powerhouse No. 2 penstocks, surge tank, and penstock towers. These facilities would continue to detract from the visual quality of this area, since they are visible from US 101, State Highway 106 (located on the east shore of Hood Canal), Hood Canal Recreation Park, Hood Canal, and other places including the Skokomish Delta.

Moving the Dry Creek Trailhead to join with the Copper Creek Trailhead will provide visual benefits by eliminating that portion of the trail that passes near residences.

4.8.1.3 Aesthetic Enhancement Measures

By assisting the LCDC with management and enforcement of existing covenants and by developing new covenants when necessary to manage reservoir shorelines, Tacoma would improve visual quality and help restore reservoir shorelines to a more natural state. Tacoma would help restore and maintain reservoir shorelines by assisting Mason County with enforcing the Mason

County Shoreline Management Program and monitoring for compliance, thereby benefitting Lake Cushman recreationists and shoreline residents.

Tacoma would encourage LCDC and other leaseholders on Lake Cushman Road to develop a policy to regulate use of signs and other visual detractors on Lake Cushman Road. These policies could slightly improve visual quality in the area.

By removing trash from dump sites and revegetating the ROW, Tacoma would improve scenic quality along the transmission line corridor. In addition, Tacoma's Proposal to gate the transmission line road and seasonally patrol and maintain the ROW would improve and maintain aesthetic quality in the area.

4.8.2 Alternative 1 (No Action)

Under Alternative 1, there would be few changes to the existing visual environment or the visual resources described in section 3.8. The aesthetics of the shoreline at the Staircase Road Recreation Area could continue to decline from overuse, misuse, and lack of management. Litter could continue to accumulate in the Staircase Road Recreation Area, Potlatch Road, and along the transmission line corridor. The penstocks for Powerhouse No. 2 would continue to be highly visible.

Numerous cases of abandoned campfires are reported by FS each summer in the Staircase Road Recreation Area (letter from T. Stubblefield, Forest Supervisor, FS, Olympia, Washington, May 16, 1990). Because some unregulated use could continue in this popular area, there would be continued risk that an abandoned fire could get out of control and cause a forest fire. Because the surrounding forestlands largely define the high visual quality of the reservoir setting, a major forest fire in the Staircase Road Recreation Area would leave long-term scars that would significantly change the area's aesthetic quality. Fire damage in this area would be highly visible to Lake Cushman boaters, residents of the northwest shore, and several key viewing areas (figure 3-13): Staircase Road, Staircase Road and Bear Gulch Recreation Areas, and the Dry Creek Boater Destination Park.

Under Alternative 1, parcels proposed for wildlife habitat under Tacoma's Proposal or Alternatives 2 and 3 would not be protected and could be developed in a non-visually compatible use.

4.8.3 Alternative 2

4.8.3.1 Construction Impacts

The construction of the new powerhouse, substation, and transmission line would have similar impacts on aesthetics as described in section 4.8.1.1.

4.8.3.2 Long-term Impacts

The new transmission lines associated with Powerhouse No. 3 would have the same impacts as described in section 4.8.1.2. The new substation would be located over 200 feet downstream from Dam No. 2 and would not be visible from Lake Kokanee.

Lake Cushman reservoir operations from April to September would be similar to those under existing conditions, thereby maintaining the visual quality of the shoreline during the peak recreation season. Lake Cushman would be typically higher during the remainder of the year (section 4.6.3.2). This measure would improve the aesthetic quality of the reservoir setting by reducing the amount of unattractive, unvegetated exposed shoreline.

Because no aesthetic studies were conducted on returning nearly full flows to the North Fork, no specific conclusions can be made regarding aesthetics in the bypass reach or the mainstem. Even so, the dramatic increase in North Fork flows would increase the vitality and water sounds of the river. Because views of the North Fork are limited, increasing flows in the North Fork would have the same minor aesthetic impacts as described in section 4.8.1.2.

Increased flows in the North Fork could affect the aesthetics of the mainstem, which can be viewed by recreationists and residents from several locations. Returning full flows to the North Fork would substantially increase flows in the mainstem and change the appearance of the mainstem significantly. The mainstem's increase in width, depth, water sounds, and turbulence would be noticeable and impressive.

The vegetation and wildlife enhancements under this proposal would provide the same types of aesthetic benefits as described under Tacoma's Proposal (section 4.8.1.2). Although this proposal would dedicate 15,742 acres of land to these enhancements, increasing the protected area by a factor of four, a large portion of the land (about 10,000 acres) included in Alternative 2's enhancement plan is outside of the project area. Consequently, visual benefits within the project area from enhancement lands would be slightly greater than would occur under Tacoma's Proposal.

Aesthetic impacts from recreation enhancements would be the same as would occur under Tacoma's Proposal (section 4.8.1.2). In addition, the development of a new public access at the southern portion of Lake Cushman would provide new viewing opportunities at the lake.

Removing dikes on Nalley Ranch would ultimately restore much of the original estuary character to the mouth of the Skokomish River.

4.8.4 Alternative 3

4.8.4.1 Construction Impacts

The construction of the new powerhouse, substation, and transmission line would have similar impacts on aesthetics as described in section 4.8.1.1.

4.8.4.2 Long-term Impacts

Lake Cushman reservoir operations would have the same aesthetic impacts as described in section 4.8.3.2.

Increased flows in the North Fork could affect the aesthetics of the mainstem, which is visible to the public from several locations. Releasing 240 to 400 cfs into the North Fork would occasionally noticeably increase flows in the mainstem and could modestly change the river's appearance. The mainstem would increase in width, depth, water sounds, and turbulence.

The vegetation and wildlife enhancements under this proposal would provide the same types of aesthetic benefits as described under Tacoma's Proposal (section 4.8.1.2). This proposal, however, would dedicate 5,981 acres of land, about 40 percent more land than proposed under Tacoma's Proposal, along the entire lower North Fork, the west side of both project reservoirs, and at other locations to these enhancements, thus preserving a larger portion of the Lake Cushman viewshed in natural conditions.

The recreation enhancements would provide the same aesthetic benefits as described under Tacoma's Proposal (section 4.8.1.2). In addition, the development of a new public access at the southern portion of Lake Cushman would provide new views of the lake. An additional viewpoint would provide a view of Dam No. 1, which would be visually interesting for many visitors.

Under this alternative, more universally accessible facilities would be constructed (at the Dam No. 1 overlook, Big Creek Campground, and a site in the Staircase Road Recreation Area), therefore more views would be available to the disabled.

The visual benefits of dike removal on Nalley Ranch would be the same as under Alternative 2 (section 4.7.3.2).

After consulting with the Washington SHPO to ensure that the historic character and context of the facility is preserved, Tacoma would paint the silver-colored Dam No. 2 penstocks, surge tank, and penstock towers with nonreflective natural paint colors so that these obtrusive project features would blend in better with the surroundings. This enhancement measure would reduce their prominence in the viewscape as seen from US 101, State Highway 106 (on the east shore of Hood Canal), Hood Canal Recreation Park, Hood Canal, and other places including the Skokomish Delta.

4.8.5 Alternative 4 (Decommissioning)

4.8.5.1 Construction Impacts

No construction impacts would occur if project facilities were left in place. If the reservoirs would continue to be operated as they are under existing conditions, no impacts on shoreline aesthetics would occur.

If the dams were removed, the water elevation within each reservoir basin would be lowered and a wide expanse of unvegetated land dotted with dead stumps would be exposed, thus permanently changing the visual character of the area. Impacts would be major and would persist until vegetation became re-established within the former reservoir basins. After vegetation became re-established, the old impoundment areas would blend with the surroundings.

4.8.5.2 Long-term Impacts

Project decommissioning without dam removal would have no effect on area aesthetics. Decommissioning with dam removal would convert impounded water to free-flowing water. The area would be transformed into a broad flat valley with about 10 miles of meandering river and a smaller lake (original Lake Cushman). Dam removal could be perceived as a benefit by viewers that prefer riverine settings and would be perceived as a negative impact by viewers that prefer large lake settings. Lakeshore residents, who were attracted to Lake Cushman and Lake Kokanee by the aesthetic benefits of living along a large body of water, would experience a significant negative impact.

Dam removal would eliminate the flood protection benefits that the existing project provides. Flooding events could affect the shorelines of the North Fork and mainstem and degrade shoreline aesthetics by destroying riparian vegetation and damaging the river bank.

Removal of other highly visible, obtrusive structures such as powerlines, substations, Dam No. 2 penstocks, surge tank, and penstock towers would be a major long-term benefit to aesthetic quality in the project region.

4.8.6 Lower Lake Cushman Option

Managing Lake Cushman at elevation 725 feet would have a negative impact from May until September when the lake is normally at full pool elevation (about 738 feet). Because this time period is the peak recreation season, lower reservoir levels would have a severe negative aesthetic impact.

Lowering the reservoir levels to 725 feet would expose about 278 acres of unvegetated, rocky, steeply sloping shoreline littered with stumps. At the lowest target level (700 feet in winter) an additional 470 acres would be exposed. The recreation facilities and residences that have been designed for the reservoir when it is at elevation 738 would be less attractive to recreationists and residents.

The reservoir lowering would affect many thousands of viewers a year (Lake Cushman recreationists, residents, and people traveling to the ONP Staircase Campground and Ranger Station area). These viewers have a high expectation of visual quality in the Lake Cushman area during the summer months.

If the reservoir banks could be successfully revegetated down to 725 feet, some of the visual impacts related to the lake lowering would be limited to short- to medium-term. If new recreation facilities and accesses could be built to serve the lower reservoir level, recreationists would be able to enjoy recreation activities at Lake Cushman's new shoreline areas. There would be fewer coves and inlets than there are at 738 feet, however, and the shoreline would be more uniform at the lower reservoir level.

4.8.7 Fish Passage Option

The exact locations of fish passage facilities have not been determined. As a result, it is unclear to what extent fish-collection hoppers and truck transfer areas would be visible. The gulper in Lake Cushman, however, would be visible from water and shoreline viewpoints and would be an unnatural visual intrusion in lake views.

4.8.8 Staff Conclusions

Under Tacoma's Proposal and Alternatives 1 and 3, Lake Cushman would be operated as it is currently. Alternative 2 would enhance the visual quality of the shoreline from October through March by maintaining Lake Cushman at a higher elevation (elevation 723 feet). This measure would maintain the aesthetic quality of the reservoir setting by exposing less unvegetated shoreline.

Under Alternative 3, the Dam No. 2 penstocks, surge tank, and penstock towers would be painted with non-reflective, natural-colored paint to minimize their prominence in the viewscape, as seen from several key viewing locations in the area. Tacoma's Proposal and the other project alternatives would not provide this benefit.

Increased flows in the North Fork could have a beneficial effect on the aesthetics of the mainstem by increasing its depth, turbulence, and sound. The full flows that would occur in the North Fork under Alternative 2 or 4 would provide the greatest visual enhancement to the mainstem where public access is available. Alternative 3 would, on occasion, noticeably increase flows in the mainstem and could modestly change the river's appearance. Tacoma's Proposal would have a minimal effect on mainstem aesthetics.

Lowering Lake Cushman to elevation 725 feet under Tacoma's Proposal or Alternative 2 or 3 would significantly alter the visual character of the shoreline during peak recreation months until the area was revegetated. Following restoration of shoreline vegetation, the visual quality of the area would return.

Although decommissioning with project removal would provide some positive visual changes by removing some highly visible structures, the draining of the reservoirs would permanently change the visual character of the area.

4.9 Socioeconomic Resources

4.9.1 Tacoma's Proposal

4.9.1.1 Construction Impacts

Economic benefits for the state of Washington and the communities surrounding the project area would be generated during construction from both primary and secondary economic impacts of the project. Primary economic impacts are those directly resulting from the project, such as employment payrolls. Secondary impacts are indirectly generated as the income from the direct project expenditures are spent again on other goods and services, thereby resulting in additional project-related sales and job opportunities.

The construction of a new powerhouse at Dam No. 2 would employ about 20 to 40 workers for 12 to 18 months. Removing the McTaggert Creek diversion would be completed by about 10 people in one month. Approximately 3 to 5 workers could remove the culvert barriers at Big and Dow Creeks in a little over a month. Approximately 40 to 50 workers would require 4 to 5 months to construct the recreation facilities proposed by Tacoma.

Under Tacoma's Proposal, project construction would be completed within a total of an 18-month period and would require a peak labor force of up to 105 workers. Between June 1990 and July of 1991, 502 individuals in the structural work occupations (including construction workers) were unemployed in Mason County for an average of 13.8 weeks (ESD, 1991). Given the size of the region's labor force and the consistently high unemployment rate in Mason County (section 3.9.1.2) and adjacent counties, we assume that there will be an ample supply of construction workers within the commuting distance to meet the needs of this project. Aside from project managers and a few specialty workers who may not be available locally, it is not anticipated that relocation of workers into the project area will be required.

A few additional jobs might be created in the valley as local firms provide project supplies and services; however, the amount of secondary employment generated by the project would be limited. Because the project would not employ a large number of people for an extended period of time, the short-term socioeconomic benefits to the state and regional economy would be minor. Communities in the project area, such as Shelton and Hoodsport could receive some increase in sales tax revenue and minor project-related increases in economic activity.

In the unlikely event that a small percentage of the workers choose to relocate to the project area during the construction period, available housing within a reasonable commuting distance from the job sites should be more than adequate to accommodate them. Mason County has one of the lowest housing occupancy rates (65.3 percent) of any county in the project region and a rental housing vacancy rate of 6.5 percent (OFM, 1992b).

No impact on local government services is anticipated because of the minimal in-migration of labor anticipated for construction.

To the extent that construction materials would be purchased in Mason County and the surrounding area, the project would produce an additional minor short-term sales tax revenue stream for local jurisdictions and the state. Project construction would also generate indirect sales tax revenues when project workers spend their wages. Again, this temporary revenue source would be minimal for local communities.

4.9.1.2 Long-term Impacts

Because the reservoirs would continue to be operated as they are under existing conditions, Tacoma's Proposal would have no adverse impacts on socioeconomics. With the reservoirs operating at 738 feet during the summer, they would continue to attract tourist dollars from recreationists to the region. Recreation enhancements proposed by Tacoma should benefit the local economy by providing increased recreational opportunities that could draw new visitors to the area.

Increasing North Fork minimum flows to 100 cfs should slow aggradation in the North Fork and mainstem. This measure should decrease flooding in the Skokomish River Valley. Decreasing the flood hazard would reduce adverse socioeconomic impacts from flooding in the valley, including on the Skokomish Indian Reservation.

Fisheries enhancement measures in the lower North Fork, McTaggert Creek, Big Creek, and Dow Creek would increase trout and salmon habitats (section 4.4.1). If fish populations respond to these habitat increases, angling opportunities could be enhanced in the river basin. Reservoir stocking of trout and kokanee would increase catch rates. In addition, the provision of a 100-cfs minimum bypass reach flow might enhance fish production and could subsequently improve river and marine catch rates slightly. If habitat enhancements to the North Fork and mainstem are successful in increasing Skokomish River salmon populations, there would be an incremental increase in salmon in Hood Canal that could benefit commercial fishing operations. These fisheries enhancement measures could improve catch rates for Native Americans that depend on the salmon fisheries of the river and Hood Canal for commercial fishing and subsistence.

The existing forest lands that would be dedicated to wildlife habitat would be taken out of timber production. As noted in sections 3.9.1.2 and 4.6.1, the forest products industry is a major contributor to the economic well-being of Mason County. The lands to be converted under Tacoma's Proposal are currently under private ownership. Although it is not as affected as other parts of the state, the forest products industry in Mason County has seen some shrinkage in the amount of land that is available for timber harvesting. Consequently, while comprising less than 1 percent of all forest production land in Mason County, the conversion of this land from timber production will remove more of this economic resource from the forest products business sector.

Once the recreation facility modifications were completed, the project would use essentially the same type and level of services as currently required from Mason County. New recreation facilities would not create any new risks or create any new demand for fire protection or emergency medical services. In fact, proposals to regulate and monitor use at the Staircase Road Recreation Area should improve public safety and reduce the fire hazard in this area. Although recreation uses would change in certain areas of the project because of proposed measures, these measures are not expected to influence total project visitation numbers significantly above the normal regional growth rates anticipated for recreation activities.

4.9.2 Alternative 1 (No Action)

Under Alternative 1, Mason County would be subject to the regional development and growth patterns described in section 3.6. No additional employment or income would result from implementation of this alternative.

Because the reservoirs would be operated as they are under existing conditions, the 3,000 residential lots (including over 300 lakefront properties) near Lake Cushman and Lake Kokanee would maintain their value and the residents would continue to make a major contribution to the local tax revenue. The LCDC leasehold land was appraised by the Mason County Assessor's Office in 1993 at over $34 million, not including the value of personal property built on the lands (letter from G. Barlow, Trustee, Lake Cushman Maintenance Company, Hoodsport, Washington, October 27, 1993). The tax revenue generated by these residences is important to the local economy in an area that has been hard hit by losses in timber industry jobs. Because the reservoirs would continue to be operated at 738 feet, the reservoirs would continue to attract tourist dollars from recreationists to the region.

Under this alternative, fish habitat in the North Fork and mainstem would not be enhanced and fish populations could continue to decline. This decline would have a negative impact on tribal and commercial fishing.

The project would continue to help maintain dependable, low-cost electric power.

4.9.3 Alternative 2

4.9.3.1 Construction Impacts

The construction of a new underground powerhouse at Dam No. 2 would employ 30 to 50 workers for 24 to 36 months. Modifying the Dam No. 1 intake would require about 20 people for 4 months. Approximately 20 workers would need 4 months to construct the impoundment for a wetland at upper Lake Cushman. Diversion and culvert removal at McTaggert, Big, and Dow

Creeks would require the same workers and time as discussed in section 4.9.1.1. Approximately 60 to 70 workers would require 4 to 5 months to construct the recreation facilities proposed under this alternative.

Under this alternative, project construction would be completed within a 36-month period and would require a peak labor force of 140 to 170 workers. Although Alternative 2 would require more worker-months than Tacoma's Proposal, the overall socioeconomic benefits would be minor and would be similar to those described in section 4.9.1.1.

4.9.3.2 Long-term Impacts

Lake Cushman reservoir operations from April to September would be similar to those under existing conditions, therefore, there would be no socioeconomic impacts on lakeshore land owners. Lake Cushman would be typically higher during the remainder of the year (section 4.6.3.2), thereby improving the use and enjoyment of the reservoir shoreline. The higher lake elevation would, however, reduce flood storage capacity. This could, in turn, result in more frequent or more severe flooding with associated costs in property damage higher than would occur under Tacoma's Proposal or Alternative 3.

By returning full flows to the North Fork, the ability to generate electric power from the river would be dramatically reduced. Without this source of low cost hydropower, electric utility customers would pay rates higher that those expected under Alternative 1.

Returning full flows to the North Fork would significantly slow aggradation in the North Fork and mainstem. Reducing river aggradation may ultimately decrease flooding and subsequent damages and property in the Skokomish River Valley, including on the Skokomish Indian Reservation.

Returning full flows to the North Fork would substantially change the river's character and may increase certain fish habitats. If salmon populations respond to these habitat increases, angling opportunities and commercial fishing could be enhanced in the river basin. Removing dikes on Nalley Ranch would increase the intertidal area. Dike removal could improve shellfish habitat, which could lead to improved shellfish catch rates. Marine catch rates could also improve with full flows.

The proposed fisheries enhancement measures could significantly improve catch rates for Native Americans that depend on the salmon fisheries of the river and Hood Canal for commercial fishing and subsistence. If at-risk fish populations are eliminated, this action could have a negative effect on commercial fishing.

The conversion of Richert Farm land to wildlife conservation land, by establishing a conservation easement would restrict some activities and commercial development that might otherwise occur on the property, but will not preclude continuation of agricultural activities.

Under this alternative, about 9,999 acres, 3,900 of which is privately owned, would be converted from timber production to wildlife habitat. This represents about 2 percent of all county land currently used for forest products. As discussed in section 4.6.1.2 given the decreasing amount of forest land available for timber production within the state, this land conversion would remove another portion of this important economic resource from the forest products business sector.

The socioeconomic benefits of the recreation measures under this alternative would be the same as under Tacoma's Proposal (section 4.9.1.2).

4.9.3.3 Skokomish Indian Tribe Recommendations

The Tribe has recommended several measures to mitigate the socioeconomic impacts of the project on reservation lands and the tribe. Specifically, the Tribe states that Tacoma should:

- provide $2.5 million to purchase lands to be identified and exclusively used for spiritual and traditional educational purposes by the Tribe;

- provide $1 million to mitigate the project's elimination or degradation of usual and accustomed tribal fishing, hunting, and gathering sites;

- fund the design and construction of a tribal cultural center prescribed by the Tribe;

- remove the project transmission line from within the Skokomish Indian Reservation boundaries;

- provide $3.5 million to purchase developable property from non-tribal landowners within the Skokomish Indian Reservation;

- fund studies of measures to mitigate the project's effects on the physical habitability of lands within the Skokomish Indian Reservation. Measures to be studied would include removing or modifying River Road, modifying the US 101 bridge across the Skokomish River, and upgrading and expanding reservation water and sewer systems; and

- fund studies of measures to mitigate the project's effects on the economic self-sufficiency of individual Tribe members, on the social structure of kinship groups, and on the ability of tribal government to provide basic services to the tribal community. Measures to be studied would include the funding of: individual Indian money accounts, a Tribal economic development (venture capital) trust fund, expanding and modernizing health care facilities, expanding and modernizing reservation law enforcement capabilities, an adult continuing education trust fund, a trust fund for vocational and college counseling and high school scholarships, and a Tribal on-reservation home mortgage trust fund.

Tacoma's Proposal or Alternative 2 or 3 should substantially improve the socioeconomic situation of the Tribe relative to Alternative 1. Benefits would be realized in the form of improved fish runs in the Skokomish River system, increased shellfish populations in the Skokomish Estuary, and reduced flood hazard at the Skokomish Indian Reservation. Because any of these alternatives would substantially improve Tribal socioeconomics, and because a majority of these requests bear little or no relationship to the Cushman Project, additional mitigation measures are not warranted. We do not recommend, therefore, the above mitigation measures or studies of mitigation measures.

4.9.4 Alternative 3

4.9.4.1 Construction Impacts

The construction of a new powerhouse at Dam No. 2 would employ about 30 to 50 workers for 18 to 30 months. Modifying the Dam No. 1 intake would require about 20 people for 4 months. Removing the McTaggert Creek diversion would be completed by about 10 people in 1 month. Approximately 60 to 70 workers would require 4 to 5 months to construct the recreation facilities under this alternative.

Under this alternative, project construction would be completed within a 30-month period and would require a peak labor force of 120 to 150 workers. Although Alternative 3 would require more worker-months than Tacoma's Proposal, the overall socioeconomic benefits would be minor and would be similar to those described in section 4.9.1.1.

4.9.4.2 Long-term Impacts

Lake Cushman reservoir operations would have the same socioeconomic impacts as described in Tacoma's Proposal (section 4.9.1.2).

Returning 240 to 400 cfs to the North Fork would reduce the ability to generate electric power from the river. Without this source of hydropower, electric utility customers would pay rates somewhat higher than those expected under Alternative 1.

Increasing minimum flows in the North Fork to 100 to 400 cfs could slow aggradation in the North Fork and mainstem, which could in turn help decrease flooding and associated property damage in the Skokomish River Valley, including on the Skokomish Indian Reservation.

Increasing MIFs to 240 to 400 cfs should increase trout and salmon habitats. If salmon populations respond to these habitat increases, fishing opportunities could be enhanced in the river basin within the life of the license. Marine catch rates could also improve with full flows, which could have a beneficial economic impact on the Tribe and on commercial fishing operations in Hood Canal. Removing dikes on Nalley Ranch would increase the intertidal area. Dike removal could improve shellfish habitat, which could subsequently improve shellfish catch rates.

Under this alternative, Tacoma would obtain a conservation easement for wildlife management on Richert Farm. The impacts of this action would be the same as discussed in section 4.9.3.2.

This alternative would include the conversion of 2,940 acres of privately owned land from timber production to wildlife conservation. This represents less than 1 percent of all land currently used for timber production within Mason County. While not of major significance at this time, as discussed in section 4.6.1.2, this conversion would remove more of this decreasing resource from further economic exploitation.

The socioeconomic benefits of the recreation measures under this alternative would be the same as under Tacoma's Proposal (section 4.9.1.2).

4.9.5 Alternative 4 (Decommissioning)

Decommissioning would remove this source of low-cost hydropower. Thus, electric utility customers would pay rates higher than those expected under Alternative 1.

Aside from the possible rate changes to utility customers, decommissioning without dam removal would have no significant socioeconomic effect on the region.

Decommissioning with dam removal would create short-term employment and income in the area during the construction period. Demolition and removal of each dam would take up to 2 years and employ up to 50 workers. Because the project decommissioning would not employ a large number of workers for an extended period of time, the short-term socioeconomic benefits to the state and regional economy would be minor.

The loss of Lake Cushman and Lake Kokanee could reduce the property values of about 3,000 residential units in the area surrounding the two reservoirs. More than 300 homes along the reservoirs' shores could lose their attraction and value as lakefront property. A reduction in property values would cause a reduction in tax revenue generated by the properties.

The loss of Lake Cushman and Lake Kokanee would have an adverse impact on lake-oriented tourism and would, at least temporarily, reduce the number of tourism dollars that are brought into the project area. If the reservoir basins are revegetated and the river becomes popular with river boaters and river anglers, the loss of tourist dollars from displaced reservoir recreationists would be at least partially offset.

4.9.6 Lower Lake Cushman Option

Lowering Lake Cushman under Tacoma's Proposal or Alternative 2 or 3 could negatively affect the property values of about 3,000 residential lots in the area surrounding the reservoir. The impact would be the most severe on about 250 lakeshore properties along Lake Cushman.

At the lower lake level, existing shoreline facilities would become useless and would require removal or replacement. Residential docks and bulkheads, WSPRC public boat ramps, private park boat ramps, and numerous shoreline picnic sites, both public and private, would have to be moved or rebuilt at great cost.

4.9.7 Fish Passage Option

Construction of a fish passage facility downstream from Dam No. 2 would employ about 20 workers for about 4 months. The short-term benefits of this small construction project would have minor beneficial impacts. Fish passage would likely improve fish production, which could subsequently improve catch rates for recreational anglers and Native Americans who rely on the salmon for subsistence or income.

4.9.8 Staff Conclusions

Short-term socioeconomic impacts of construction under any of the alternatives would be minor. Most workers involved with project construction would come from Mason County or commute from adjacent counties. Communities in the project area such as Shelton and Hoodsport would receive additional sales tax revenue and some minor project-related increases in economic activity.

Important long-term socioeconomic benefits from anticipated fisheries enhancements are expected under Tacoma's Proposal or Alternative 2 or 3. The fisheries improvements could benefit the Tribe and individual economic sectors (commercial and sportfishing industries) that depend on the fisheries for their well-being. Anticipated reductions in aggradation and subsequent reductions in flood hazards along the mainstem Skokomish River that would occur under Alternative 2 or 3 would also prompt long-term socioeconomic benefits to the area. The fisheries improvements and flood reduction measures would most likely benefit the Tribe. Alternative 3 would provide the most benefit without the potential risks associated with Alternative 2.

Conversion of forest production lands under Tacoma's Proposal and Alternatives 2 and 3 to wildlife conservation would contribute to the decreasing supply of timber producing lands within the state and as such could have some long-term cumulative financial consequences. The most significant negative impact would result from implementing Alternative 2, the least from implementing Alternative 1 or 4. Conversion of timber-producing lands under Tacoma's Proposal and Alternative 3, the staff-recommended alternative proposal, would have minor negative impacts on the area's economy.

Decommissioning the project, Alternative 4, with dam removal, or lowering Lake Cushman under Tacoma's Proposal or Alternative 2 or 3 could have a significant negative impact on the value of lake front property. It would also have a negative effect on tourist visitation to the area, thereby affecting tourist spending in the area.

4.10 Cultural Resources

The Commission, Tacoma, the Tribe, and other applicable agencies have executed a PA for the long-term protection and maintenance of cultural resources in the APE at the Cushman Project. The agreement states that "... the purpose of this PA is to ensure the systematic and comprehensive identification, evaluation, and consideration of the Project's effects to historic properties." Any impacts on cultural resources associated with Tacoma's Proposal or any of the alternatives would be reviewed in compliance with this PA, or under alternative procedures in compliance with the National Historic Preservation Act.

4.10.1 Tacoma's Proposal

Actions under Tacoma's Proposal that might cause new impacts on archeological resources include the removal of the McTaggert Creek diversion and re-establishment of the original stream channel. In re-establishing the stream, potential impacts could occur if the flow diverges from the original stream channel and cuts a new path. In this case the water action that creates the new stream channel could cause scouring of sites not previously identified by archeological surveys. This should not be a problem as long as the process is carefully monitored and controlled. Increasing flows to the North Fork could also have a similar effect and that action should also be monitored.

The ethnographic study compiled by Bouchard and Kennedy (Tacoma, 1995b) for Tacoma's application identifies 72 properties with historical and/or contemporary Native American cultural affiliations. A number of these properties are located in, or in close proximity to, areas proposed for various wildlife or recreation enhancements. Though it is unlikely that all of the properties are of a significance that makes them eligible for inclusion in the National Register as TCPs, it is clear that many of them continue to be used by the Tribe today. Although the proposed improvements may have no effect on these traditional cultural uses or values, Tacoma should consult with the Tribe in finalizing plans for these areas in order to ensure that traditional activities are not displaced or affected by the improvements. The PA signed between the Commission, Tacoma, and the Tribe should provide the mechanism to ensure that appropriate attention is given to all cultural resources and culturally significant properties that may be affected by the project.

Tacoma has proposed the construction of a replica Skokomish tribal longhouse/day-use center for use by both the Tribe and the public. This facility is likely to be of little value to the Tribe unless Tacoma institutes a reservation system to allow the Tribe to reserve the facility for its exclusive use for Tribal functions.

Tacoma has proposed a number of improvements to day-use facilities along Staircase Road (section 4.7.1.2). As noted in section 3.10.2.3, three log bridges were identified on Old Staircase Road that may be remainders of work completed by the CCC in the 1930's. Further investigations should be performed on these features to determine their significance and connection to the CCC. If appropriate, and in compliance with the PA, measures should be taken to ensure their protection.

Under Tacoma's Proposal a new powerhouse would be constructed in the canyon at the base of Dam No. 2. As noted in section 3.10.2.3, "Cushman Hydroelectric Power Plant No. 2" and ancillary facilities are listed in the National Register of Historic Places. Although the visibility of new structures will be extremely limited, Tacoma should consider the historic character of existing structures in developing the final design for any new above ground facilities.

4.10.2 Alternative 1 (No Action)

Under Alternative 1, conditions within the APE would remain as they currently exist and there would be no changes to the management of cultural resources.

4.10.3 Alternative 2

Under this option, full flows would be returned to the North Fork. Documentation provided in ethnographic studies of the Tribe indicate that they historically fished, and continue to fish, on the North Fork. Although studies indicate that a number of fishing holes and the lower falls were historically located on the North Fork, many of these traditional fishing sites have not been used since the mid-1930's because of the substantial reduction in salmon caused by lower river flows resulting from the diversion of water from the North Fork at Dam No. 2 (Bouchard and Kennedy, 1994). Restoration of full flows, along with the proposed fish habitat enhancements, could restore this resource for Native American use.

The mainstem, from its mouth at Hood Canal to its confluence with the North and South Forks, has been a traditional fishing resource area for at least the past century and has been identified as a possible Traditional Cultural District by Bouchard and Kennedy (Tacoma, 1995b). A higher flow in the North Fork would increase flows in the mainstem. As noted in section 3.10.2.2, the Skokomish River fishery resources are valued by the Tribe for cultural subsistence, and economic reasons. As a result, any increase in fish populations would benefit the Tribe.

Conversely, if flows were increased too rapidly, they could have an adverse effect on at-risk fish populations, the loss of which would be a significant negative impact on the Tribe's traditional fishing activities.

Under Alternative 2, the land surrounding the North Fork would be set aside for wildlife habitat, and hunting would not be allowed. This area has been identified by the Tribe as a historically important area for hunting. Restricting hunting from this area could have a negative impact on the Tribe's traditional hunting activities.

As noted in 4.10.1, Tacoma's Proposal (restoration of flows to the North Fork) could cause new impacts on archeological sites not previously identified by surveys. To prevent inadvertent destruction of sites, if they exist, archeological monitoring of the North Fork banks would be required until the river reached its natural flow level.

In addition to the North Fork improvements, this alternative calls for removing the dikes and planting waterfowl forage crops on agricultural lands at Nalley Ranch. Ethnographic studies identified this area as historically important for harvesting shellfish and various plant materials and noted that present-day Skokomish continue to fish in the river adjacent to this property. The report also noted that changes to the Nalley lands, possibly the construction of dikes by Mr. Nalley in the 1930's and subsequent cultivation of the property for agricultural crops, caused resources to diminish or disappear (Bouchard and Kennedy, 1994). Restoration of this estuary could create conditions that would increase shellfish production and, consequently, the quantity of shellfish available for harvesting. In addition, the restoration of the native plants and waterfowl forage crops to this land are likely, in time, to restore some of the property's value to Native Americans.

This alternative also proposes environmental and recreation improvements that are in close proximity to areas identified as having traditional cultural associations to the Tribe. As discussed in section 4.10.1, Tacoma should discuss enhancement plans with the Tribe prior to implementation to ensure that traditional use areas are not adversely affected.

4.10.4 Alternative 3

This alternative contains many of the same potential effects as discussed under sections 4.10.1 and 4.10.3. Though it would not provide full flows, this alternative would restore higher flows to the North Fork than Tacoma's Proposal. It would also provide wildlife habitat and fishery enhancements likely to restore salmon populations to the North Fork. This alternative could, therefore, provide significant benefits to the Tribe. Alternative 3 would include removing dikes at Nalley Ranch, and implementing estuary and shellfish enhancements at the mouth of the Skokomish River. The effects of these actions would be the same as described in section 4.10.3. It also proposes recreation enhancements for some areas that are in close proximity to properties identified as having a traditional cultural value to the Tribe. As noted in section 4.10.1, Tacoma should discuss enhancement plans and options with the Tribe prior to implementation to ensure that traditional use areas are not adversely affected.

This alternative includes the construction of a new above ground powerhouse at the base of Dam No. 2. Both Powerhouses No. 1 and No. 2 and associated facilities have been determined to be of historical significance and are included in the National Register of Historic Places. Although the proposed Powerhouse No. 3 will not be visible from most viewing locations around the historic structures, Tacoma should consider the historical character of the existing structures and design the new plant to be compatible with them.

Tacoma has expressed concern over possible impacts on an archeological site that could be affected by the staff's recommended extension of the boat ramp at LCSP. To ensure protection of extant archeological resources, Tacoma should consult with the SHPO concerning ramp design and construction methods. Considering that a ramp already exists and is actively used by the public, the proposed ramp extension should create no new adverse effects from public access to the site.

4.10.5 Alternative 4 (Decommissioning)

Under decommissioning with or without dam removal, near full to full flows would be restored to the North Fork. The effect of the restored flow would be the same as discussed under Alternative 2 (section 4.10.3).

Under decommissioning with or without dam removal, properties listed on the National Register of Historic Places could be adversely affected by either physical alteration or demolition, or through deterioration and visual degradation of project structures and surrounding grounds through neglect. To minimize these effects, the historic structures could be documented; however, an order for removal would cause their permanent destruction.

Although the title to the project facilities and structures could be transferred to an individual or entity that might preserve the historic project features, there are no assurances that such a scenario would occur. Transfer of the property would not have an adverse effect if adequate restrictions or conditions were included in the transfer to ensure preservation.

Under this alternative, the PA would not apply to any yet undiscovered historic or archeological resources that might be affected by future development activities within the project area or by bank erosion along the project impoundment.

4.10.6 Lower Lake Cushman Option

Operating Lake Cushman at a water level that is lower than current low water conditions could affect currently unknown archeological sites. Erosion, caused by the annual rise and fall of the reservoir pool at a new lower elevation, could expose previously undetected archeological sites to potential destruction both from recreationists and from the effects of natural weather conditions. To protect resources from inadvertent impacts, the shoreline would require continuous monitoring by a qualified archeologist.

4.10.7 Fish Passage Option

Construction of fish passage facilities and fish habitat enhancements in the North Fork, if successful, could also increase fish populations in the mainstem. As noted in section 3.10.2.2, the Skokomish River fishery resources are valued by the Tribe for cultural subsistence, and economic reasons. As a result, increased fish diversity and populations that could result from fish passage would be of significant cultural benefit to the Tribe.

4.10.8 Staff Conclusions

Restoring the McTaggert Creek stream channel and higher flows to the North Fork under Tacoma's Proposal or Alternative 2, 3, or 4 would ultimately provide benefits to Native Americans who use the area for its various resources. There is concern, however, that as these features are brought back to their former flow rates, unexpected changes in stream location could expose previously undetected archeological sites. To avoid affecting such resources, if they exist, Tacoma should have a qualified archeologist periodically monitor the shoreline to identify any resources that may become exposed and take the appropriate actions for their protection.

Increased flows to the North Fork that would occur with implementation of Alternatives 2, 3, or 4 could provide habitat that could increase fish production in both the North Fork and the mainstem. Since the North Fork and mainstem are traditional fishing areas of importance to the Tribe (section 3.10.2.2), any improvement that would increase fish populations would be beneficial to the Tribe. Conversely, the inadvertent elimination of any of the historically important fish populations, as could occur under Alternatives 2 and 4 if flows increased too rapidly, would be extremely negative.

A number of properties of historical significance to the Tribe were identified by Bouchard in the vicinity of locations proposed under Tacoma's Proposal and Alternatives 2 and 3 for recreation or wildlife enhancements. To ensure that improvements do not adversely affect the traditional use or cultural significance of these properties, we recommend that Tacoma work closely with the Tribe and the SHPO, as appropriate, as it develops the final plans for these areas.

Recreation improvements included in Tacoma's Proposal and Alternatives 2 and 3 in the Staircase Road area also have the potential to affect resources related to historic CCC activities. Further work needs to be completed to determine the significance of the three bridges identified as possible remainders of CCC work and to develop a management plan for them, if appropriate.

4.11 Cumulative Impacts

An action can cause cumulative impacts on the environment if its impacts overlap in space or in time with the impacts of other past, present, and reasonably foreseeable future actions. The individually minor impacts of multiple actions, when added together in space and time, can amount to collectively significant cumulative impacts. The existing environment shows the effects of past and present actions and provides the context for determining cumulative impacts of future actions.

For this cumulative impact analysis we focused on the Skokomish River Basin and its estuary in Hood Canal. In general, our recommended alternative, Alternative 3, would provide substantial cumulative benefits to fisheries, wildlife, and recreation.

4.11.1 Geology, Soils, and Channel Morphometry

By diverting water out of the North Fork, the project has contributed to cumulative geomorphic effects in the North Fork and mainstem. Simons & Associates (1993) found that historic project operation has been responsible for about half of the estimated 0.04 foot per year aggradation rate in the mainstem.

Under Tacoma's Proposal there would be minor changes in North Fork morphometry. Upstream from the McTaggert Creek confluence, channel changes, including widening and deepening to convey the new dominant discharge of 100 cfs and substrate coarsening, would probably be noticeable. Downstream from the McTaggert Creek confluence, changes would be slight. Under Alternative 1, there would be no project-induced changes in North Fork morphometry. Under Alternative 2, the North Fork channel would change dramatically, reclaiming most of the pre-project channel and coarsening substrates. Under Alternative 3, the North Fork would change moderately, increasing width and depth, and slightly coarsening substrates. Under Alternative 4 with dam removal, the North Fork would rapidly return to its pre-project form, potentially disrupting existing land use (farming) near the confluence with the mainstem. Under Alternative 4 with dam retention, effects similar to those described for Alternative 2 would occur.

Under Tacoma's Proposal and Alternative 1, the project's contribution to mainstem aggradation would continue at or near historic rates (about 0.02 foot per year). Under Alternative 2 the project would cease diverting water out of basin and aggradation rates would decline. By combining JRP-recommended measures to enhance the mainstem's conveyance capacity, with ongoing South Fork watershed restoration efforts being conducted by FS, Alternative 2 would result in long-term improvement in mainstem conveyance capacity and a reduction in the frequency and severity of out-of-bank flows. Under Alternative 3, participation in Mason County's Flood Hazard Management Plan would increase the mainstem's conveyance capacity. Channel maintenance flows or other measures would be used to maintain the enhanced conveyance capacity. Under Alternative 4 with dam removal, rapid changes in mainstem morphometry would occur. While the channel is adjusting to the 60 percent increase in peak flows, severe overbank flows could be expected, causing property damage and disrupting existing land uses. Combined with ongoing watershed restoration efforts, this alternative would gradually return the mainstem to near pre-project conditions. Persistent watershed damage, existing roads and dikes, and potential future human flood control measures, however, could slow or arrest the process. Under Alternative 4 with dam retention, the effects on mainstem morphometry would be similar to those described for Alternative 2.

4.11.2 Water Quantity

By diverting 96 percent of incoming water out of basin, the Cushman Project has profoundly affected water allocation in the Skokomish River. Under Tacoma's Proposal, the project would divert about 87 percent of incoming water out of basin. Under Alternative 1, the project would continue to divert about 96 percent of incoming water out of basin. Under Alternative 2, the project would divert about 3 percent of incoming water out of basin. Under Alternative 3, the project would divert about 71 percent of incoming water out of basin. Under Alternative 4 with dam removal, the project would cease out-of-basin diversion. Under Alternative 4 with dam retention, the project would divert about 3 percent of incoming water out of basin.

Aggradation in the mainstem has increased flood hazards for Skokomish Valley residents (Canning et al., 1988). By diverting water out of basin for power generation the project contributes to aggradation (section 4.11.1). By withholding water in Lake Cushman during downstream flooding, however, the project reduces the effects of severe flooding. Overall, the project reduces the downstream effects of severe, watershed-wide floods. Because Skokomish Valley communities and residents have adjusted to frequent, nuisance flooding and because the project has beneficial effects on the most damaging floods, we consider the project's overall effect on downstream flood hazards to be beneficial. The peak flow reduction benefits of Lake Cushman would continue under all of the alternatives considered except Alternative 4 with dam removal.

4.11.3 Water Quality

There are no anticipated cumulative impacts from continuing project operation on water quality under Tacoma's Proposal or any of the project alternatives.

4.11.4 Aquatic Resources

Past activities in the project area and elsewhere, including fishing pressure on Hood Canal anadromous stocks, Cushman Project construction, land development, and logging, have contributed to the decrease in anadromous fish diversity and production in the Skokomish River. These activities also continue to affect the fisheries.

Cumulative impacts on fisheries from Tacoma's Proposal and the proposed alternatives vary from none (no action) to long-term cumulative benefits. By providing an increased MIF, fish habitat enhancements, and fish passage facilities, it is likely that Alternative 2 would provide greater cumulative benefits to aquatic resources than Tacoma's Proposal. Alternative 2 could also, however, cause adverse impacts on fish from more flooding and cooler water temperatures in the lower North Fork. Furthermore, an abrupt change to much more dynamic habitat conditions could place anadromous stocks that are already at low levels at more severe risk of extinction. Alternative 3 would provide greater cumulative benefits than Tacoma's Proposal and Alternative 2 and without the potential adverse impacts associated with Alternative 2. Alternative 3 should cumulatively benefit Pacific Ocean, Strait of Juan de Fuca, and Hood Canal commercial, tribal, and sport fisheries. All of Alternative 3's aquatic enhancements taken together are likely to substantially increase chinook, steelhead, coho, and chum populations in the Skokomish River and in the Hood Canal.

Alternative 1 (no action) would continue existing cumulative effects and would not substantially increase benefits or adverse impacts. Alternative 4 (decommissioning) with dam removal would provide aquatic resource benefits but not as great as those under Tacoma's Proposal, Alternative 2, or Alternative 3. The adverse effects of decommissioning with dam removal, however, would be major and long-term, essentially causing loss of lake fisheries (except for a much smaller fishery that would remain in the historic Lake Cushman) and potential catastrophic erosion effects. Like Alternative 2, an abrupt change to highly dynamic habitat conditions could place some anadromous stocks at more severe risk of extinction. Decommissioning without dam removal would have substantially lower benefits because project revenues would not be accessible to improve lake tributary habitat, stock the lakes, or construct structural habitat improvements and augment spawning gravel in the lower North Fork.

4.11.5 Terrestrial Resources

Construction of the Cushman Project during the 1920's inundated an estimated 3,736 acres of upland and palustrine wetland habitat including 194 acres of palustrine forest and 88 acres of palustrine scrub-shrub vegetation along the river and historic Lake Cushman shore. Project-reduced lower North Fork and mainstem river flows, combined with previous and subsequent diking to develop lower North Fork and mainstem bottomlands for agriculture, restricted channel evolution processes important to maintaining riparian forest diversity. High rates of mature upland forest logging on private, FS, and WDNR timberlands in the subbasin and basin began in the 1940's and 1950's and has continued into the 1990's. Residential development on LCDC lands beginning in the

1960's had additionally reduced the amount of mature forest at the project by about 2,050 acres in 1990.

Because of riverine habitat losses and degradation, harlequin ducks that were formerly common on the North Fork (Tacoma, 1974) are now absent. The loss of valley bottomlands to the project and agricultural developments has reduced available winter habitat for Roosevelt elk. Old-growth forest losses have undoubtedly caused substantial marbled murrelet, spotted owl, and fisher population reductions in Skokomish River Basin.

To lessen or reverse these impacts, resource entities in the basin are changing their land management practices. FS has restricted timber harvests and is implementing measures to enhance mature forest development and old-growth wildlife (USDA and DOI, 1994). WDNR has restricted timber harvests on sensitive lands at Lilliwaup Swamp and is in the process of developing a new management plan for the area (letter from Bonnie B. Bunning, Region Manager, WDNR, Enumclaw, Washington, November 8, 1994). The Tribe has fostered efforts to coordinate land management activities in the basin (Skokomish Indian Tribe, 1994).

In addition to reversing adverse impacts on the lands it includes, Tacoma's Proposal would complement and interact with these other resource management measures to enhance terrestrial resources on adjacent lands. Protecting the Westside parcel would provide a buffer for spotted owls and marbled murrelets nesting on nearby ONF lands. Moreover, protection of the Dow Mountain and LCSP parcels would provide a buffer for elk and other sensitive wildlife on Lilliwaup Swamp parcel lands.

Additional lands included in Alternative 3 would further complement and interact with land management actions to reverse adverse impacts on terrestrial resources in the basin. This alternative would protect migration corridors and winter range for the Skokomish elk herd that summers on ONF lands in the South Fork sub-basin. By protecting a wide buffer along the entire lower North Fork, it would provide a continuous dispersal corridor for wildlife and vegetation. Concurrently, it would enhance anadromous fishery forage resources for wildlife along the river from dam No. 2 to the estuary, where estuary restoration would further enhance wildlife habitats.

In addition to the cumulative benefits under Alternative 3, by acquiring the Lilliwaup Swamp parcel, Alternative 2 would keep private inholding development and continuing timber harvests from disturbing Lilliwaup elk herd migration corridors and winter range along with valuable wetland habitats in the Special Management Zone. Furthermore, acquiring the Belfair Wetlands parcel would combine with WDFW's and Hood Canal Land Trust's management of adjacent properties to protect a continuous block of estuarine habitats at the Union River mouth.

In contrast to the benefits of Tacoma's Proposal and Alternatives 2 and 3, continued logging and residential development on the proposed parcels under Alternatives 1 and 4 would exacerbate past habitat and wildlife losses and reduce the effectiveness of management improvements on adjacent FS and WDNR lands.

4.11.6 Land Use

The amount of land available for timber harvesting and forest products in Washington State has been decreasing, especially over the past few years because of recent environmental concerns. Implementing wildlife habitat enhancements proposed under Tacoma's Proposal or Alternative 2 or

3 would convert land actively used for timber production to wildlife habitat. The conversion of forest land to wildlife conservation land is significant when viewed in the context of the cumulative reduction in the availability of this resource within the state. Tacoma's Proposal and Alternative 3 would have only minor effects on timber resources because they would each convert less than 1 percent of all timber-producing land in the county. Alternative 2 would convert about 2 percent of county timber-producing lands to wildlife habitat and would therefore have a greater negative effect. Alternatives 1 (no action) and 4 (decommissioning) would have no effect on timber producing lands.

Residential development along waterways in western Washington is increasing and removing more land from a natural state. By dedicating shoreline uses along Lake Cushman and Lake Kokanee to wildlife habitat and recreation, as proposed under Tacoma's Proposal or Alternative 2 or 3, residential growth along these reservoirs would slow and the value of the shorelines as natural lands and wildlife habitat would be preserved. Alternatives 1 and 4 would not provide any protective measures to preserve natural areas.

4.11.7 Recreation Resources

The Skokomish River Valley is a popular recreation destination with numerous attractions including the Staircase area of ONP, the upper North Fork, National Forest lands, Lake Cushman, Lake Kokanee, and Big Creek. Recreation facilities proposed by Tacoma and included under Alternatives 2 and 3 would provide a cumulative benefit by supplying quality facilities to meet the demand for recreation opportunities in the area. The increased size and number of facilities would also serve to accommodate some visitor overflow from other area destinations. Alternative 3 would provide the most recreation enhancements and new facilities and therefore the greatest cumulative benefits. Tacoma's Proposal and Alternative 2 would also enhance facilities and provide cumulative benefits, but to a lesser extent than Alternative 3. Alternative 1 would provide no new recreation resources and would not change usage patterns or level of use at existing regional recreation facilities. Decommissioning with dam removal would have a serious adverse effect on regional recreation opportunities because facilities designed for the existing Lake Cushman and Lake Kokanee shorelines would no longer be functional. Recreationists displaced by this action would probably seek recreation opportunities at other regional facilities, which could cause overcrowding or overuse.

In addition to the more formal recreation areas and activities noted above, the Lake Cushman area is also a destination for fishers and hunters. Wildlife habitat enhancement and protection areas proposed under Tacoma's Proposal and Alternatives 2 and 3 should provide long-term benefits to wildlife with the result of increased wildlife populations. As a result, hunting opportunities are expected to increase along with opportunities for recreationists to view wildlife in its natural environment. Habitat enhancement and increased flow in the North Fork under Alternatives 2 and 3 should provide similar benefits to fish populations thereby creating greater opportunities for fishing. Tacoma's Proposal would have a minimal change on fisheries and Alternatives 1 and 4 would have no recreation enhancements.

4.11.8 Aesthetic Resources

Prior to project construction, the broad valley of the upper North Fork was characterized by a free flowing river, a small natural lake (original Lake Cushman), water falls, rapids, and pools. With the construction of the hydropower facilities and subsequent logging and residential, agricultural, and recreational development of the area, a continually increasing amount of land has been removed from its natural state. In addition, logging activities in the project vicinity have also contributed to the loss of natural landscapes. The dedication of lands for wildlife habitat under Tacoma's Proposal or Alternative 2 or 3 would prevent some further loss of the natural environment by ensuring that little or no development would occur within those specific areas.

Alternative 2 would protect the largest amount of land from development. Consequently, from a cumulative perspective, Alternative 2 would provide the greatest visual benefit to the region. Almost two thirds of the acreage proposed for protection under Alternative 2, however, is outside of the immediate project area viewshed and the more localized aesthetic benefits within the project area would be almost identical to those that would occur under Alternative 3. With less acreage to be protected, the local aesthetic benefits of Tacoma's Proposal would be slightly less than those that would occur under Alternative 2 or 3. Alternatives 1 and 4 would not protect any lands in their natural state.

4.11.9 Socioeconomic Resources

The lands set aside for wildlife enhancements under Tacoma's Proposal and Alternatives 2 and 3 would be permanently removed from timber production and agricultural use, or other developed land use. Of particular concern from a socioeconomic perspective is the removal of commercial forest land used for timber production. This reduction in revenue-generating lands dedicated to the forest products industry is significant when viewed as part of the increasingly restricted supply of this resource on a state-wide basis. Alternative 2 would have the greatest negative effect on the forest products industry because it would remove about 2 percent of all land in Mason County in timber production from this use. Tacoma's Proposal and Alternative 3 would remove less than 1 percent of all county land in timber production and would, therefore, have only a minor negative impact on this industry. Alternatives 1 and 4 would have no effect on the timber products industry.

By improving fish habitat and the Skokomish Estuary, fish production should improve in the Skokomish River and possibly in Hood Canal and Puget Sound. Increased productivity in these waters would improve subsistence and commercial catch rates for the Tribe and the commercial fishing industry. The greatest benefit to this resource would be anticipated under Alternative 3. Although Alternative 2 could ultimately improve fisheries resources in the North Fork and mainstem, this alternative could also eliminate or severely deplete Skokomish River anadromous fish populations. Consequently, Alternative 2 could have significant negative impacts on the commercial fishing industry. Increased flows and habitat improvements in the North Fork proposed under Alternative 3 should increase fish production and provide substantial benefits to the commercial fishing industry without the risk associated with Alternative 2. Tacoma's Proposal would provide fewer improvements than Alternative 3 and, consequently, fewer cumulative benefits. Alternatives 1 and 4 (with the dam retained) would provide no fisheries enhancements and therefore no benefits. Alternative 4 with dams removed would have the same risks as Alternative 2 and would provide no enhancements.

4.11.10 Cultural Resources

Relatively few archeological studies have been done on the Olympic Peninsula of Washington and little information exists concerning its prehistoric occupants. Archeological information gathered for this project will contribute to the cumulative knowledge of regional prehistoric people and activities.

4.12 Unavoidable Adverse Impacts

This section identifies the unavoidable adverse impacts that would occur with implementation of staff-recommended Alternative 3.

Under Alternative 3, minor long-term entrainment impacts in the Lake Kokanee intake structure would continue.

Construction of new project facilities and habitat enhancement measures would clear more than 50 acres of mixed forest vegetation and would temporarily disturb some wildlife. Periodic maintenance of the transmission line ROW and lower North Fork instream habitat enhancement structures would require periodic vegetation clearing and would also temporarily disturb wildlife.

Under Alternative 3, about 2,940 acres of privately owned land devoted to the forest products industry would be converted from commercial use to wildlife conservation land and 798 acres of Richert Farm would be converted from forestry and agricultural production.

Alternative 3 would close the Staircase Road Recreation Area to overnight use. The loss of shoreline camping opportunities would be mitigated by the construction of new camping facilities at Big Creek Campground and LCSP.

4.13 Irreversible and Irretrievable Commitment of Resources

Under Alternative 3, a majority of the lands and waters previously committed for power production would continue to be used for that purpose. In addition, the new Powerhouse No. 3 and transmission lines would commit an additional 3.5 acres to this use. Implementing our flow recommendation would irretrievably commit waters for fishery, recreational, and visual enhancement away from power production. Implementing our wildlife habitat enhancements would irretrievably commit 5,981 acres of land to this use and away from forestry, agricultural, recreational, and residential uses.

5.0 DEVELOPMENTAL RESOURCES

In this section, we analyze the project's use of water resources for hydropower purposes, provide our estimate of the economic benefits of the proposed project and the alternatives, and review the effects of environmental protection or enhancement measures on project economics.

In section 4.0, we analyzed recommendations made by Tacoma, the resource agencies, and others for mitigating, protecting, or enhancing nondevelopmental resources affected by the Cushman Project. Environmental enhancement measures would affect the project in several ways, including: (1) adding costs to the project for constructing facilities or conducting studies, (2) limiting diversions for power generation, and (3) changing the project's dependable capacity rating. All of these effects translate into economic costs.

The project's generating capacity varies among alternatives. The various MIF options would affect the water available for generation and thus affect annual generation. We used a daily operations model to estimate the average annual generation for each alternative (table 5-1). Annual energy loss and capacity loss for each alternative are also presented in table 5-1. The analysis presented in this section for Tacoma's Proposal and for Alternatives 2 and 3 assumes that a new powerhouse would be constructed at the base of Dam No. 2. The size of the powerhouse varies among the alternatives.

5.1 Water Resource Development

The Cushman Project was constructed in essentially two phases: Dam No. 1 was built in 1925-26 and Dam No. 2 was built in 1929-30. Tacoma added a third generator to Powerhouse No. 2 in 1952, increasing capacity from 54 MW to 81 MW. The project is an important part of Tacoma's generating system, providing operation to meet load-following and peak demand period needs (section 1.4.2). As part of the PNCA, project operations are coordinated with the operations of other utilities to meet regional firm capacity needs.

Tacoma currently holds state water rights to 1,000 cfs for hydropower generation purposes. State water right applications for 2,500 cfs are pending (section 3.3.1.3).

The estimated mean annual flow of the North Fork at Dam No. 2 is approximately 784 cfs. Since construction of the project in the 1920's until July 1988, all discharge from Lake Kokanee at Dam No. 2 was routed out of the North Fork Basin through the power tunnel and penstocks to Powerhouse No. 2, which discharges into Hood Canal. During this period, seepage and tributaries provided the only water to the North Fork channel below Dam No. 2. Since July 1988, the project has been operated to pass 30 cfs down the North Fork below Dam No. 2. Since then, most interested parties have suggested that Tacoma increase flows in the North Fork channel and correspondingly reduce flows diverted out of the North Fork Basin through Powerhouse No. 2. Increased flows downstream from Dam No. 2 would enhance fish habitat in the lower North Fork.

5.1.1 Tacoma's Proposal

Tacoma proposes to increase the MIF below Dam No. 2 to 100 cfs year-round with specific seasonal pulse flow releases and flushing flow releases (section 2.3.2). These flow releases in the

Table 5-1. Mean annual Cushman Project generation (MWh), annual energy loss (MWh), and capacity loss (MW) under each alternative with Lake Cushman water level and fish passage options.[1]

Alternative	Lake Cushman water level and fish passage options[2]											
	Base			A			B			C		
	Generation	Loss		Generation	Loss		Generation	Loss		Generation	Loss	
		MWh	MW		MWh	MW		MWh	MW		MWh	MW
Tacoma's Proposal	332,000	11,000	2	324,000	19,000	5	332,000	11,000	2	324,000	19,000	5
Alternative 1 (No Action)	343,000	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alternative 2	203,000	140,000	62	195,000	148,000	63	203,000	140,000	62	195,000	148,000	63
Alternative 3	293,000	50,000	5	285,000	58,000	8	293,000	50,000	5	285,000	58,000	8
Alternative 4 (Decommissioning) — retain project facilities	0	343,000	101	0	343,000	101	0	343,000	101	0	343,000	101

1 Source: the staff.
2 Base - Manage Lake Cushman as proposed in the alternative and do not provide fish passage.
A - Maintain Lake Cushman water level below 725 feet.
B - Provide fish passage.
C - Maintain Lake Cushman water level below 725 feet and provide fish passage.
NA = Not applicable

North Fork channel would be made through a new 1.3-MW powerhouse at the base of Dam No. 2 or through an alternative release facility.

On average, 784 cfs would pass through Powerhouse No. 1, 684 cfs would be diverted to Powerhouse No. 2, and 100 cfs would pass through Powerhouse No. 3. Because Powerhouse No. 3 would have about 280 feet less head than Powerhouse No. 1, annual generation would decrease from 343 GWh to 332 GWh (table 5-1).

5.1.2 Alternative 1 (No Action)

Under Alternative 1, no changes would be made to existing project facilities or operations. On average, about 784 cfs would pass through Powerhouse No. 1 and 754 cfs would be diverted to Powerhouse No. 2. Average annual generation would be about 343 GWh.

5.1.3 Alternative 2

Under this alternative, Tacoma would cease out-of-basin diversion except to the extent necessary to provide downstream flood protection. A new powerhouse (Powerhouse No. 3) with a generating capacity of 16 MW and a hydraulic capacity of 1,300 cfs (section 2.5.1.1) would be constructed at the base of Dam No. 2. Alternatively, a release facility could be provided.

On average, 765 cfs would pass through Powerhouse No. 1, 22 cfs would be diverted to Powerhouse No. 2, and 682 cfs would pass through Powerhouse No. 3. Project annual generation would decrease from 343 GWh under Alternative 1 to 203 GWh.

5.1.4 Alternative 3

An MIF schedule, ranging from 240 to 400 cfs (table 2-5) would be implemented in the lower North Fork. Powerhouse No. 2 would continue operating on a reduced scale. A new powerhouse (Powerhouse No. 3) would be constructed at the base of Dam No. 2 to release the MIF. This new powerhouse would have a generating capacity of 3 MW and a hydraulic capacity of 240 cfs. Alternatively, a release facility could be provided.

An average of 784 cfs would pass through Powerhouse No. 1, 534 cfs would be diverted to Powerhouse No. 2, and 237 cfs would pass through Powerhouse No. 3. Alternative 3 would decrease project annual generation from 343 GWh under Alternative 1 to 293 GWh.

5.1.5 Alternative 4 (Decommissioning)

5.1.5.1 Removal of Project Facilities

Under this decommissioning scenario, the project dams, flowlines, and powerhouses would be removed and the hydropower generating capability of the Cushman Project would not be used. There would be no out-of-basin diversions to Hood Canal.

5.1.5.2 Retaining Project Facilities

Under this decommissioning scenario, hydropower generating facilities of the Cushman Project would not be used. This would discontinue the use of the flow line to Powerhouse No. 2, except perhaps for flood flow release conditions. There would be essentially no out-of-basin diversions to Hood Canal and the 343 GWh now produced annually at the project would have to be procured from another source.

5.2 Costs of Alternatives

The cost of alternatives includes capital improvement costs as well as operation and maintenance (O&M) costs that are incurred annually. Capital costs are construction costs, study costs, and other costs that occur over the initial portion of the license period. The costs shown in tables 5-2, 5-3, and 5-4 do not include lost generation. For the economic analysis, each project alternative includes $25,400,000 (letter from Paul H. Svoboda, Natural Resources Manager, Light Division, Tacoma, Tacoma, December 5, 1994), which is the latest available value of undepreciated project debt and sunk relicensing costs, which are amortized over 30 years in our economic evaluation. We presented costs in 1996 dollars.

5.2.1 Tacoma's Proposal

An itemized cost estimate for Tacoma's Proposal is presented in table 5-2. The capital cost of Tacoma's Proposal would be about $22,306,000, including construction costs for the new 100-cfs Powerhouse No. 3 at the base of Dam No. 2 and all of the environmental mitigation and enhancement capital improvement costs. Significant costs in Tacoma's Proposal include an estimated $6,700,000 for a new powerhouse at the base of Dam No. 2 to pass a MIF of 100 cfs and $12,100,000 for wildlife habitat enhancements.

Table 5-2. Cost estimate for Tacoma's Proposal (1996 dollars). [1]

Cost items	Estimated capital cost	Estimated O&M cost	Estimated annual total for capital and O&M costs
Existing project facilities	---	1,920,000	1,920,000
Powerhouse No. 3 (100 cfs)	6,700,000	27,000	567,000
McTaggert Creek diversion removal	66,000	---	5,000
Recreation improvements	1,370,000	187,000	297,000
Lake Cushman fish stocking	1,300,000	252,000	357,000
Fish habitat enhancements	770,000	20,000	82,000
Wildlife habitat enhancements	12,100,000	205,000	1,180,000
Total	22,306,000	2,611,000	4,408,000

[1] Sources: the staff; Tacoma, 1991c; Tacoma, 1992a; Tacoma, 1993a; letter from Paul H. Svoboda, Natural Resources Manager, Light Division, Tacoma, Tacoma, Washington, December 5, 1994; Tacoma, 1996; appendix C.

5.2.2 Alternative 1 (No Action)

There would not be any capital improvement costs associated with Alternative 1.

5.2.3 Alternative 2

An itemized cost estimate for Alternative 2 is presented in table 5-3. The capital cost of this alternative would be about $167,252,000, including $32,000,000 in construction costs for the new 1,300-cfs Powerhouse No. 3 at the base of Dam No. 2 and $119,000,000 for wildlife habitat enhancements. The majority of the wildlife habitat enhancement cost is for purchasing lands. Also included is $5,600,000 to modify Dam No. 1 intake to withdraw water from the upper strata of Lake Cushman in the summer and $8,350,000 for lower North Fork anadromous fish stocking.

Table 5-3. Cost estimate for Alternative 2 (1996 dollars). [1]

Cost items	Estimated capital cost	Estimated O&M cost	Estimated annual total for capital and O&M costs
Existing project facilities	---	1,190,000	1,190,000
Powerhouse No. 3 (1,300 cfs)	32,000,000	156,000	2,735,000
McTaggert Creek diversion removal	66,000	---	5,000
Recreation improvements	1,420,000	194,000	308,000
Modify No. 1 intake	5,600,000	31,000	482,000
Lower North Fork anadromous fish stocking	8,350,000	616,000	1,289,000
Fish habitat enhancements	105,000	---	9,000
Wildlife habitat enhancements	119,000,000	870,000	10,460,000
Shellfish enhancements	711,000	1,190,000	1,247,000
Total	167,252,000	4,247,000	17,725,000

[1] Sources: the staff; Tacoma, 1990; Tacoma, 1991c; Tacoma, 1992a; Tacoma, 1993b; Tacoma, 1996; appendix C.

5.2.4 Alternative 3

Table 5-4 shows an itemized cost estimate for Alternative 3. The capital cost of this alternative would be about $57,882,000, including an estimated $12,500,000 in construction costs for the new 240-cfs Powerhouse No. 3 at the base of Dam No. 2 and $27,400,000 for wildlife habitat enhancements. We also included $5,600,000 to modify the Dam No. 1 intake to withdraw water from the upper strata of Lake Cushman in the summer, $1,300,000 for Lake Cushman resident fish stocking, $3,600,000 for lower North Fork anadromous fish stocking, and $5,000,000 for the cost of Tacoma's participation in Mason County's Flood Hazard Management Plan. The line item labelled "Miscellaneous" includes geomorphic and fish habitat studies; stream gage installation, upgrading, and operation; dissolved gas monitoring; construction and maintenance of two bridges at Richert Farm; fish and wildlife enforcement; and archeological monitoring at McTaggert Creek and the North Fork.

Table 5-4. Cost estimate for Alternative 3 (1996 dollars).[1]

Cost items	Estimated capital cost	Estimated O&M cost	Estimated annual total for capital and O&M costs
Existing project facilities	---	1,920,000	1,920,000
Powerhouse No. 3 (240 cfs)	12,500,000	77,000	1,084,000
McTaggert Creek diversion removal	66,000	---	5,000
Recreation improvements	1,730,000	206,000	345,000
Modify No. 1 intake	5,600,000	31,000	482,000
Lake Cushman resident fish stocking	1,300,000	252,000	357,000
Lower North Fork anadromous fish stocking	3,600,000	271,000	561,000
Fish habitat enhancements	105,000	---	9,000
Wildlife habitat enhancements	27,400,000	334,000	2,542,000
Participation in MCFMP	5,000,000	---	403,000
Miscellaneous	581,000	95,000	142,000
Total	57,882,000	3,186,000	7,850,000

[1] Sources: the staff; Tacoma, 1990; Tacoma, 1991c; Tacoma, 1992a; letter from Paul H. Svoboda, Natural Resources Manager, Light Division, Tacoma, Tacoma, Washington, December 5, 1994; Tacoma, 1993a; Tacoma, 1996; appendix C.

5.2.5 Alternative 4 (Decommissioning)

5.2.5.1 Removal of Project Facilities

Removal of the project facilities and rehabilitation of the areas of the dams and reservoirs would be an action of considerable scope (section 2.7.1.1). Based partly on estimated costs to remove the Elwha Hydroelectric Project (FERC Project No. 2638) and the Glines Canyon Hydroelectric Project (FERC Project No. 588), which are also on the Olympic Peninsula, we estimated that the cost of such action on the Cushman Project would be of the magnitude of $100,000,000. This cost could vary considerably depending on the extent of rehabilitation work including sediment removal.

Because project removal would have significant environmental impacts and because of Lake Cushman's importance to flood control, recreation, and lakeside residents, it is not likely that project facilities would be removed. We therefore did not evaluate the economic effects of facilities removal further.

5.2.5.2 Retaining Project Facilities

This alternative would represent a minimum capital expenditure to conclude project power generation. The estimated capital cost to remove the turbine-generator units from both powerhouses would be $400,000. Project operations would probably be similar to those under Alternative 2, except without power generation.

5.2.6 Lowered Lake Cushman Water Level Option

This option would limit the maximum level in Lake Cushman to elevation 725 feet to keep the reservoir outside of the present boundary of ONP. Historically, the maximum lake level has been 738 feet through the summer. Approximately $50,000 would be included under this option to modify existing docks around Lake Cushman to accommodate this reduced lake level. Table 5-1 shows the effect for each alternative of elevation 725 feet on annual project generation.

5.2.7 Fish Passage Option

We considered fish passage that would provide transport for upstream and downstream migrants for each alternative. A fish "gulper" system (appendix C) in Lake Cushman would collect fish for transport below Dam No. 2. A trap-and-haul facility would be located below Dam No. 2 to collect fish for transport upstream to Lake Cushman. The capital cost of these fish passage facilities would be about $9,000,000 and the estimated annual cost to operate the facilities would be about $210,000. The proposed fish passage facilities would not use significant amounts of water and, therefore, would not greatly affect annual project generation.

5.2.8 Summary of Annual Costs

A summary of annual costs for alternatives is presented in table 5-5. This summary considers total annual cost of each alternative by including the value of generation and capacity loss. For this evaluation, replacement power has a current value of $21.00 per MWh to account for energy and capacity (Tacoma, 1996). In the current cost analysis, these values were fixed over the 30-year term and not annually escalated.

5.3 Economic Comparison

To facilitate comparison among alternatives, we used a net benefit analysis. Net benefits represent savings to the ratepayer over replacement energy available to Tacoma. Net benefit is the difference between the value of replacement energy and the cost the project incurs to generate the equivalent amount of energy. Hydropower generation (table 5-1) as well as capacity value are the only benefits considered in this analysis. We discussed and evaluated other benefits of the project such as flood control, fish habitat, wildlife habitat, recreation, and historic preservation in section 4.

We based our economic analysis on our daily operations model, staff-developed improvement costs, and economic data submitted by Tacoma (letter from Paul H. Svoboda, Natural Resources Manager, Light Division, Tacoma, Tacoma, Washington, December 5, 1994, and Tacoma, 1996). We assumed all capital improvement costs, studies, and planning would occur in a 2- to 3-year period beginning in 1996. We based our assumptions on Tacoma's input of construction schedule and the identified scope of the alternatives. All recurring costs associated with increased operational, maintenance, and monitoring activities are assumed to begin in 1996 and run for the duration of a 30-year license. (The actual license term will be determined by the Commission and could be 30, 40, or 50 years.) All costs are based on Tacoma's or the staff's estimates and are reported in 1996 dollars. We assumed a discount rate of 7 percent for present value calculations.

We used a current cost approach to comparing the cost of the project under various alternatives to the cost of a likely source of alternative power, as required by the Commission's

Table 5-5. Total annual cost of Tacoma's Proposal and project alternatives. [1]

Base alternative	Annual cost ($)[2]	Annual energy loss (MWh)[3]	Capacity loss (MW)[3]	Annual value of generation and capacity loss ($)[4]	Total annual cost of alternative ($)
Tacoma's Proposal	4,408,000[5]	11,000	2	231,000	4,639,000
Alternative 1 (No Action)	1,920,000[6]	0	0	0	1,920,000
Alternative 2	17,725,000[7]	140,000	62	2,940,000	20,665,000
Alternative 3	7,850,000[8]	50,000	5	1,050,000	8,900,000
Alternative 4 (Decommissioning) — retain project facilities	432,000	343,000	101	7,203,000	7,635,000
Options[9]					
Maintain Lake Cushman water level below 725	4,000	8,000	3	168,000	172,000
Provide fish passage	935,000	0	0	0	935,000

[1] Source: the staff.
[2] Levelized capital cost plus O&M cost (does not include cost of $25,400,000 existing project debt).
[3] From table 5-1.
[4] Based on $21.00 per MWh for energy and capacity value.
[5] From table 5-2.
[6] Existing O&M cost.
[7] From table 5-3.
[8] From table 5-4.
[9] Applicable to Tacoma's Proposal, Alternative 2, and Alternative 3.

order in Mead Paper Corp., 72 FERC Para. 61,027 (1995). Under this method, no assumptions are made concerning future escalation or de-escalation of various costs of producing project power or alternative power, such as fossil fuels and maintenance. The analysis is not entirely a first year analysis as certain costs, such as major capital investments, would not be expensed in a single year. The maximum period used to annualize such costs is 30 years. Also, some future expenses, such as tax depreciation expenses are known and measurable.

Project costs include all costs associated with capital improvement, O&M, and indirect functions associated with the facility. We discussed improvement costs in more detail in section 5.2. O&M costs are a function of annual generation and installed capacity as well as the extent of environmental mitigation and enhancements.

We included annual O&M costs of $400,000 in 1996 dollars in Alternative 4 (retain project facilities) to provide maintenance of the dams, flowlines, and powerhouses. Actual O&M costs of decommissioning could be more or less than this estimate.

Table 5-6 provides a summary comparison of the effects that the proposed project and each alternative package would have on power generation, costs, and annual net benefit. Alternative 1 (no action) is the base case.

Table 5-6. Comparison of effects of proposed project and alternatives on power generation, costs, and annual net benefit.[1]

	Tacoma's Proposal	Alternative 1 (No action)	Alternative 2	Alternative 3	Alternative 4 (Decommission)
Incremental capital cost (1996 $)	22,306,000	0	167,252,000	57,882,000	400,000
Incremental annual O&M cost (1996 $)	691,000	0	3,057,000	1,266,000	(1,520,000)
Annual energy loss (MWh)	11,000	0	140,000	50,000	343,000
Capacity loss (MW)	2	0	62	5	101
Annual value of generation loss (1996 $)	231,000	0	2,940,000	1,050,000	7,203,000
Annual power value (1996 $)	6,972,000	7,203,000	4,263,000	6,153,000	0
Annual total costs (1996 $)	6,852,000	4,030,000	21,934,000	10,590,000	2,619,000
Annual net benefit (1996 $)	120,000	3,173,000	(17,671,000)	(4,437,000)	(2,619,000)

[1] Source: the staff.

5.3.1 Tacoma's Proposal

Under Tacoma's Proposal, the average annual generation would be about 332,000 MWh. The project's dependable capacity would be about 99 MW. The resulting annual power value in 1996 dollars is estimated to be about $6,972,000 at 21.0 mills/kWh.

The incremental capital cost of Tacoma's Proposal, including all proposed environmental enhancement measures, is estimated to be about $22,306,000. Incremental annual O&M costs are estimated to be $691,000. The annual total project costs would be about $6,852,000 or 20.6 mills/kWh. The project's annual net benefit would be about $120,000 or 0.4 mills/kWh. Compared with Alternative 1, Tacoma's Proposal would reduce the project's annual net benefit by $3,053,000 (96.2 percent).

5.3.2 Alternative 1 (No Action)

Alternative 1 would be the continued operation of the project under the terms and conditions of the existing license, with no new environmental protection or enhancement measures, and provides the basis for comparison for the proposed project and for alternatives. Average generation would be about 343,000 MWh per year. The project's dependable capacity would remain at 101 MW. The annual power value in 1996 dollars is estimated to be about $7,203,000 at 21.0 mills/kWh.

There would be no additional capital construction or O&M costs associated with Alternative 1; total annual costs would be about $4,030,000 or 11.7 mills/kWh. The project's annual net benefit would be about $3,173,000 or 9.3 mills/kWh.

5.3.3 Alternative 2

For Alternative 2, the average annual generation would be about 203,000 MWh. The project's dependable capacity would be about 39 MW. The resulting annual power value in 1996 dollars is estimated to be about $4,263,000 at 21.0 mills/kWh.

The incremental capital cost of Alternative 2, including all recommended environmental enhancement measures, is estimated to be about $167,252,000. Incremental annual O&M costs are estimated to be $3,057,000. The annual total project costs would be about $21,934,000 or 108.1 mills/kWh. The project's annual net benefit (loss) would be about ($17,671,000) or (87.1 mills/kWh). Operation of the project under Alternative 2 would provide no annual net benefit and would actually cause a loss (negative net benefit) because high costs exceed reduced generation benefit.

The environmental benefits of Alternative 2 include minimized out-of-basin diversions and enhancements to fisheries, wildlife, and recreation resources. Although we agree with some aspects of these recommendations, on balance, we find they are inconsistent with the comprehensive development standard of Section 10(a) of the FPA.

5.3.4 Alternative 3

With our recommended enhancement measures, the average annual generation would be about 293,000 MWh. The project's dependable capacity would be about 96 MW. The resulting annual power value in 1996 dollars is estimated to be about $6,153,000 at 21.0 mills/kWh.

The incremental capital cost of Tacoma's Proposal with staff modifications, including all recommended environmental enhancement measures, is estimated to be about $57,882,000. Incremental annual O&M costs are estimated to be $1,266,000. The annual total project costs would be about $10,590,000 or 36.1 mills/kWh. The project's annual net benefit (loss) would be about ($4,437,000) or (15.1 mills/kWh). Compared with Alternative 1, our proposal would reduce the project's annual net benefit by $7,610,000 (239.8 percent).

The environmental benefits of our recommendations include reduced out-of-basin diversions and enhancements to fisheries, wildlife, and recreation resources. We conclude that our mix of developmental and nondevelopmental resources provides a better balance of resources than other alternative enhancement and mitigation recommendations.

5.3.5 Alternative 4 (Decommissioning)

Under this alternative, with the retain project facilities option, project structures would remain in place and a minimum capital expenditure would be made to conclude project power generation. The turbine-generator units would be removed from both powerhouses at an estimated capital cost of $400,000. Project operations would probably be similar to those under Alternative 2, except without power generation. Incremental annual O&M costs are estimated to be ($1,520,000) (i.e., cost reduction, not incremental cost increase), with $400,000 allocated annually to maintenance of existing structures. There is no project annual net benefit because, by definition, the benefit of generation is removed. The estimated loss is less than that for Alternatives 2 and 3, as shown in Table 5-6.

5.3.6 Conclusion

Alternative 1 (no-action) provides no environmental enhancement. Alternative 3 with our recommendations provides more environmental enhancement than the measures proposed by Tacoma. We believe that Alternative 2 with most JRP-recommended conditions does not represent an appropriate balancing of developmental and non-developmental resources, pursuant to Section 10(a) of the FPA.

Based on our independent analysis of the Cushman Project, we conclude that the existing project with our recommended mitigation and enhancement measures would be in the public interest of balancing developmental and nondevelopmental resources.

Our evaluation of the economics of our recommended alternative shows that it appears to cost more than currently available alternative power. As explained in Mead, supra, project economics is only one of the many public interest factors that we consider in determining whether or not, and under what conditions, to issue a license. We leave to Tacoma the decision of whether or not to continue operating the project under the new license.

6.0 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a) of the FPA require the Commission to give equal consideration to all uses of the waterway on which a project is located and to ensure that any project licensed will be best adapted to a comprehensive plan for improving or developing the waterway. When the Commission reviews a hydropower project, the recreation, fish and wildlife, and other non-developmental values of the waterway are considered equally with its electric energy and other developmental values. In deciding whether and under what conditions a hydropower license should be issued, the Commission must weigh the various economic and environmental values involved in the decision.

Based on our independent analysis of all relevant information, agency consultation, and comments received from the parties, we conclude that there are seven principal resource objectives, some of which conflict with each other, which are relevant to relicensing the Cushman Project. The principal issues we identified are:

- maintaining production of non-polluting, renewable electrical energy;
- preserving the project's lake environments for recreational and residential uses;
- increasing the diversity and production of anadromous fish in the North Fork and mainstem, and enhancing recreational, commercial, and subsistence fisheries based on the basin's anadromous fish;
- maintaining the project's flood protection benefits;
- enhancing wildlife habitat and protecting wildlife populations;
- improving sediment transport and ceasing and reversing channel aggradation in the Skokomish River; and
- protecting cultural resources.

For this EIS, we evaluated a wide range of possible alternatives to address these issues (section 4). Tacoma's Proposal (section 2.3) would involve some project works upgrades, a new 1.3-MW powerhouse at the base of Dam No. 2, higher MIFs for the lower North Fork (a minimum of 100 cfs), a substantial wildlife enhancement plan, and other environmental enhancements at the project.

In addition to Tacoma's Proposal for relicensing the project, we considered Alternative 1, no action, which is defined as a continuation of current conditions and operations. We used Alternative 1, no action, to establish a baseline for comparing the environmental effects of each alternative. We also developed three additional alternatives with varying levels of environmental enhancements:

- Alternative 2 (section 2.5) is adapted from the recommendations of several resource agencies and the Tribe;

- Alternative 3 (section 2.6), a staff-developed alternative; and
- Alternative 4, decommissioning the project with and without dam removal (section 2.7).

Table 2-1 summarizes components of Tacoma's Proposal and the project alternatives, and table 5-6 provides a comparison of costs.

In addition to the above alternatives, we considered the option of maintaining Lake Cushman water level below 725 feet should the land exchange with the NPS not be completed. This option could be available under any of the alternatives except Alternative 1, no action.

The following sections summarize each alternative's environmental long-term cost and impacts. The final sections present our findings and discuss consistency with fish and wildlife agency recommendations and with comprehensive plans.

6.1 Comparative Environmental Impacts of Alternatives

Tacoma's Proposal and each alternative would have both beneficial and adverse environmental effects that are relevant to the Commission's decision. Important distinctions among the alternatives are summarized in the following sections and in table 6-1. In section 4, we presented detailed discussions of these impacts.

6.1.1 Geology, Soils, and Channel Morphometry

The principal geology and soils effects involve construction-related erosion and sedimentation, and downstream channel morphometry changes, including mainstem aggradation. Decommissioning the project with dam removal would create other issues associated with bank stabilization and stream channel reconstruction.

Tacoma's Proposal and Alternatives 2 and 3 include construction of a new powerhouse (Powerhouse No. 3) at the base of Dam No. 2. To minimize adverse erosional effects, all construction activities would be conducted in conformance with a Commission-approved ESCP. Undertaking construction in accordance with this plan would minimize erosion and sedimentation to the best extent possible. Because there would be no new construction under Alternative 1, the minor effects of erosion and sedimentation would be avoided. Alternative 4 would have the highest potential erosion and sedimentation impacts because decommissioning the project with dam removal would entail substantial demolition, revegetation, and channel reconstruction. Detailed plans would be needed to minimize these effects.

Tacoma's Proposal would measurably increase flows and sediment transport capacities in McTaggert Creek, and the lower North Fork. McTaggert Creek and the lower North Fork would deepen slightly to convey the increased dominant discharge and substrates would coarsen slightly due to the increased sediment transport capacity. Only slight (probably unmeasurable) effects on channel morphometry in the mainstem are anticipated as a result of Tacoma's Proposal.

Table 6-1. Comparison of environmental impacts between Tacoma's Proposal and proposed alternatives.[1]

	Alternatives				
	Tacoma's Proposal	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Decomm.)
Fluvial processes					
Channel morphometry	Little or no change.	No change.	Substantial undefined dynamic effects in North Fork. Moderate beneficial effects in mainstem.	Moderate beneficial effects in North Fork. Minor beneficial effects in mainstem.	Similar to Alternative 2.
Aggradation	The project would continue to contribute to North Fork and mainstem aggradation.	Same as Tacoma's Proposal.	Substantial substrate coarsening and degradation in North Fork. Reduced mainstem aggradation rate by 0.02 foot per year.	Minor substrate coarsening effects in North Fork. No change in mainstem.	Similar to Alternative 2.
Skokomish Estuary morphometry	The project would continue to slightly affect estuary morphometry by reducing large sediment delivery rates.	Same as Tacoma's Proposal.	Removing the Nalley Ranch dikes would increase number of tidal channels and coarsen intertidal substrates. Increased flows would deliver more and larger substrates to the estuary.	Removing the Nalley Ranch dikes would increase number of tidal channels and coarsen intertidal substrates.	Increased flows would deliver more and larger substrates to the estuary.
Mainstem flooding	Flood frequency and magnitude would remain at current levels.	Same as Tacoma's Proposal.	Flood frequency and magnitude would remain at current levels. Channel improvements would improve flood conveyance capacity and would eventually lessen future flood impacts.	Flood frequency and magnitude would remain at current levels. A reduction in peak flows, combined with conveyance capacity enhancements, should reduce mainstem flood hazards.	Flood magnitude would roughly double, substantially increasing flood damage. The reduced rate of mainstem aggradation would eventually lessen future flood impacts.
Water quantity					
Average discharge to Powerhouse No. 1	784 cfs	784 cfs	765 cfs	782 cfs	NA
Average discharge to Powerhouse No. 2	684 cfs	754 cfs	22 cfs	555 cfs	NA
Average discharge to lower North Fork	100 cfs	30 cfs	762 cfs	229 cfs	784 cfs (with dams removed)
Average mainstem flows	1,218 cfs	1,148 cfs	1,881 cfs	1,348 cfs	2,000 cfs (with dams removed)

Table 6-1. (continued)

	Alternatives				
	Tacoma's Proposal	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Decomm.)
Water quality					
Lake Kokanee temperature	Slight decrease in summer.	Elevated summer water surface temperature.	Adjustable or modified intake construction would avoid impacts.	Minor.	With dam removal, NA; without dam removal, substantial decrease in summer.
Lower North Fork temperature	Decrease late winter through summer; slight increase in autumn and early winter.	Approach natural seasonal patterns.	Adjustable or modified intake construction would avoid impacts.	Same as Alternative 2.	With dam removal, return to normal; without dam removal, substantial decrease late winter through summer and slight increase in autumn and early winter.
Lower North Fork turbidity: short term	Minor increase.	No change.	Manageable risks of acute or chronic turbidity increases until channel equilibrium is reached.	Minor increase during construction and until channel equilibrium is reached.	With dam removal, may be significant depending on sediment management scenario used; without dam removal, moderate increase.
Lower North Fork turbidity: long term	Periodically turbid during pulse flows.	No change; mainstem periodically turbid during high runoff.	Minor increases until channel equilibrium is reached and during higher flows and floods.	Occasionally turbid during pulse flows.	Both with and without dam removal, may be significant until channel equilibrium is reached and during higher flows and floods; with dam removal, may be significant depending on sediment management scenario used.
Aquatic resources					
Lake fisheries					
Lake water levels	Summer lake level management would increase salmonid littoral production.	No change.	Same as Tacoma's Proposal.	Same as Tacoma's Proposal.	Without dam removal, no change.
Fish habitat	Barrier removal would provide 22 miles of upstream spawning and rearing habitat in Lake Cushman and 12 miles in Lake Kokanee.	No change. (Limited tributary spawning and rearing habitat in Lakes Cushman and Kokanee.)	Same as Tacoma's Proposal.	Same as Tacoma's Proposal.	No change.
Lake fish production and angler catch rates	Kokanee and cutthroat stocking would enhance lake production and angler catch rates.	No change in current kokanee and cutthroat production or angler catch rates.	Same as Tacoma's Proposal.	Same as Tacoma's Proposal.	Without dam removal, no change. With dam removal, lake fisheries dramatically reduced.

	Alternatives				
	Tacoma's Proposal	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Decomm.)
River fisheries					
Minimum flows	Increased MIF substantially increases salmon and trout habitat for spawning, juvenile, and adult life stages. Little side-channel habitat would be watered and full existing channel would not be wetted. "Pulse" flows enhance coho and steelhead outmigration.	No change. Low flows would continue to limit anadromous fish habitat and production.	More dynamic aquatic and riparian system. Adverse effects from winter floods would increase. If channel excavation is required chronic fine sediments could reduce fish production.	240-cfs MIF would increase anadromous fish habitat and encourage more species diversity by providing more habitat for species requiring greater depths and velocities, would wet full existing channel, and would flood more side-channel habitat.	Effects similar to Alternative 2. Habitat disruption could jeopardize salmon stocks already at very low levels.
Temperature	Cooler temperatures shorten cutthroat rearing season.	No change. Water temperatures are suitable.	Adjustable or modified intake construction would avoid reduced temperatures.	Same as Alternative 2.	Without dam removal, similar to Alternative 2. With dam removal, similar to upper North Fork temperatures.
Accumulated sediments	Improved spawning, fry development, and fish food production in the canyon reach below Dam 2 from fine sediment flushing.	No change. Fine sediment deposited below Dam 2 would continue to degrade spawning habitat, fry development, and aquatic insect production.	Similar to Tacoma's Proposal.	Similar to Tacoma's Proposal.	Without dam removal, no change. With dam removal, increased sediment. Potential for chronic low-level sediments or catastrophic erosion effects.
Gravel augmentation	Improved spawning above McTaggert Creek.	No change. Poor spawning gravel recruitment in lower North Fork above McTaggert Creek.	Similar to Tacoma's Proposal.	Similar to Tacoma's Proposal with higher flows providing greater potential benefits.	Without dam removal, no change. With dam removal, restored gravel recruitment would improve spawning habitat.
Fish habitat	Total habitat increases by about 11 percent. Structural habitat improvements enhance salmonid spawning, rearing, and adult staging habitat for coho, chinook, and steelhead in the lower North Fork. Improved coho rearing habitat downstream from McTaggert Creek with side-channel construction.	No change. Lack of instream cover and structural diversity for chinook, coho, and steelhead rearing and adult holding habitat for chinook and steelhead. Little side-channel habitat.	Total habitat increases by about 47 percent. More diverse natural instream structure. Structural habitat enhancements would be redesigned for new design flows and channel structure to improve rearing and adult staging habitat for coho, chinook, and steelhead in the lower North Fork.	Total habitat increases by about 26 percent. Side-channels watered without excavation.	Similar to Alternative 2 but with no funds available for other fishery enhancements.
McTaggert Creek	Diversion removed to restore McTaggert Creek flow, and spawning gravel and woody debris (fish cover) recruitment to improve fish habitat.	No change. Flow and spawning gravel and woody debris recruitment to McTaggert Creek remain limited.	Same as Tacoma's Proposal.	Same as Tacoma's Proposal.	No change (with or without dam removal).

	Alternatives				
	Tacoma's Proposal	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Decomm.)
Lower Falls passage	Lower falls modified to improve anadromous fish passage.	No change. Anadromous fish passage impeded by lower falls, except for steelhead.	Lower falls passage could be achieved year round except August, fish production would increase.	240 cfs flows with falls modification, if needed, could provide passage of lower falls.	Without dam removal, passage of lower falls possible with higher flows. With dam removal, passage to upper North Fork possible.
Hatchery support	No change.	No change. Tacoma would continue current levels of support.	Tacoma would support state-of-the-art gene conservation hatchery. Benefits uncertain.	Hatchery support to increase abundance and diversity of anadromous fish.	Funds for hatchery support unavailable.
Estuary	Negligible change. Delta recession would continue near-current rates.	No change. Estuary delta would continue receding at current rates.	There would be short- and long-term sediment increases, and the delta would prograde. Brackish and saline marsh and mudflat would be restored, and there would be long-term habitat benefits for shellfish, salmon, and marine fisheries.	There would be minor short-term sediment increases with essentially no delta recession or progradation Brackish and saline marsh and mudflat restoration and long-term habitat benefits for shellfish, salmon, and marine fisheries would be similar to Alternative 2.	Sediments would increase and the delta would prograde with or without dam removal. If the Nalley Ranch dikes were also breached or removed, then marsh and mudflat restoration and habitat benefits for fisheries would be similar to Alternative 2.
Terrestrial vegetation and wildlife enhancements	Would protect aquatic resources and improve fish cover, juvenile rearing areas, fish food production, and large woody debris recruitment along upper lower North Fork.	No change.	Would protect and improve juvenile rearing areas, fish food production, and large woody debris recruitment along entire lower North Fork. Wetland in upper Lake Cushman would improve juvenile rearing habitat and aquatic insect production.	Would protect and improve juvenile rearing areas, fish food production, and large woody debris recruitment along entire lower North Fork.	No enhancement benefits.
Terrestrial resources					
Riparian habitats	Short-term damage to 6 to 7 acres of terrestrial riparian habitat but long-term protection of more than 5 miles of riparian corridor.	Would not protect or enhance terrestrial riparian habitats.	Short-term damage to more than 100 acres of terrestrial riparian habitat but long-term protection of almost 11 miles of riparian corridor.	Short-term damage to dozens of acres of terrestrial riparian habitat but long-term protection of almost 11 miles of riparian corridor.	Without dam removal, similar to Alternative 2. With dam removal, similar to Alternative 2 and would restore about 10 miles of riparian corridor.
Wetlands	Would protect and enhance 222 acres of palustrine wetland habitats and associated wildlife.	Would not protect or enhance wetlands.	Would protect and enhance 1,139 acres of palustrine wetland habitats and wildlife and 776 acres of estuarine wetlands.	Would protect and enhance 459 acres of palustrine wetland habitats and wildlife and 624 acres of estuarine wetlands.	Similar to Alternative 1.
Mature forest	Would protect and enhance 1,782 acres of mature forest habitats and associated wildlife.	Would not protect or enhance mature forest habitats and wildlife.	Would protect and enhance 7,841 acres of mature forest habitats and wildlife.	Would protect and enhance 2,249 acres of mature forest habitats and wildlife.	Similar to Alternative 1.

	Alternatives				
	Tacoma's Proposal	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Decomm.)
Elk	Would protect only the margins of migration corridors.	Large portions of migration corridors and winter range would be at risk of loss to logging and development.	Would protect migration corridors and winter range for both Lilliwaup and Skokomish elk herds.	Would protect Skokomish elk herd migration corridor and winter range.	Similar to Alternative 1.
Threatened and endangered species	Would provide buffer between LCDC land developments and marbled murrelets and spotted owls nesting on adjacent ONF lands. Would also protect some potential future murrelet and owl habitat.	No protection of bald eagles, marbled murrelets, or spotted owls.	Same as Alternative 3 except that it would protect much more potential future habitat for murrelets and owls.	Same as Tacoma's Proposal but would protect more potential future murrelet and spotted owl habitat. Would also protect the most heavily used bald eagle winter roost in the vicinity.	Similar to Alternative 1.
Land use					
Land use conversion	3,599 acres converted from forestry and other uses to wildlife habitat.	No change.	15,742 acres converted from forestry, agriculture, and other uses to wildlife habitat.	5,981 acres converted from forestry, agriculture, and other uses to wildlife habitat.	No change.
Recreation					
	Some enhancement to recreation resources.	No change.	Greater enhancement to recreation resources.	Greatest enhancement to recreation resources.	Without dam removal, no change. With dam removal, significant loss of opportunities.
Aesthetics					
	Habitat parcels would preserve natural character.	No change.	Habitat parcels would preserve natural character.	Habitat parcels would preserve natural character.	Without dam removal, no change. With dam removal, significant negative impact.
Socioeconomics					
Job creation	Construction could take up to 1.5 years and employ up to 105 workers.	No new employment.	Construction could take up to 3 years and employ up to 170 workers.	Construction could take up to 2.5 years and employ up to 150 workers.	With dam removal, could employ up to 50 workers for up to 2 years.
Property values	No change to values of shorefront properties.	No change.	No change to values of shorefront properties.	No change to values of shorefront properties.	Without dam removal, no change. With dam removal, shorefront property values could drop.
Forest products	Would remove less than 1% of county land dedicated to timber products from use by the industry.	No change.	Would remove about 2% of county land dedicated to timber products from use by the industry.	Similar to Tacoma's Proposal.	No change.

	Alternatives				
	Tacoma's Proposal	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Decomm.)
Commercial and subsistence fishing	Fish habitat enhancement could increase fish catch rates.	No change.	Restoration of full flows to North Fork should increase fish populations.	Should increase fish and shellfish populations and catch rates.	Same as Alternative 2.
Cultural resources					
Archeological sites	Re-introduction of flows to McTaggert Creek could cause scouring of undetected sites.	No change.	Same as Tacoma's Proposal.	Same as Tacoma's Proposal.	Same as Tacoma's Proposal.
Historic structures	No change.	No change.	No change.	No change.	Could have negative impact through neglect, deterioration, or removal. Would change historic context of facilities.
Traditional cultural use areas	Possible indirect negative impact on some traditional use areas.	No change.	Possible negative impacts on at-risk fish populations in the proposed Salmon Fishing Sites TCP District. Probable improvement in estuary habitat and shellfish populations in the proposed Procurement Sites TCP District.	Possible indirect negative impact on some traditional use. Probable improvement in fish population in the proposed Salmon Fishing Sites TCP District and to shellfish populations in the proposed Procurement Sites TCP District.	No change.

[1] Source: the staff.

NA = Not applicable.

Under Alternative 1, no action, channel aggradation and associated problems with channel conveyance capacity and fish habitat deficiencies would continue in the lower North Fork, McTaggert Creek, and the mainstem.

Alternative 2 would have dramatic effects on the lower North Fork. The channel would undergo a series of changes likely to include deepening and widening, substrate coarsening, and island and side-channel formation, and would reclaim much of the pre-project channel within the life of the license. Aggradation rates in the mainstem would be reduced by about 0.02 foot per year on average (Simons & Associates, 1993).

Alternative 3 would have moderate effects on the lower North Fork channel. The channel would probably deepen, substrates would coarsen, and side channels and islands would probably form. Tacoma would participate in implementing Mason County Flood Hazard Management Plan projects, which should measurably enhance the mainstem's conveyance capacity and reduce flood hazards.

Alternative 4, decommissioning the project, without dam removal would produce flow and channel morphometry conditions similar to those described under Alternative 2. Removing the dams would further increase peak flows, resulting in larger and more rapid channel morphometry changes in the lower North Fork and mainstem, but would also dramatically increase flooding.

Under Tacoma's Proposal or any of the alternatives, maintaining Lake Cushman water levels below 725 feet would temporarily increase the area susceptible to erosion and increase the sediment load to the lake until the reservoir's slopes were revegetated. Provision of fish passage facilities would cause localized, minor, short-term erosion effects on soil resources.

6.1.2 Water Quantity

Tacoma's Proposal and Alternatives 2 and 3 would result in more water flowing in the lower North Fork and less water available for diversion to Powerhouse No. 2 for power generation than under no action, Alternative 1 (table 6-1). Under Alternative 1, about 4 percent of project inflows would be discharged to the lower North Fork. Tacoma's Proposal would return 13 percent of natural flows to the lower North Fork. Alternative 2 would return about 97 percent of the natural flows to the lower North Fork and Alternative 3 would return about 32 percent of natural flows to the lower North Fork. Decommissioning the project with or without dam removal would completely eliminate power production at the project resulting in the return of 100 percent natural flows to the lower North Fork.

Tacoma's Proposal and Alternatives 2 and 3 include upgrading project facilities to increase Powerhouse No. 2's hydraulic capacity to approximately 2,940 cfs. This is a 240-cfs increase over existing conditions.

Maintaining a lower Lake Cushman water level would reduce generation at Powerhouse No. 1 by about 8 GWh per year under each alternative. If the additional available storage could be used to attenuate floods, minor flood reduction benefits would be provided downstream. The same effects would occur under each alternative.

The Cushman Project has long-term beneficial effects on peak flows downstream from the project. Peak flows would be similar under all of the alternatives except decommissioning with dam removal (Alternative 4), which would increase flows by about 60 percent. Alternatives 2 and 3 would have the most significant beneficial effects on downstream flood hazards because they combine the peak flow reducing effects of the project with mainstem conveyance capacity enhancement. Because of the long-term channel maintenance benefits provided by frequent near-flood flows in the mainstem, Alternative 2 would provide the highest flood hazard reduction benefits of the alternatives considered. These benefits would, however, result in a significant loss of hydropower generation (section 5.1.3).

6.1.3 Water Quality

There are two water quality issues associated with project operations - the potential for project spills or powerhouse discharges to contain supersaturated concentrations of atmospheric gasses (an agency concern) and the potential for increased MIFs to cause undesirable water temperature effects in Lake Kokanee and the lower North Fork. Under Tacoma's Proposal and Alternatives 2 and 3, we considered gas supersaturation to be unlikely in the North Fork downstream from Powerhouse No 3 and the Dam No. 2 spillway during high spill flows. Although it is unlikely, because of project design, that gas supersaturation would occur, the recommended monitoring would be an extremely low-cost and short-term measure. The recommendation would not have a significant negative effect on the project purpose, nor would the expense of implementing it have any significant economic effect on the feasibility of the project. We therefore recommend that Tacoma monitor dissolved gasses at all powerhouses, outfalls, and spillways during spill events.

Under Alternative 1, no action, Lake Kokanee summer water surface temperature would continue to be elevated. The 30-cfs MIF for the lower North Fork would continue to have little supersaturation potential, and water temperature would continue to approach natural seasonal patterns.

Under Tacoma's Proposal we anticipate that lower North Fork summer water temperatures would decrease by 1.0 to 2.5°C, resulting in temperatures of about 9 to 12°C. These temperatures are near optimal for fish rearing and growth. Lake Kokanee summer water temperature would decrease slightly.

Under Alternatives 2 and 3, however, higher flow releases would likely create suboptimal summer water temperature conditions (5 to 6°C water temperatures) for aquatic life in Lake Kokanee and downstream. We recommend that Tacoma develop and install an adjustable or modified intake for Powerhouse No. 1 to selectively withdraw warmer water from Lake Cushman and ensure near-optimal summer water temperatures for salmonid growth in Lake Kokanee and in the North Fork downstream from Dam No. 2.

6.1.4 Aquatic Resources

Tacoma's Proposal would substantially enhance aquatic resources but to a lesser extent than Alternative 2 or 3. Under Tacoma's Proposal, adverse impacts would include construction impacts and minor entrainment impacts in Lake Kokanee, which would be mitigated by lake stocking. The potential for false attraction of adult fish to Powerhouse No. 2 would be the highest under this alternative because the highest flows would be discharged from Powerhouse No. 2 to Hood Canal.

Under no action, Alternative 1, 30-cfs MIF for the lower North Fork might continue to improve anadromous fish production in the short term but enhancement would ultimately be limited by flow and suitable habitat. Lake fisheries would probably not improve. Existing conditions of aquatic resources would not change and there would be no opportunities to improve lake fisheries and increase anadromous fish diversity and production.

Alternative 2 compares favorably to other alternatives with regard to realizing benefits of moderate long-term enhancements such as lake level management and lower North Fork MIF and structural habitat enhancements. Dynamic flow and habitat features created by restored flows in the lower North Fork could affect steelhead and coho survival. Though the alternative has short-term but manageable risks of water quality impacts or habitat disruption, in the long run, it is likely to benefit aquatic resources more than the other alternatives.

Alternative 3's provision of 240-cfs MIF to the lower North Fork would provide a major, long-term benefit to the river's fisheries by greatly improving flow-related habitat conditions and providing salmon passage of the lower falls. These measures, coupled with anadromous fish stocking would substantially increase anadromous fish production potential and are more likely to increase diversity than Tacoma's Proposal.

Decommissioning without dam removal is much like Alternative 2, creating a more dynamic aquatic and riparian environment with greater adverse impacts from floods. Project revenues would not be available to carry out fishery enhancement measures.

6.1.5 Terrestrial Resources

Powerhouse construction, fisheries enhancements, and recreation improvements under Tacoma's Proposal would clear 19 to 22 acres of native vegetation. Tacoma's Proposal would protect and enhance 7,617 acres of land and water including mature and old-growth forest, wetlands and riparian areas, and the margins of elk migration corridors, but it would not include elk winter range or habitats frequently used by threatened and endangered species. Tacoma's Proposal would have modest to moderate benefits for bald eagles, marbled murrelets, and spotted owls. Overall, Tacoma's Proposal would substantially benefit terrestrial resources in the project vicinity.

Under Alternative 1, Tacoma would continue to clear all trees and shrubs in the transmission line ROW, and reservoir fluctuations would continue to prevent the development of wetland vegetation along the shore. Without protection, the amount of mature forest vegetation on enhancement parcels would decrease 30 percent and the number of HUs for the HEP wildlife species would decrease an average of 25 percent. There would be slight adverse impacts on bald eagles under this alternative. Overall, no action would have substantial adverse effects on terrestrial resources in the project vicinity.

Under Alternative 2, powerhouse construction, fish habitat enhancements, and recreation improvements would clear or disturb 35 to 40 acres of vegetation and high instream flows would displace an additional 98 acres of riparian and upland forest. This alternative would protect and enhance 19,689 acres of land and water including mature and old growth forest, habitats used by threatened and endangered species, large areas of wetland and riparian habitat, and virtually all elk migration corridors and winter range in the project vicinity. Although this alternative could have short-term adverse effects on bald eagles, it also has potentially substantial long-term benefits for eagles, murrelets, and spotted owls. Alternative 2 would, overall, immensely benefit terrestrial resources in the project vicinity.

Powerhouse construction, fisheries enhancements, and recreation improvements under Alternative 3 would clear 34 to 37 acres of native vegetation and would protect and enhance a total of 9,999 acres of land and water including elk winter range and migration corridors, wetlands and riparian areas, mature and old growth forest, and habitats used by threatened and endangered species. This alternative would have substantial potential benefits for bald eagles, marbled murrelets, and spotted owls. Overall, Alternative 3 would significantly enhance terrestrial resources in the project vicinity.

The effects of decommissioning without dam removal would be similar to the effects of no action, except that vegetation would be allowed to grow in the transmission line ROW if this area wasn't developed, and osprey nests on transmission towers would be eliminated. The additional effects of decommissioning with dam removal would be uncertain. Several acres of vegetation at the dam sites would be disturbed by demolition activities, and full river flows would displace about 98 acres each of lower North Fork riparian and upland forest. Lake habitat reductions would adversely affect ospreys, but would benefit riverine species. Herbaceous ground cover would be established on the exposed lake beds as they are drawn down, but the subsequent vegetation and effects on wildlife depend on unknown land use scenarios. Decommissioning would likely have minor adverse effects on bald eagles. Overall, decommissioning would probably have substantial adverse effects on terrestrial resources in the project vicinity.

6.1.6 Land Use

The land exchanges between Tacoma and NPS and Tacoma and FS could occur under any of the alternatives. The land exchanges would give Tacoma ownership of all ONP and ONF lands that could potentially be inundated by Lake Cushman. NPS would acquire ownership of inholdings within the ONP boundary. FS would acquire lands at Dry Creek. If the NPS-Tacoma land exchange does not occur, then Lake Cushman could be maintained below 725 feet to avoid project inundation of ONP lands. Lowering Lake Cushman to elevation 725 feet, under Tacoma's Proposal or any of the alternatives, would have severe long-term adverse impacts on recreation and residential land uses abutting the reservoir. Alternative 4 with dam removal would also have a severe negative effect on the use and enjoyment of shoreline recreation areas and residences.

Under Alternatives 1 and 4, lands in the project vicinity could continue to be developed and used for recreation, residences, timber production, and agriculture. Under Tacoma's Proposal and Alternatives 2 and 3, large parcels of land in the project vicinity would be converted from current uses to wildlife protection areas. Although there would be significant benefits from preserving the proposed parcels in a natural state, there would also be negative effects from this action. Alternative 2 would have the most significant adverse effect because it would convert the largest amount of land from productive commercial timber and agricultural use to wildlife habitat. Although it would have only minor effects on agricultural and timber production lands, Tacoma's Proposal would provide the least amount of wildlife habitat. Alternative 3 would provide the most significant benefits by protecting a large amount of land as wildlife habitat with only minor effects on agricultural and timber production lands. Under Alternative 4, it is uncertain whether lands would be preserved for wildlife.

6.1.7 Recreation Resources

Tacoma's Proposal and Alternatives 2 and 3 would increase overnight camping opportunities by constructing new camping units at Big Creek Campground. Alternative 3 would provide the most overnight camping opportunities by also constructing units at LCSP and at Bear Gulch access. New facilities and improvements (toilets, picnic tables, parking, trail improvements, bath house, boating and universal access) would enhance recreation opportunities at Staircase Road Recreation Area, LCSP, Lake Cushman viewpoint, and Hood Canal Recreation Park.

Under Alternative 1, overuse and misuse of the Staircase Road Recreation Area and crowding at boat launches at southern portions of Lake Cushman and Hood Canal Recreation Park would continue. The project reservoirs and the lower North Fork would continue to provide a declining, marginal sport fishery.

Tacoma's Proposal and Alternatives 2 and 3 would increase flows in the lower North Fork and increase fish and wildlife habitat in the project area. If fish populations respond to the habitat enhancements, along with stocking in project reservoirs, angling and hunting success could improve. Though it would not provide as high MIFs as Alternative 2, Alternative 3 is anticipated to provide significant benefits to the North Fork's recreational fishery without risk to those populations. Removing the Nalley Ranch dikes under Alternatives 2 and 3 would increase the intertidal area and could increase shellfish habitat and catch rates.

Under Alternatives 2 and 3, boat mooring and launch facilities and universal access would be further enhanced over Tacoma's Proposal. Under Alternative 1 or Alternative 4, no new facilities would be constructed.

If Lake Cushman were maintained at or below 725 feet on a permanent basis under any of the project alternatives, most existing recreation facilities such as boat launches, docks, and shoreline parks would be unusable or less attractive to recreationists. If Lake Cushman were maintained at 738 feet under the decommissioning alternative, the recreation value of the reservoirs and existing facilities could be maintained. Decommissioning with dam removal would displace reservoir recreationists to other regional lakes, which could lead to crowding at other regional facilities. In time, however, as the river and Lake Cushman regained their original configurations, new recreation opportunities would evolve.

6.1.8 Aesthetic Resources

Under Alternative 1, the aesthetics of the shoreline at the Staircase Road Recreation Area could continue to decline from overuse, misuse, and lack of management. In addition, the potential for forest fires due to abandoned campfires could continue to threaten the aesthetic quality of the Lake Cushman setting. Litter could continue to accumulate in the Staircase Road Recreation Area. The Powerhouse No. 2 penstocks, surge tank, and penstock towers would continue to be highly visible.

Under Tacoma's Proposal and Alternatives 2 and 3, Tacoma would assist LCDC and Mason County to implement shoreline management regulations to improve visual quality and help restore reservoir shorelines to a more natural state. Aesthetic enhancements under Tacoma's Proposal would also occur under Alternatives 2 and 3. Under Alternative 3, however, Tacoma would paint the silver-colored Dam No. 2 penstocks, surge tank, and penstock towers with nonreflective natural paint colors so that these project features would blend in better with the surroundings.

Under Tacoma's Proposal and Alternative 3, the proposed 70-by-120-foot substation on the left abutment of Dam No. 2 would be visible from Lake Kokanee and the WDFW boating access.

Under Alternative 2, the substation would be located about 200 feet downstream from Dam No. 2 and would not be visible from the lake.

Mainstem river aesthetics would remain unchanged under Alternative 1 and Tacoma's Proposal. Increased flows in the mainstem could occasionally be noticeably enhanced by the increased minimum flows from the North Fork under Alternative 3. Alternatives 2 and 4 would restore natural flows to the North Fork and mainstem and could substantially enhance river aesthetics.

Under Tacoma's Proposal and Alternatives 2 and 3, additional amounts of land would be managed for wildlife habitat with restrictions on logging. These measures would help protect vegetation and wildlife diversity, and thus preserve the natural aesthetic character of these lands. Alternatives 3 and 4 would provide the greatest benefits within the project viewshed.

Alternative 4 with dam removal and lowering Lake Cushman below 725 feet under any of the alternatives would expose a wide expanse of unvegetated, rocky, steeply sloping shoreline littered with stumps. Over time the old impoundment would blend in with the surrounding area as vegetation became re-established. By converting Lake Cushman's large lake setting to a riverine setting, dam removal would change the area's aesthetic character.

6.1.9 Socioeconomics Resources

Under Alternative 1, the Skokomish River fishery would continue to be depressed and the Tribe would continue to experience marginal socioeconomic fishery benefits. Alternatives 2 and 4 would return full or near full flows to the North Fork. Restoration of full flows along with the proposed fish habitat enhancements could provide a substantial benefit to the Tribe and commercial fishing operations by restoring a historically valuable fishery resource. The high flows, however, could also have a significant negative impact on habitat if they eliminated at-risk fish populations (section 4.4.3.1). Although Alternative 3 would not provide full flows, it would provide increased flows and habitat enhancements that would significantly improve this resource without the potential for the negative effects that are possible under Alternative 2 or decommissioning. Tacoma's Proposal would provide greater potential for increasing fish populations than Alternative 1, but less potential that Alternative 3.

Under Alternative 1, flood hazards and flood damage in the Skokomish Valley would slowly increase over time. Tacoma's Proposal would have a minimal beneficial effect on flood reduction. Although flows proposed under Alternative 2 would be beneficial in reducing flood hazards, they could also have several negative effects on fisheries. Under Alternative 2, however, the minimum level of Lake Cushman would remain higher year round, thereby reducing flood storage capacity. Under Alternative 3, Tacoma would maintain current reservoir operations and participate in flood hazard reduction studies and projects to reduce flooding in the mainstem. By decreasing the flood hazard, adverse socioeconomic impacts from flooding would be reduced in the valley, including the Skokomish Indian Reservation. Decommissioning (Alternative 4) with dam removal would approximately double flood flows.

Because neither Tacoma's Proposal nor the alternatives would employ a large number of construction workers for an extended period of time, the socioeconomic benefits to the state and regional economy would be short-term and minor.

If Lake Cushman were lowered to not exceed 725 feet, the property values of about 3,000 residential lots in the area could be reduced, with the impact most severe on about 250 lakeshore properties that abut Lake Cushman. In this situation, tax revenue generated by the properties would be reduced. Shoreline facilities would also have to be removed or rebuilt at considerable cost, but over time it is likely that residents and tourists would adjust to the new shoreline.

Under Alternative 4 with dam removal, the loss of Lake Cushman and Lake Kokanee could cause substantial social disruption to residents and reservoir recreationists. The property values of about 3,000 residential units in the area could be reduced, and more than 300 homes along the reservoirs' shores could lose their attraction and value as lakefront property. This reduction in property values would cause a reduction in tax revenue generated by the properties. Loss of the reservoirs could have an adverse impact on tourism.

6.1.10 Cultural Resources

Under Tacoma's Proposal or Alternative 2, 3, or 4, removing the McTaggert Creek diversion and providing higher flows to the North Fork could cause scouring of currently undetected archeological sites and would require monitoring until the stream channels were re-established. If new sites were uncovered, measures could be taken to ensure documentation or protection as appropriate, based on site significance and anticipated impacts.

The North Fork and the mainstem have been identified as containing fishery resources of traditional cultural importance to the Tribe. Restoration of full flows to the North Fork under Alternative 2 or 4 would provide significant long-term fishery benefits but could also have an adverse effect on some historically important fish populations. Although Tacoma's Proposal would provide a higher flow than currently exists along with some fish habitat enhancements, Alternative 3 would provide higher instream flows and greater habitat improvements without the risk associated with Alternative 2 or 4. Any improvements to fish populations would be of significant cultural benefit to the Tribe.

Decommissioning is the only alternative that would have a significant negative impact on historic structures that are listed in the National Register of Historic Places. Decommissioning with dam removal would require removing the historic dams and possibly some of the other historically significant structures. It would also change the historical context of any facilities that remain. Although documentation would help to mitigate the negative impact of removal, the physical structures would no longer exist and the public would no longer be able to view the facility as a working hydropower project. Decommissioning without dam removal could also have an adverse effect on the historic powerhouses and associated structures because it could alter or diminish the integrity of the characteristics that qualify these properties for inclusion in the National Register of Historic Places.

6.2 Comparative Economic Costs of the Alternatives

To compare the economic effects, we computed each alternative's present net value using a 30-year stream of incremental costs attributable to various elements of the alternatives with options. Costs include $25.4 million of undepreciated project debt. We compared each alternative's costs to the costs of generating an equivalent amount of power by other means. For Alternative 4, we estimated the cost of maintaining the project site without power generation over a 30-year period.

Discrete combinations of average annual generation, annual cost, and net annual benefit characterize each alternative (table 6-2). Section 5.3 provides a detailed discussion of the economic evaluation of each alternative.

As indicated in table 6-2, Tacoma's Proposal and Alternative 1 would have positive net economic benefits (i.e., they would cost less on an annualized unit output basis than an equivalent amount of energy from an alternative generating source). Alternatives 2 and 3 would reduce generation output and incur significant costs for a larger Powerhouse No. 3 and for wildlife habitat enhancements and, consequently, would not have a positive net economic benefit.

Under Tacoma's Proposal, the project's annual generation would average 332 GWh at a annual cost of 20.6 mills/kWh and a net benefit of 0.4 mills/kWh. Limiting the maximum level in Lake Cushman to elevation 725 feet would decrease generation by about 8 GWh/year and the net benefit would be reduced by about 0.6 mills/kWh. Providing fish passage under Tacoma's proposal would increase the annual cost by about 3.1 mills/kWh, and the net benefit would be reduced by 3.1 mills/kWh.

Alternative 2 would provide less power generation (203 GWh per year) at an annual cost of 108.1 mills/kWh. Several of the enhancement measures would add substantial costs to the project without providing commensurate environmental benefits. The high costs cause negative net economic benefit. For the cost of the various elements of this alternative, the annual net cost (not benefit) is 87.1 mills/kWh for operation of the project compared with the costs of generating an equivalent amount of power by other means. Limiting the maximum level in Lake Cushman to elevation 725 feet would decrease generation, and the net loss would be increased by about 4.4 mills/kWh to 91.5 mills/kWh. Providing fish passage under this alternative would increase the annual cost by about 5.1 mills/kWh and would result in an annual net loss of 92.2 mills/kWh.

Under Alternative 3, the project's annual generation would average 293 GWh at an annual cost of 36.1 mills/kWh and a net loss of 15.1 mills/kWh. Limiting the maximum level in Lake Cushman to elevation 725 feet would decrease generation and the net loss would be increased by about 1.1 mills/kWh to 16.2 mills/kWh. Providing fish passage under this alternative would increase the annual cost by about 3.5 mills/kWh and would result in an annual net loss of 18.6 mills/kWh.

Alternative 4 would produce no power at the site and, depending on the site's future, could involve a wide variety of capital and annual costs. We estimated that one decommissioning scenario to retain project facilities would incur a total annualized cost of approximately $2,619,000.

Alternative 1 would provide 343 GWh and have the highest net annual benefit of 9.3 mills/kWh. This is based on a calculation assuming there are no capital improvements and that power generation could continue year by year at present levels.

6.3 Consistency with Comprehensive Plans and Other Resource Plans

Section 10(a)(2) of the FPA requires the Commission to consider the extent to which a proposed project would be consistent with comprehensive plans for improving, developing, or conserving waterways affected by the project. Under Section 10(a)(2), 21 comprehensive plans were reviewed, of which the following 14 were identified as relevant to this project:

Table 6-2. Mean annual values of energy and capacity, total costs, and net annual benefits[1] of each alternative with and without alternative reservoir level management and fish passage options.[2,3]

Alternative	Average annual generation (GWh)		Project dependable capacity		Annual power value[4] (mills/kWh)				Annual total costs (mills/kWh)				Annual net benefit (mills/kWh)			
	A	B	A	B	A	B	C	D	A	B	C	D	A	B	C	D
Tacoma's Proposal	332	324	99	96	21.0	21.0	21.0	21.0	20.6	21.2	23.7	24.3	0.4	(0.2)	(2.7)	(3.3)
Alternative 1 (No Action)	343	NA	101	NA	21.0	NA	NA	NA	11.7	NA	NA	NA	9.3	NA	NA	NA
Alternative 2	203	195	39	38	21.0	21.0	21.0	21.0	108.1	112.5	113.2	117.8	(87.1)	(91.5)	(92.2)	(96.8)
Alternative 3	293	285	96	93	21.0	21.0	21.0	21.0	36.1	37.2	39.6	40.7	(15.1)	(16.2)	(18.6)	(19.7)
Alternative 4 (Decommissioning)	0	0	0	0	0	NA	NA	NA	–	NA	NA	NA	< 0	NA	NA	NA

[1] Based on a 30-year license period in 1996 dollars.
[2] Source: the staff.
[3] A - Under current reservoir rule curve (table 2-3).
B - Under 725-foot maximum reservoir level rule curve (table 2-6).
C - Under current reservoir rule curve with fish passage.
D - Under 725-foot maximum reservoir level rule curve with fish passage.
[4] Based on $21.00 per MWh for energy and capacity values.
NA = Not applicable.

1. Final EIS and Fishery Management Plan for Commercial and Recreational Salmon Fisheries Off the Coasts of Washington, Oregon, and California Commencing in 1978 (NMFS, 1978); and Eighth Amendment to the Fishery Management Plan for Commercial and Recreational Salmon Fisheries Off the Coasts of Washington, Oregon, and California Commencing in 1978 (PFMC, 1988);

2. Hood Canal Salmon Management Plan (WDF et al., 1986);

3. Northwest Conservation and Electric Power Plan (NPPC, 1991); Protected Areas Amendments (NPPC, 1988);

4. Land and Resource Management Plan, Olympic National Forest (FS, 1990), and Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA and DOI, 1994);

5. Resource Protection Planning Process — Southern Puget Sound Study Unit (Washington State Department of Community Development, 1987);

6. Resource Protection Planning Process — Study Unit Transportation (Washington State Department of Community Development, 1989);

7. Strategies for Washington's Wildlife, 1987-1993 (Washington Department of Game, 1987);

8. Washington's Statewide Comprehensive Outdoor Recreation Plan (ICOR, 1985);

9. Washington Outdoors: Assessment and Policy Plan for 1990 - 1995 (ICOR, 1990);

10. Washington State Trails Plan: Policy and Action Document (ICOR, 1991);

11. Scenic Rivers Program — Report (WSPRC, 1988);

12. Statute Establishing the State Scenic River System, Chapter 79.72 RCW (State of Washington, 1977);

13. Washington State Scenic River Assessment (WSPRC et al., 1988); and

14. Shoreline Master Program Handbook (WDOE, 1994), Application of Shoreline Management to Hydroelectric Developments (WDOE, 1986).

Based on our review of these plans we conclude that Tacoma's Proposal and Alternative 3 would be consistent with the above plans. Their recommended habitat enhancement and protection programs, and recreation improvements support the plans' goals and objectives. Alternative 2 would be consistent with all of the plans if the increased flows did not have an adverse effect on Skokomish River fisheries. If fisheries declined or were eliminated, Alternative 2 would not be consistent with plans 1 and 2, which seek to enhance and increase salmon stocks. Alternatives 1 (no action) and 4 (decommissioning) would be inconsistent with plan 7 since they would not provide any measures for wildlife habitat purchase, protection, or enhancement. Alternative 4, with facilities removed, would be inconsistent with plans 5 and 6 since historic structures would be destroyed. Alternative 4 would also be inconsistent with plan 3, since it would no longer meet the plan's primary goal of ensuring adequate, efficient, economical, and reliable electricity. Alternative 4 would be partially inconsistent with plan 8 because it would remove recreation opportunities.

In addition to the Section 10(a)(2) plans, we also examined over 20 other resource plans under Section 10(a) of the FPA that were provided by resource agencies, intervenors, and the Tribe. Although these plans do not have the same status as the comprehensive plans, the Commission recognizes them as relevant, ongoing planning processes to consider in this EIS. Those that were determined to be relevant to this project are:

15. 1991 Puget Sound Water Quality Management Plan (Puget Sound Water Quality Authority, 1991);

16. Aquatic Lands, Strategic Plan (WDNR, 1992a);

17. Comprehensive Plan, Skokomish Indian Reservation (The Latourell Associates for the Skokomish Indian Tribe, 1974);

18. Final Framework Amendment for Managing Ocean Salmon Fisheries off the Coasts of Washington, Oregon, and California Commencing in 1985 (the sixth amendment) (PFMC, 1984);

19. Hood Canal — Priorities for Tomorrow, an Initial Report on Fish and Wildlife, Developmental Aspects and Planning Considerations for Hood Canal, Washington (Yoshinaka and Ellifrit, 1974);

20. Mason County Conservation District Long Range Plan (SCS, 1994);

21. Mason County Shoreline Master Program, Amended (Mason County Planning Department, 1988);

22. Master Plan, Olympic National Park (NPS, 1976); Olympic National Park Land Protection Plan (NPS, 1983); Resources Management Plan (NPS, 1991);

23. State of Washington Natural Resources Conservation Areas Statewide Management Plan (WDNR, 1992b);

24. Recreational Shellfish Action Plan, Public Review Draft (WDOE et al., 1993);

25. Salmon 2000, Phase 2: Puget Sound, Washington Coast and Integrated Planning (WDF, 1992);

26. Skokomish River Comprehensive Flood Control Management Plan, Preliminary Draft Plan (WDOE, 1988);

27. Skokomish River Comprehensive Flood Hazard Management Plan, Volume II, Draft Report (Mason County, 1993);

28. Washington State Coastal Zone Management Program (WDOE, 1993);

29. Water Resources of the Skokomish Indian Tribe (James and Martino, 1980);

30. Watershed Planning Proposed Enhancement Report (WDF, 1987b);

31. Coastal Zone Considerations, Skokomish Indian Tribe (Pacific Rim Planners, Inc. 1981); and

32. Overall Economic Development Plan, Skokomish Indian Tribe (South Puget Intertribal Planning Agency and Skokomish Consulting Services, 1979).

We conclude that Tacoma's Proposal and Alternatives 2 and 3 are generally consistent with the above plans. Inconsistencies are identified below.

Tacoma's Proposal and Alternatives 1 and 4 (without dam removal) are inconsistent with plan 18, which seeks to improve provisions for "safe passage of anadromous salmonids at existing or future obstructions, dams and pump intakes." In addition, Tacoma's Proposal and Alternatives 1 and 4 (without dam removal) are inconsistent with plan 22, which includes the goal of restoring the upper North Fork ecosystem.

Based on information from the Tribe, Tacoma's Proposal is inconsistent with plan 29. The Tribe has stated that Tacoma's "proposal for continued operation of the Cushman Project is inconsistent with the tribal goals" (letter from Victor Martino, Skokomish Indian Tribe, Shelton, Washington, October 30, 1994). In general, fish habitat improvements and increased MIFs in the lower North Fork, proposed under Alternatives 2 and 3, should contribute to meeting the plan's goal of restoring fish habitat and fish populations. Alternative 2 would be inconsistent, however, if its increased flows had an adverse effect on fish populations. Alternatives 1 and 4 would be inconsistent with this plan since they include no provisions for enhancing fish habitat or populations.

Tacoma's Proposal and Alternatives 2 and 3 are partially inconsistent with plan 21. Recreation improvements proposed for the Staircase Road Recreation Area are located in an area designated by the Shoreline Master Program as natural shoreline, which is intended to preserve and restore natural resource systems. Because the proposed improvements are, however, intended to reduce adverse impacts from informal, dispersed recreation and overuse of the area, they should be beneficial and serve to meet the intent of the "natural" designation.

Alternatives 2 and 4 would be inconsistent with plans 17, 25, 30, and 31 if the restored North Fork flows had an adverse effect on anadromous fish populations.

Alternatives 1 and 4 would be inconsistent with plans 15 and 19 because they would provide no enhancement or protection of aquatic habitat. They would be inconsistent with plans 18 and 32 since they would not provide any enhancements that would increase salmon production.

6.4 Mandatory Requirements

6.4.1 Section 4(e) Requirements

Because the project occupies ONF lands, under Section 4(e) of the FPA, FS submitted mandatory project license conditions applicable to FS lands in the project area. The preliminary 4(e) conditions that FS submitted on December 15, 1994, include the following requirements:

- a recreation plan that addresses and includes project-induced recreation impacts relevant to recreation development; provisions for recreation operation and maintenance; effects of recreation use on sanitation and water quality; interpretive programs; appropriate land-ownership adjustments; and measures to accomplish administrative and law enforcement programs;

- a fire plan that addresses and includes project-induced impacts related to fire prevention, pre-suppression, and suppression, and associated administrative and law enforcement programs;

- a road management plan that addresses and includes project-induced impacts relevant to the history of road development and use, projected future use levels, public safety, year-round access needs, winter maintenance, and objectives for future road standards that may facilitate jurisdiction by public road management agencies such as Mason County or the state;

- a fish and wildlife habitat mitigation plan approved by FS and submitted to the Commission within 1 year of license issuance;

- the license articles contained in the Commission's Standard Form L-2;

- the requirement that Tacoma obtain a FS Special-Use Authorization within 6 months of license issuance and before starting any land-disturbing activities;

- written FS approval, prior to any project construction on FS lands, of the final designs for all project components potentially affecting National Forest System resources;

- written FS approval of any project changes or other departures from approved exhibits filed with the Commission;

- annual consultation with FS in regard to measures needed to ensure protection and development of natural resource values in the project area; and

- the Commission's Standard Special License Article 5.VI.3, which would require that Tacoma monitor recreation use to determine whether or not existing recreation facilities are meeting recreation needs.

We adopt all of these requirements in compliance with the FS' authority under Section 4(e) of the FPA.

FS also requires that we assess the project's consistency with the ONF Land and Resource Management Plan as amended by the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD).

In addition to the ONF Land and Resource Management Plan, the ROD amends the planning documents for 18 other National Forests and seven Bureau of Land Management (BLM) districts in Washington, Oregon, and northern California, in an effort to coordinate the management of these lands under a comprehensive ecosystem approach designed to maintain and enhance habitats for late-successional and old-growth forest-related species and aquatic resources, while continuing to provide a sustainable level of timber production. To meet these ends, the ROD establishes seven land allocation categories (Congressionally Reserved Areas, Late-Successional Reserves [LSRs], Adaptive Management Areas [AMAs], Managed Late-Successional Areas, Administratively Withdrawn Areas, Riparian Reserves [RRs], and Matrix) along with specific management standards and guidelines for each land allocation category. To provide extra protection for riparian resources on these same lands, the ROD also establishes an Aquatic Conservation Strategy (ACS) with nine objectives to be implemented through four components: the RR land allocations with their standards and guidelines, Key Watershed designations with standards and guidelines, Watershed Analysis, and Watershed Restoration. Land allocations or designations often overlap, in which case the standards and guidelines for all overlapping allocations or designations apply, with the more restrictive standards and guidelines taking precedence if there are any conflicts among the combined standards and guidelines.

At the upper end of Lake Cushman, there are approximately 11 acres of ONF land within the proposed project boundary at elevation 742 feet (figure 2-5). The ROD designated these lands as LSRs and RRs within a Tier 1 Key Watershed, so the standards and guidelines for all three of these designations apply to ONF lands within the proposed project boundary. FS lands where Tacoma proposes Dry Creek trail improvements are also designated as LSR within a Tier 1 Key Watershed, and those portions of the trail designated as RR include: areas within a distance equal to two site-potential trees or 300 feet slope distance from Dry Creek, whichever is greater; areas within a distance equal to the height of one site-potential tree or 150 feet slope distance from the edge of Lake Cushman at full pool, whichever is greater; and areas within a distance equal to the height of one site-potential tree or 100 feet slope distance from intermittent streams, whichever is greater. The FS Big Creek Campground where Tacoma proposes to develop additional camping facilities is on land designated as AMA, with those lands within a distance equal to two site-potential trees or 300 feet slope distance from Big Creek, whichever is greater, also designated as RR.

6.4.1.1 Late-Successional Reserves

The objective of LSRs is to protect and enhance late-successional and old-growth forest ecosystem conditions. Project lands are a small portion of a large LSR for which, under the ROD, FS must prepare a management assessment before designing or implementing any habitat manipulation activities. Projects and activities within LSRs may go forward before such large LSR assessments are completed, however, provided that there is an initial assessment of sufficient detail to determine whether or not the activities are consistent with LSR objectives.

The ROD specifies LSR standards and guidelines for silviculture and several multiple-use activities, of which the standards and guidelines for developments, rights-of-way, recreational uses, habitat improvement projects, and land exchanges are applicable to the Cushman Project. Existing developments, including utility sites and recreational facilities and their maintenance are generally consistent with LSR objectives and may remain. New developments that address public needs or provide significant public benefits may be approved when planning can minimize and mitigate any adverse effects on LSRs.

Existing ROW agreements, easements, and special use permits for LSR lands are recognized as valid LSR uses under the ROD, but should be modified if LSR objectives are not being met. Dispersed recreational uses are generally consistent with LSR objectives, but the ROD recommends that measures be taken when recreational uses retard or prevent attainment of LSR objectives. Habitat improvement projects can be implemented if they benefit late-successional habitats, or if their adverse effects on late-successional species are negligible. LSR lands can be exchanged when exchanges would maintain or improve LSR sizes, distributions, and quality, especially where public and private lands are intermingled.

6.4.1.2 Riparian Reserves

The objectives of RRs are to maintain and restore riparian habitats and functions of intermittent streams, to enhance habitats for riparian-dependent and -associated species other than fish, to improve travel and dispersal corridors for terrestrial wildlife and plants, and to provide greater habitat connectivity within watersheds. Of the RR standards and guidelines included in the ROD, those specified for land, recreation, fish and wildlife, and road management are applicable to the Cushman Project. Land management guidelines and standards require flow and habitat conditions that maintain or restore riparian resources and channel integrity. Any new project support facilities should be located outside RRs, and existing facilities inside RRs should be managed to ensure that ACS objectives are met.

New recreational facilities within RRs should not prevent meeting ACS objectives, and the impacts of existing facilities should be evaluated and mitigated so that they also either contribute to, or do not prevent the attainment of, ACS objectives. Dispersed or developed recreation uses that retard or prevent ACS objectives should be adjusted or eliminated if adjustments are ineffective. Fish and wildlife habitat enhancements should be designed to further ACS objectives. The management of existing roads should also meet ACS objectives by minimizing road locations in RRs, minimizing disruption of natural hydrologic flow paths, restricting sidecasting, and other measures.

6.4.1.3 Tier 1 Key Watersheds

The objective of Tier 1 Key Watershed designations is to provide a system of widely distributed refugia crucial to maintaining and recovering habitat for at-risk anadromous salmonid and bull trout populations. Standards and guidelines for Key Watersheds include performing a watershed analysis before implementing management activities not categorically excluded under NEPA, and reducing or not increasing the net amount of existing road mileage.

6.4.1.4 Adaptive Management Areas

The objective of AMAs is to develop and test new management approaches to integrate and achieve ecological, economic, and other social and community objectives. Under the ROD, the FS is required to develop plans for AMAs and to meet the intents of standards and guidelines for certain other land allocation categories, but to provide the freedom to develop innovative management approaches it prescribes specific standards and guidelines only for LSRs within AMAs, Key Watersheds, old-growth fragments, site-treatment practices, and bat roosts that do not apply in this case.

6.4.1.5 Consistency Determinations

Because FS expects that this EIS will serve as a watershed analysis that must be completed before any Cushman Project-related actions affecting ONF lands can be implemented (letter from J. Lowe, Regional Forester, FS, Portland, Oregon, December, 15, 1994), we expect that this EIS will also be adequate to serve as an initial LSR management assessment that must also be completed before any such actions go forward. We conclude that the preferred alternative (Alternative 3, section 6.6) is consistent with these requirements of the ROD.

Because existing developments are consistent with LSR objectives and the Cushman Project is an existing development, continued project operation under Tacoma's Proposal or Alternative 1, 2, or 3 would be consistent with existing development standards for LSRs (letter from J. Lowe, Regional Forester, FS, Portland, Oregon, December 15, 1994). Because Tacoma's Proposal and Alternatives 2 and 3 would not prevent the protection and enhancement of existing late-successional and old-growth forest conditions on ONF lands affected by the project, renewal of the project's special use permit would be consistent with the ROD's standards and guidelines for existing ROWs, easements, and special use permits. And because there are only limited riparian resources on project-affected ONF lands and these resources would generally be protected, these same alternatives would not be inconsistent with RR land management guidelines and standards requiring habitat conditions that maintain or restore riparian resources.

Developing recreation sites along Staircase Road under Tacoma's Proposal and Alternatives 2 and 3 would be consistent with RR land management guidelines because these sites would be developed to reduce dispersed recreation impacts on LSR and RR resources and would thus be consistent with LSR and RR guidelines to take corrective measures when dispersed recreation uses retard or prevent LSR and ACS objectives.

The Dry Creek trail would be rerouted through a stand of relatively young second-growth timber, so implementing this action under Tacoma's Proposal and Alternatives 2 and 3 would not be inconsistent with LSR objectives. Because FS would have final approval over trail and facility improvement plans and would have to comply with ROD standards and guidelines, these plans would include measures to ensure that attainment of ACS objectives would not be prevented where improvements are located in RR areas. This action would therefore be consistent with the RR standards and guidelines. Most new facilities proposed for the FS Big Creek Campground would be located in AMA-designated areas that lack any standards or guidelines with which proposed campground improvements could be inconsistent. As at the Dry Creek trail, measures probably would also be taken to ensure that campground construction on RR-designated areas along Big Creek would not prevent attainment of ACS objectives and to thus maintain consistency with the standards and guidelines for RRs.

Alternative 1, no action, would also be generally consistent with LSR and RR objectives because it would involve no changes in existing land uses or management. Even so, it would be somewhat less consistent with standards and guidelines for LSR special use permits and dispersed recreation, and RR standards and guidelines for land management and dispersed recreation, than would Tacoma's Proposal or Alternative 2 or 3, because late-successional forest and riparian resources would receive less protection from continuing adverse dispersed recreational use impacts.

Impounding the upper portion of Lake Cushman to create wetlands under Alternative 2 would be consistent with LSR and RR standards and guidelines for habitat enhancements because it would have negligible effects on late-successional forest species and would support wetland-related ACS objectives. If Staircase Road could be paved under Alternative 2 without disturbing late-successional and riparian habitats and natural hydrologic flow patterns, and without increasing sediment inputs from the road to any intermittent channels or the lake, then this measure would not be inconsistent with LSR and RR standards and guidelines for roads.

Decommissioning the project (Alternative 4) without dam removal would have essentially the same effects on FS lands as would Alternative 1 (no action) so it would be generally consistent with the ROD, although it would also be somewhat less consistent than Tacoma's Proposal or Alternative 2 or 3. Decommissioning the project with dam removal would likely have temporary adverse sedimentation and other impacts in restored stream channels on FS lands, which could create short-term inconsistencies with ACS objectives, but would be consistent with ACS objectives in the long term because it would restore habitat for at-risk anadromous and resident salmonid fish stocks.

The proposed land exchange between Tacoma and FS that could occur under Tacoma's Proposal or Alternatives 1, 2, 3, and 4 would be consistent with LSR land exchange guidelines because it would increase the actual amount of late-successional forest in the LSR, protect the habitat quality of these lands, and reduce the amount of private inholdings in the LSR. If this exchange is completed, it would remove the project from ONF lands and eliminate the ROD's applicability to project lands and waters.

6.4.2 Fish Passage Measures

DOI has requested a reservation of authority to prescribe fish passage for the Cushman Project. By letter dated March 29, 1996, DOI informed the Commission that it was prescribing upstream and downstream fish passage facilities to pass anadromous fish around Dams No. 1 and No. 2. However, DOI did not prescribe specific designs or methodologies for fish passage, but instead would require Tacoma, in consultation with and approval by FWS and other fisheries agencies, to design, construct, and begin operation and maintenance of passage facilities within 24 months of license issuance. DOI also states in this letter that it reserves the authority to amend its prescription at any time prior to license issuance and during the license term and requests inclusion of such reservation in any license issued for the project. Although we initially indicated that we would accept DOI's purported prescription, upon further review we conclude that DOI's recommendation is untimely and is not sufficiently specific to constitute a fishway prescription under Section 18 of the FPA. The Commission will ultimately resolve this issue in its licensing decision. Because DOI has requested a reservation of authority to prescribe upstream and downstream fishways, and therefore may do so at some time during the new license term, we examined the economic and environmental impacts of various fish passage options in appendix C and section 4.4.7. We have also considered DOI's fish passage measures as recommendations under Section 10(a) of the FPA but do not adopt them because the measures' likelihood of biological success is too uncertain, and they do not represent the best balance of developmental and non-developmental resources. Although we do not adopt these measures, we recommend that any license for the project include DOI's request for a reservation of authority to prescribe fishways in the future.

6.5 Fish and Wildlife Agency Recommendations

The FPA, as amended by the 1986 Electric Consumers Protection Act, requires the Commission to include in each hydroelectric license, conditions based on federal and state fish and wildlife agency recommendations for the protection, mitigation, and enhancement of such resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission believes that any fish and wildlife agency recommendation may be inconsistent with the purposes and requirements of the FPA or other applicable law, then the Commission and the agency shall attempt to resolve such inconsistency, giving due weight to the agency's recommendation, expertise, and statutory responsibilities.

In table 6-3, we summarize the resource agencies' recommendations, their relation to Section 10(j), and our positions on the recommendations. We studied each recommendation to determine its beneficial and adverse effects on the environment and then reviewed other recommendations to help us identify the optimum combination of environmental protection, mitigation, and enhancement for the project. Recommendations that we determined to be outside the scope of Section 10(j) were evaluated as recommendations under Section 10(a) and discussed in section 4. Our reasons for recommending or not recommending adoption of the Section 10(j) recommendations are summarized here and discussed more fully in the appropriate resource sections of chapter 4.

We do not recommend adoption of the following 10(j) recommendations because we conclude that they may be inconsistent with Sections 4(e) or 10(a) of the FPA or other applicable law, or because they lack substantial supporting evidence. We do not recommend adoption of agency-recommended instream flows (recommendation 1 in table 6-3) because the long-term fishery benefits of such high flows are too uncertain to justify their significant long-term impacts on power production. Because we do not recommend the agency-recommended flows, we also do not recommend adoption of recommendation 31 to restore riparian vegetation that would be damaged by the high flows and associated river channel capacity enhancement measures. We do not recommend restoring anadromous fish in Lake Cushman (recommendation 18) because its benefits and feasibility are too uncertain and it does not represent the best balance of developmental and non-developmental resources. We do not recommend adoption of recommendations 24, 25, 26, 27, and 29 and only partially recommend adoption of recommendation 28 because the shellfish resources they would enhance are unaffected by the project.

The following agency recommendations are outside the scope of Section 10(j). Agency recommendation 4 is outside the scope of Section 10(j) because: it would leave project operations unspecified and as such is not a specific measure to protect, mitigate, or enhance fish and wildlife resources; would grant authority over project operations and facilities to a committee rather than the Commission; and would defer to the post-licensing stage much of the analysis and judgment that we are required to undertake in considering whether to issue a new license under the FPA. Recommendation 11 is outside of 10(j) because it requests post-licensing studies of a measure that has in fact been studied and found to be infeasible. Recommendations to enhance the mainstem's channel capacity (14 and 15) are outside of 10(j) because they are intended to reduce flood hazards rather than to protect or enhance fish and wildlife resources. Recommendations to fund WDFW positions (22, 34, and 35) are outside the scope of 10(j) and because they seek funds to supplement the agency's general budget. Recommendations 38 through 44 are outside of 10(j) because they are intended to enhance recreation rather than to protect or enhance fish and wildlife. Recommendations 45, 51, and 56 are outside the scope of Section 10(j) because they are not specific measures for fish and wildlife.

6.6 Findings and Recommendations

In the preceding sections of this EIS, we analyzed the environmental and economic effects of Tacoma's Proposal and four alternatives. This section presents our findings regarding our preferred alternative and preliminary recommendations for implementing the preferred alternative.

Table 6-3. Summary of all fish and wildlife resource agency 10(j) recommendations for the Cushman Project, their associated costs, and staff positions.[1]

	Agency recommendation	Agency	Within scope of § 10(j)	Annual cost of environmental measures ($)	Adopted
1	In consultation with and with approval by the resource agencies and the Tribe, develop a plan to stop diverting North Fork Skokomish River waters out of the basin, except to the extent necessary for flood protection. The plan shall include: • staged interim and final minimum and maximum flows, flow release schedules, hydrographs, and ramping rates; • a range of Lake Cushman water levels and minimum flow releases that, in combination, can be achieved through the summer months in a critical water year; • short-term tests to evaluate relationships among streamflow, sediment transport, and channel morphology; • riparian vegetation protection and restoration; and, • long-term monitoring and evaluation with provisions for operational changes. Tacoma shall fully fund any monitoring or other measures needed to develop this plan.	DOI-FWS NMFS	No	5,700,000	No. This recommendation is inconsistent with the comprehensive development standard of Section 10(a) because its long-term fisheries benefits are too uncertain to justify its significant impacts on power production.
2	Initiate implementation of the developed flow plan within 1 year of license issuance, and fully implement the plan within 5 years of license issuance.	DOI-FWS NMFS	Yes	Indeterminate	Partially – we recommend implementation of our instream flow regime within 1 year of license issuance.
3	Until implementation of the developed flow plan begins, release and maintain a 240-cfs interim minimum instream flow downstream from Dam No. 2.	DOI-FWS NMFS	Yes	1,200,000	Partially – we recommend that the project pass at least 240 cfs (or inflow if lower in the summer months), throughout the year.

4	Implement a Streamflow Resolution Process (SRP) with an Instream Flow Committee (IFC) including representatives from Tacoma, the resource agencies, the Tribe, and a FERC administrative law judge, that shall develop, within 5 years of license issuance, a plan to optimize North Fork and mainstem flows. While this optimized flow plan is being developed, implement minimum interim flows, to be determined by the IFC within 90 days of license issuance, that wet the main channel's full width, *provide flow in existing side* channels, optimize riffle and pool depths, and provide main channel water velocities consistent with the habitat requirements of juvenile and other age classes of salmon. Augment these minimum interim flows with additional 20-cfs releases for juvenile salmonid outmigration on selected dates during the spring, late summer, and fall, *and augment them with an* additional 25 percent of minimum flows for upstream migrant adult salmon on different selected dates during late summer and fall.	WDFW	No	Indeterminate	No. This recommendation leaves instream flows and other project operations unspecified and is therefore not a specific recommendation for the protection, mitigation, or enhancement of fish and wildlife. We do not adopt it because it defers to post-licensing the analysis and judgement required for licensing decisions under the FPA.
5	Continuously pass licensed flows to the lower North Fork on an instantaneous basis; water shall be released through the spillways as needed to pass these flows during project shut-downs.	WDFW	Yes	0	Yes
6	Operate the project in a modified peaking mode that maintains minimum flows and ramping rates at *all times*, giving precedence to fish and wildlife considerations over *load-following demands*. Do not operate the project in a cycling mode.	WDFW	Yes	0	Yes
7	*Until a critical flow has been* determined by the agencies and the Tribe, operate the project to *meet the following ramping* rates.	*DOI-FWS* NMFS WDFW	*Yes*	*Moderate*	*Partially* – we adopt this recommendation but because Dam No. 2 does not currently include facilities capable of accurately metering and regulating such flows, we recommend that Tacoma be given up to 5 years to develop such facilities and comply with these interim rates or rates to be determined by our recommended critical flow studies that would be conducted in consultation with the agencies.

8	At the nearest suitable sites to be identified in consultation with and with approval by the agencies and the Tribe, install, operate, and maintain telemetered recording stream flow gages on the North Fork immediately downstream from Dam No. 2, on the South Fork immediately upstream of its confluence with the North Fork, and on the mainstem immediately downstream from the North and South Fork confluence.	DOI-FWS NMFS	Yes	40,000	Partially - we recommend that Tacoma install a telemetered streamgage at an appropriate site on the South Fork rather than immediately upstream of its confluence with the North Fork because the recommended site is not suitable for gaging. We do not recommend that Tacoma install new gages on the North Fork below Dam No. 2 or on the mainstem below the North and South Fork confluence because there are existing gages on the North Fork below Dam No. 2 (U.S.G.S. Station No. 12058800) and on the lower North Fork (U.S.G.S. Station No. 12059500) just above its confluence with the South Fork that provide the same capability. We do, however, recommend that Tacoma telemeter U.S.G.S. Station No. 12059500 and provide for the operation and maintenance of all three of these gages.
9	Install, operate, and maintain a telemetered recording stream flow gage at the nearest suitable site within 1 mile downstream from Dam No. 2. The gage shall be capable of continuously recording flows year-round and of telemetering the data to USGS receiving stations and to project facilities, where the unit shall be connected to an alarm signalling unexpected flow changes. Maintain flow data records, including flows at 15-minute intervals and daily and monthly means, and provide these data to the agencies upon request.	WDFW	Yes	13,000	Yes - we recommend that Tacoma modify and operate the existing telemetered gage on the North Fork below Dam No. 2 (U.S.G.S. Station No. 12058800) as described in this recommendation.
10	In consultation with and with approval by the agencies and the Tribe, remove the diversion dam on McTaggert Creek and restore the creeks' natural streamflows and riparian habitats.	DOI-FWS NMFS WDFW	Yes	47,000	Yes, with the exception of authority for approval which is outside the scope of 10(j) and not adopted because it conflicts with Commission authority over the project.
11	Have the IFC study ways to increase flows (from Lake Cushman or other sources) in McTaggert Creek to enhance the creek's anadromous fish production.	WDFW	No	Indeterminate	No. This recommendation is outside the scope of 10(j) because it requests post-licensing studies of alternative project operations that could have been studied pre-licensing. It is not adopted because the Tribe has already conducted such studies and found that this measure would not be feasible.

12	In consultation with and with approval by the agencies and the Tribe, develop, fund, and implement a plan for augmenting gravel in the lower North Fork between Dam No. 2 and the McTaggert Creek mouth, as needed, for the life of the project.	DOI-FWS NMFS WDFW	Yes	5,000	Yes, with the exception of authority for approval which is outside the scope of 10(j) and not adopted because it conflicts with Commission authority over the project.
13	Have Tacoma fund a North Fork fish habitat enhancement program that is tailored to licensed flows and that includes measures such as placing large trees, logs, rootballs, and boulders in the stream, developing new side channels, and fencing to exclude livestock.	WDFW	Yes	70,000	Partially - we recommend post-licensing studies to define habitat needs following implementation of the instream flow regime.
14	In consultation with and with approval by the agencies and the Tribe, develop and implement a plan to restore the flow capacity of the mainstem.	NMFS	No	800,000	Partially - we recommend that Tacoma participate in Mason County's Flood Hazard Management Plan which would enhance mainstem flow conveyance and capacity and reduce flood hazards.
15	Within 2 years of license issuance, study fish and wildlife habitats, channel geomorphology and hydrology, flooding, gravel removal, and estuary restoration of the mainstem. Study results should be incorporated into a final Comprehensive Flood Hazard Management Plan that would be approved by the IFC, and would include channel capacity enhancement measures. These enhancement measures would be subject to agency approval, and could include weir construction, gravel removal, and increased flows.	WDFW	No	Substantial	This recommendation is outside the scope of 10(j) because it requests post-licensing studies that could have been conducted pre-licensing. This recommendation is partially adopted because we recommend higher river flows, estuary restoration and studies, and having Tacoma participate in Mason County's Flood Hazard Management Plan, which would include studies and measures to enhance mainstem flow conveyance and capacity.

16	Have Tacoma fund and begin to implement, within 18 months of license issuance, a mainstem and estuary fish and wildlife habitat enhancement plan including: • side-channel habitat development by excavating or improving existing channels; • placing large downed trees and rootballs in the mainstem's lower reaches; • sequentially removing dikes at Nalley Ranch; and, • re-establishing riparian and estuarine vegetation on areas that have been cleared, grazed, logged, or otherwise altered.	WDFW	Yes	Substantial	Partially – we do not adopt side-channel development directly because it would flood privately owned lands where side channels are located and would thus be inconsistent with Section 10(a), but we expect that side-channels would be developed in cooperation with local landowners under our recommendation that Tacoma participate in the Mason County Flood Hazard Management Plan. We do recommend that Tacoma develop and implement a plan to remove dikes at Nalley Ranch, and that Tacoma assess the number of logs and rootballs at the estuary after the dikes are removed and then augment them if needed. The recommendation to re-establish riparian vegetation on altered lands along the mainstem is outside the scope of 10(j) and is not adopted because it is a measure to mitigate impacts not caused by the project.
17	In consultation with and with approval by the agencies and the Tribe, develop and implement a program to monitor North Fork fish population responses to river flow and habitat enhancements.	DOI-FWS NMFS	Yes	Indeterminate	Yes, with the exception of authority for approval which is outside the scope of 10(j) and not adopted because it conflicts with Commission authority over the project.
18	In consultation with and with approval by the agencies and the Tribe, develop within 1 year of license issuance, and implement during license years 2 to 9, a program to restore anadromous fish populations, including sockeye and coho salmon, in Lake Cushman.	DOI-FWS NMFS	Yes	2,225,000	No. This recommendation is inconsistent with the comprehensive development standard of Section 10(a) because its benefits and feasibility are too uncertain to warrant its high costs.
19	Have Tacoma fund the development, operation, and maintenance of fish hatchery facilities to be developed in consultation with and approval by the agencies and the Tribe.	DOI-FWS NMFS	Yes	1,800,000	Partially - we recommend that Tacoma develop a plan to identify and fund hatchery production enhancements needed to augment fish populations at the project.
20	Within 1 year of license issuance, develop and begin to implement an anadromous fish gene conservation program that would use existing hatchery facilities to develop brood stock for rehabilitating natural fish populations and supporting a modernized hatchery.	WDFW	Yes	Substantial	Partially - we recommend that Tacoma develop a plan to identify and fund hatchery production enhancements needed to augment fish populations at the project. A gene conservation program could be included in this plan.
21	Within 1 year of license issuance, develop and implement a plan to renovate the George Adams and Hoodsport Fish Hatcheries, and have Tacoma assume all hatchery construction, operation, and maintenance costs.	WDFW	Yes	Substantial	Partially - we recommend that Tacoma develop a plan to identify and fund hatchery production enhancements needed to augment fish populations at the project. Renovation of these hatcheries and contributions to their operation and maintenance could be included in this plan.

22	In consultation with and with approval from WDFW, and within 2 years of license issuance, implement a resident fisheries enhancement plan that includes: • modifying or removing a fish passage barrier at the Big Creek mouth; • maintaining Lake Cushman water levels at 738 feet between Memorial Day and Labor Day, drawing the lake down no more than 0.5 feet per day to no lower than 723 feet, and completing drawdown by November 15; • annually stocking 1.5 million kokanee fry and 140,000 catchable sea-run cutthroat trout in Lake Cushman; • designing and constructing, in consultation and concurrence with WDFW and the agencies, Lake Cushman kokanee egg-taking and acclimation facilities; • modifying or removing a fish passage barrier on Dow Creek 0.8 miles upstream of Lake Kokanee; • annually stocking 12,000 catchable rainbow trout in Lake Kokanee; and, • funding a full-time journey-level WDFW fisheries biologist position.	WDFW	Yes	200,000	Partially - we recommend that Tacoma remove the fish passage barriers at Big and Dow Creeks, stock kokanee and cutthroat trout in Lake Cushman, develop kokanee egg-taking and acclimation facilities at Lake Cushman, and stock rainbow trout in Lake Kokanee. We do not recommend that Tacoma maintain Lake Cushman's minimum level at 723 feet because it would increase downstream flooding risks and would thus be inconsistent with Section 10(a). Funding for a journeyman-level fisheries biologist is outside the scope of Section 10(j) and not adopted because it is a measure to supplement the agency's budget rather than a measure to protect, mitigate, or enhance specific fish and wildlife resources.
23	With the oversight and approval of WDFW, design and implement measures to increase the area of intertidal habitats and eelgrass beds in the Skokomish Estuary by 40 and 18 percent, respectively.	WDFW	Yes	Substantial	Partially – our recommended measures to restore estuarine conditions at Nalley Ranch would increase intertidal habitat by 26 percent. The request for authority to approve these measures is outside the scope of 10(j) and not adopted because it conflicts with Commission authority over the project.
24	To protect estuarine habitats and enhance kelp beds, construct barrier reefs at select locations on the outer estuary.	WDFW	Yes	Moderate to substantial	No. There is no evidence that the project has ever had any effect on kelp beds or that the estuary would continue to recede with our recommended estuary restoration measures and instream flows. Furthermore, barrier reefs could interfere with navigation in Hood Canal and thus be inconsistent with FPA Section 4(e).

25	Enhance gravels and seed manila or littleneck clams at beaches between Hoodsport and Union. Enhancement sites and methods shall be selected by WDFW and the Point No Point Treaty Council.	WDFW	Yes	1,009,000	No. There is no evidence that the project affects clams outside of the Skokomish delta. All of the specific sites that WDFW identifies for clam enhancements are outside of the Skokomish delta and therefore unaffected by the project. This recommendation thus seeks enhancement of resources that are unaffected by the project, lacks evidentiary support, and is inconsistent with balanced development.
26	Enhance oyster fisheries at selected mudflats between Hoodsport and Union by conducting clutched seeding and other measures.	WDFW	Yes	86,000	No. There is no evidence that the project affects oysters outside of the Skokomish delta. All of the specific sites that WDFW identifies for oyster enhancements are outside of the Skokomish delta and therefore unaffected by the project. This recommendation thus seeks enhancement of resources that are unaffected by the project, lacks evidentiary support, and is inconsistent with balanced development.
27	Seed juvenile geoduck clams in selected mudflats on Hood Canal. Enhancement sites and methods shall be selected by WDFW and the Point No Point Treaty Council.	WDFW	Yes	21,000	No. There is no evidence that the project affects geoduck clams outside of the Skokomish delta. WDFW targets west-shore Hood Canal geoduck fisheries for enhancements but the Skokomish delta is not on the west shore of Hood Canal so fisheries there are unaffected by the project. This recommendation thus seeks enhancement of resources that are unaffected by the project, lacks evidentiary support, and is inconsistent with balanced development.
28	Monitor and enhance Dungeness crab, red-rock crab, and spot shrimp populations in the Skokomish Estuary by fully funding a program that includes: • baseline crustacean population and habitat studies to begin upon license issuance and to continue for 3 to 5 years; • long-term monitoring for at least 4 more years; and, • crustacean habitat enhancement measures such as adding oyster shells or other appropriate materials. Monitoring and enhancement sites and methods shall be selected by WDFW.	WDFW	Yes	Moderate to Substantial	Partially – we recommend that Tacoma monitor estuary habitat and population responses for 5 years after removing the dikes at Nalley Ranch. We expect that crustacean populations would be included in this monitoring and that restoring estuarine conditions to diked areas would substantially enhance intertidal crustacean habitats.

29	Renovate the WDFW Point Whitney Shellfish Facility and assume 30 percent of the facility's operation and maintenance costs.	WDFW	Yes	124,000	No. There is no evidence that the project affects shellfish outside of the Skokomish delta and WDFW has recommended no delta shellfish enhancements for which hatchery produced shellfish would be needed. This recommendation thus seeks enhancement of resources that are unaffected by the project, lacks evidentiary support, and is inconsistent with balanced development.
30	Within 2 years of license issuance, implement the "WDOE Standards Shellfish Protection Strategy for Hood Canal" along the Hood Canal shoreline from Hoodsport to Belfair.	WDFW	No	Indeterminate	This recommendation is outside of the scope of Section 10(j) because it does not identify specific measures to protect, mitigate, or enhance fish and wildlife. This recommendation is not adopted because WDFW has provided no data indicating that the project has increased bacterial contamination of recreational shellfisheries in Hood Canal, and the recommendation thus lacks evidentiary support and seeks mitigation for impacts not caused by the project and enhancement of areas unaffected by the project.
31	In consultation with and with approval from the resource agencies and the Tribe, protect and restore North Fork Skokomish River riparian vegetation that would be affected by higher river flows.	DOI-FWS NMFS	Yes	Moderate	No. This measure is inconsistent with balanced development because we do not adopt the agency-recommended flows that would adversely affect riparian vegetation along the North Fork, and because we do not expect our recommended flows to substantially affect North Fork riparian vegetation.
32	Within 2 years of license issuance, and in consultation with and with approval from the resource agencies and the Tribe, acquire the following parcels or their equivalents: Lilliwaup Swamp and adjacent lands, Northern and Southern Lower North Fork parcels (including Richert Farm), Purdy Creek, Nalley Ranch, Belfair Wetlands, Westside, Dow Mountain, and Deer Meadow.	DOI-FWS NMFS WDFW	Yes	10,030,000	Partially – we recommend that Tacoma acquire title or development rights to all of these parcels except Lilliwaup Swamp and Belfair Wetlands because they are unaffected by the project and/or are inconsistent with balanced development. The request for authority to approve these acquisitions is outside the scope of 10(j) and not adopted because it conflicts with Commission authority over the project.
33	Within 5 years of license issuance, and in consultation with and with approval from the resource agencies and the Tribe, develop and implement a habitat improvement and management plan for acquired wildlife mitigation lands.	DOI-FWS NMFS WDFW	Yes	403,000	Yes, with the exception of authority for approval, which is outside the scope of 10(j) and not adopted because it conflicts with Commission authority over the project.
34	Reimburse WDFW for the salary, benefits, overhead, equipment, and travel costs for a full-time journey-level wildlife biologist assigned to manage project wildlife mitigation lands.	WDFW	No	55,000	No. This recommendation is outside the scope of 10(j) and not adopted because it is a measure to supplement the agency's budget and not a measure to protect, mitigate, or enhance specific fish and wildlife resources.

35	Reimburse WDFW for the salary, benefits, overhead, equipment, and travel costs for a full-time journey-level enforcement officer assigned to protect fish and wildlife resources on project lands.	WDFW	No	55,000	Partially - we recommend that Tacoma develop a plan to provide for monitoring and enforcement of environmental protection measures on NPS exchange and other project lands, enhancement parcels, and LCDC lands.
36	Rigorously enforce existing covenants on LCDC lands.	WDFW	Yes	Minor	Yes
37	Implement a comprehensive transmission line ROW management plan including measures for vegetation management, tall shrub enhancement, grass/forb forage plots, snag habitat enhancement, ROW-access road gating or closure, wetland protection and enhancement, and Christmas tree farm lease evaluation.	WDFW	Yes	37,000	Yes
38	Improve public access and boat launch facilities at Lake Cushman State Park, including expanding the launch, constructing a mooring float, adding gravel parking spaces at the boat launch and day-use areas, adding overnight camp sites, and upgrading and increasing restrooms, picnic sites, and other facilities.	WDFW	No	65,000	Yes
39	Assume maintenance of the Lake Kokanee boat ramp facilities, including repairing or replacing broken slabs in the ramp, installing new concrete vault toilets, pumping toilets when necessary, removing garbage and litter, adding new crushed rock to the parking area, grading the parking area annually, and other general maintenance as required.	WDFW	No	20,000	Yes
40	For the WDFW's mainstem water access facilities, assume maintenance and implement improvements including redesigning the vehicle pull-in, elevating the road grade between the parking lot and river, and expanding the parking lot at the access on the south bank off Highway 101; and grading the access road and parking lot at the access on the north bank off Sunnyside Road.	WDFW	No	7,000	No
41	Improve Hood Canal Park by enlarging the boat launch, building a floating dock, stabilizing the bank along 500 to 1,000 feet of shoreline, building a stairway or ramp from picnic area to the beach, and providing two full-time vehicle traffic controllers during the shrimping season.	WDFW	No	43,000	Yes

42	Near Dam No. 1 on Lake Cushman, develop and maintain a day-use boat ramp including a concrete boat ramp, a mooring float, two or more permanent vault toilets, a parking area accommodating at least 30 vehicles, a paved entrance road, entrance signs, and covered informational billboards.	WDFW	No	Moderate	No. A boat ramp and other facilities are already available to the public at Lake Cushman Resort so there is no need for additional facilities.
43	Provide FS with funds for Big Creek Campground improvements including a group tent camping area accommodating 30 campers, gravel parking lots accommodating 45 to 50 cars and 30 RVs, two large covered eating/cooking facilities, and group fire circles, vault toilets, hand pump wells, and informational boards and signs as needed.	WDFW	No	66,000	Yes - we recommend that Tacoma develop a recreation management plan as required by the FS and we expect the plan to include similar if not identical facilities.
44	Fund maintenance of the WDNR Lilliwaup Campground, including 0.5 full-time equivalent of a WDNR Natural Resource Investigator position for campground maintenance and operation.	WDFW	No	Moderate	No
45	Apply to WDFW for Hydraulic Project Approvals (HPAs) for all construction and maintenance activities adjacent or draining to wetlands or fish-bearing water bodies.	WDFW	No	Minor	No
46	Prepare and submit, for WDFW review and approval, an erosion and sediment control plan for all project operation sites.	WDFW	Yes	800	Yes, with the exception of authority for approval which is outside the scope of 10(j) and not adopted because it conflicts with Commission authority over the project.
47	Schedule all soil-disturbing construction activities between June 1 and September 30 and stabilize and winterize all disturbed soils by October 1. Provide WDFW with monthly construction reports, and take post-construction erosion control measures.	WDFW	Yes	Indeterminate	Yes
48	Avoid spilling petroleum and chemical products and be prepared to clean up inadvertently spilled materials.	WDFW	Yes	Minor	Yes
49	Prepare an oil and toxic material spill response plan.	WDFW	Yes	800	Yes
50	Monitor dissolved gases at all powerhouse outfalls and at the spillways during spill events, and report results in an annual report. Total saturation shall not exceed 110 percent and DO shall not fall below 7 ppm.	WDFW	Yes	17,000	Yes

51	A Tacoma-funded and WDFW-supervised Environmental Monitor with the authority to stop construction if water quality standards are violated shall be present on site during construction.	WDFW	No	12,000	No, this recommendation is not adopted because it would conflict with Commission authority over project construction.
52	Equip penstock intakes with an emergency shut-off valve to prevent catastrophic erosion if a penstock ruptures.	WDFW	Yes	5,000	Yes. The Powerhouse No. 2 penstocks already have such a valve that Tacoma is currently automating, Powerhouse No. 1 has an automated gate, and we would require such capabilities at a new Powerhouse No. 3 depending on the powerhouse's final design and whether or not Tacoma opts to construct it.
53	To protect water quality and fish habitats in Lake Cushman from dust and siltation, pave and maintain currently graveled sections of Staircase Road along Lake Cushman's north shore.	WDFW	Yes	50,000	Partially - we recommend that Tacoma develop a road management plan as required by the FS and the plan is likely to include having Tacoma pave Staircase Road.
54	Within 2 years of license issuance, fully fund the design, construction, and maintenance of two bridges at river fords on Richert Farm.	WDFW	Yes	25,000	Yes
55	Allow agency and Tribe representatives to access and inspect project operation and mitigation sites at any reasonable time. Provide WDFW with keys to all gated project access roads.	WDFW	No	Minor	Yes
56	Within 6 months of license issuance, provide evidence of financial security ensuring that Tacoma will be financially responsible and capable of decommissioning the project, removing project facilities, and mitigating environmental impacts. Manage undeveloped project and wildlife habitat enhancement lands for fish, wildlife, and recreation uses in perpetuity, even if Tacoma relinquishes title to these lands.	WDFW	No	Indeterminate	No

[1] Source: the staff.

6.6.1 Major Findings and Staff-recommended Alternative

In this EIS we have evaluated numerous environmental recommendations proposed by Tacoma, resource agencies, and the Tribe for relicensing the Cushman Project. Each recommendation was individually studied to determine its beneficial and adverse effects on the environment, and then reviewed in combination with other recommendations to assist us in identifying the optimum proposal under which to relicense this project. Alternative 3, the staff-recommended alternative, combines elements from Tacoma's Proposal and recommendations from agencies and the Tribe, along with additional enhancement measures developed by staff, and provides the best balance of developmental and non-developmental resources.

Tacoma's analysis and the NPPC's Power Plan clearly indicate that the Pacific Northwest is experiencing load growth and changing energy use patterns, and that the region needs to maintain existing power generation resources. The Cushman Project provides 131 MW of the generating capacity needed in the region. Loss of the project under Alternative 4 would result in an annual energy loss of 101 MW, and would require replacement by new construction or purchase from another source, either of which would increase costs to existing and future customers. Although not as severe as Alternative 4, operating the project under Alternative 2 would result in a significant annual energy loss of 62 MW. Tacoma's Proposal and Alternative 3 would cause minimal annual energy losses of 2 and 5 MW respectively.

6.6.1.1 Mainstem Capacity and Flooding

Flooding has caused considerable problems for residents in the Skokomish River flood plain. Tacoma's Proposal and Alternative 1, no action, would have no effect on the mainstem's aggradation rate or conveyance capacity, thereby not reducing flooding. Although decommissioning the project, Alternative 4, with dam removal would increase peak flows and cause more rapid channel morphometry changes in the lower North Fork and mainstem than Tacoma's Proposal or Alternative 2 or 3, it would dramatically increase flood magnitude. Alternative 2 enhancements would increase flood conveyance capacity and could have the most beneficial effects on reducing mainstem flood hazards; however, this alternative would cause a significant loss of hydropower generation and the higher minimum elevation of Lake Cushman would reduce flood storage capacity.

Under Alternative 3, Tacoma would provide augmented flows to the North Fork that should expand channel capacity and increase sediment transport capacity and would maintain current reservoir operations. Tacoma would study the effects of the augmented flows to develop a mainstem capacity maintenance program and would also participate in implementing projects in Mason County's Final Flood Hazard Management Plan. The combined actions included in Alternative 3 should make it highly effective in reducing mainstem flood hazards, but with minimal loss of hydropower generation and minimal risk to valuable fishery populations.

6.6.1.2 Fisheries

One of the principal objectives of our Alternative 3 is to increase anadromous fish abundance and diversity in the lower North Fork. Agency proposals for restoring full flows to the lower North Fork (Alternative 2) have short-term but manageable risks of adversely affecting water quality and anadromous fish populations.

Alternative 3 would provide a reasonable level of environmental restoration and enhancement. The flow schedule proposed under Alternative 3 would provide habitat conditions under which anadromous fish diversity and production would increase, and could establish naturally reproducing chinook and steelhead populations.

Although Tacoma's Proposal would include improving fish passage in Big and Dow Creeks, and stocking Lakes Cushman and Kokanee, its proposed North Fork MIF is not sufficient to support the agency objectives for enhancing fish habitat and populations.

Alternatives 1, no action, and 4, decommissioning without dam removal, would provide no fisheries enhancements in the North Fork and fish populations would likely continue to decline. Alternative 4 with dam removal would provide no structural habitat enhancements and could have adverse effects on habitat and fish populations.

The ability to complement and further enhance fishery enhancement measures, and to form an integrated and comprehensive fish and wildlife plan, were important reasons for adopting our recommended terrestrial enhancement measures. Under Tacoma's Proposal and Alternatives 2 and 3, terrestrial enhancement measures on wildlife habitat parcels would have substantial, long-term beneficial effects on aquatic resources by providing fish cover and rearing areas, supplying organic material to support invertebrate populations that feed fish, and protecting riparian corridors from land-disturbing activities that increase erosion and turbidity and degrade habitat. Without these measures, the success of our recommended anadromous fish habitat enhancements could be severely compromised.

6.6.1.3 Wildlife

Although Tacoma's terrestrial resource proposal would protect and enhance some mature and old-growth forest, wetlands, riparian areas, and the margins of elk migration corridors, it would not meet the agencies' objectives of protecting elk winter range and habitats frequently used by threatened and endangered species. By further including the Southern Lower North Fork, Nalley Ranch, Belfair Wetlands, and Lilliwaup Swamp parcels and thereby protecting elk winter range along with threatened and endangered species habitat in addition to mature forest, riparian areas, and wetlands, Alternative 2 would meet all of the terrestrial resource objectives for the project. The Belfair Wetlands and Lilliwaup Swamp parcels are unaffected by the project, however, and this agency-recommended plan would have such extraordinary costs that it does not represent a reasonable balance of resources. Although Alternative 3's terrestrial resource plan does not include the Belfair Wetlands and Lilliwaup Swamp parcels, it would still meet all of the wildlife habitat objectives for the project, at a much lower cost than the agencies' plan, and represents the best balance of resources to meet the agencies' objectives.

6.6.1.4 Recreation

We evaluated Tacoma's recreation plan and access policy and conclude that Tacoma's Proposal along with WDFW's and our recommended measures provides the best combination of recreation opportunities while protecting terrestrial, aquatic, and aesthetic resources.

Alternatives 2 and 3 would both offset some of the excess demand for camp sites at ONP's Staircase Campground by constructing new campsites at both the Big Creek Campground and at LCSP. Tacoma's Proposal would provide new campsites only at Big Creek Campground. Alternative 3 would also more appropriately pair parking spaces with facility capacity than Tacoma's Proposal and provide more barrier free facilities. Alternatives 1 and 4 would provide no new or enhanced recreation opportunities.

6.6.1.5 Cultural Resources

The lower North Fork and the mainstem contain fishery resources of traditional cultural significance to the Tribe. The mainstem, from its mouth to its confluence with the North and South Forks, has been identified as a possible Traditional Cultural District because of its significance as a traditional Tribal fishing area. Tacoma's Proposal would provide marginal improvements to fisheries habitat and, therefore, marginal benefits to culturally significant fisheries. Alternative 1 would provide no habitat enhancements and, therefore, no benefits. Restoration of near full flows to the North Fork under Alternative 2 or 4 could have adverse effects on some culturally important fish populations. Alternative 3 would provide significant benefits to culturally important fisheries by providing conditions that should increase fish populations but without the risk to fisheries possible under Alternative 2.

Under Alternative 4, decommissioning, properties listed on the National Register of Historic Places could be adversely affected through either physical alteration or demolition, or through deterioration and visual degradation of the surrounding grounds. Tacoma's Proposal and Alternatives 1, 2, and 3 would have no effect on historic structures.

6.6.1.6 Conclusion

Based on our independent analysis, we recommend that the Commission license the project as discussed under Alternative 3. We conclude that our preferred alternative provides the best balance of developmental and non-developmental resources and is best adapted to a comprehensive plan for improving or developing a waterway as defined in FPA Section 10(a)(1).

6.6.2 Summary of Staff's Recommendations

Our Alternative 3 and recommended enhancement measures are summarized as follows.

<u>For geology and soils we recommend the following.</u>

- Conduct all land disturbing construction activities in accordance with a Commission-approved ESCP.
- Conduct annual geomorphic surveys of the lower North Fork for the first 5 years following license issuance to document changes in channel form resulting from the new operating plan.

- Participate in implementing the portion of the Mason County Flood Hazard Management Plan dealing with the Skokomish River and consult with agencies and the Tribe to identify measures to increase conveyance capacity on the mainstem Skokomish River. Tacoma should provide $5 million toward completing this plan.

- Provide up to 25,000 acre-feet per year for 5 years to facilitate analysis of flow augmentation effects on mainstem conveyance capacity.

- Determine adequacy of culverts at FS crossings on McTaggert Creek and replace if necessary.

For water quantity we recommend the following.

- Fund telemetering, maintenance, and operation of the streamgage at USGS Station Nos. 12058800, 12059500, and 12060500.

For water quality we recommend the following.

- Install an adjustable or modified intake to withdraw warmer water from Lake Cushman during the summer and fall months.

- Provide an emergency penstock intake shut-off valve at the Powerhouse No. 2 penstock intake.

- Monitor dissolved gasses at all powerhouse outfalls and spillways during spill events.

- Develop and implement, in consultation with FS, a road management plan for Staircase Road.

For aquatic resources we recommend the following.

- Provide 240 cfs MIFs in the North Fork (or inflow in the summer, whichever is less) with one month at 400 cfs flow in November.

- Provide access to upper Big Creek and Dow Creek by removing barriers to upstream migration.

- Remove the McTaggert Creek diversion.

- In consultation with the agencies, develop and implement a North Fork anadromous fish stocking plan designed to restore and enhance anadromous fish populations to the North Fork and Lake Cushman.

- Stock Lake Cushman with kokanee and cutthroat and Lake Kokanee with rainbow trout as proposed in the resident fishery enhancement plan.

- Develop a plan to monitor fish habitat and populations in the North Fork and prepare a North Fork Fishery Report every 5 years.

- Apply agency-recommended general ramping rates (Hunter, 1992) as soon as possible and until channel form and capacity stabilize so that lower North Fork "critical" flows can be determined.

- Develop a plan, in consultation with the resource agencies, to determine if the new Powerhouse No. 2 turbine runner installation substantially increases fish injury or mortality in the tailrace during project operation. If fish injury and mortality do increase substantially, install a tailrace barrier to prevent fish access.

- Design and construct the Powerhouse No. 3 tailrace such that substantial fish injury and mortality does not occur or construct a tailrace barrier.

For terrestrial resources we recommend the following.

- Develop, in consultation with the agencies, and include in a final construction plan submitted for Commission approval before initiating construction activities, measures such as blast mats and activity restrictions during the osprey breeding season, to minimize disturbance of plants and wildlife during construction of Powerhouse No. 3 and its associated facilities.

- Develop, in consultation with Simpson Timber Company and WDNR, and include in a final construction plan submitted for Commission approval before initiating construction activities, measures to restrict the development of invasive exotic plants and to enhance the development of native trees and shrubs on lands disturbed by removing the McTaggert Creek diversion structure and Dow Creek fish passage barrier.

- If lower North Fork fish habitat studies indicate that structural fish habitat enhancement measures are warranted and are then undertaken, mitigate vegetation disturbance by: avoiding wetlands and other sensitive areas; scarifying and revegetating cleared access roads and skid trails with herbaceous elk forage; covering excavation spoils with cached topsoil and litter; revegetating disturbed wetlands with native wetland plants; revegetating disturbed streambanks with native shrubs; and implementing other measures proposed by Tacoma. Construct lower North Fork instream fish habitat enhancements between May 15th and December 31st to prevent disturbance of wintering bald eagles.

- With the exception of trees that pose a threat to public safety, cut no overstory trees greater than 16 inches dbh on recreation facility improvement sites on the Dry and Copper Creek trails, along Staircase Road, at the FS Big Creek Campground, at LCSP, and at the Lake Cushman overlook.

- Develop, in consultation with FWS, FS, and WDFW, and include in final recreation or construction plans submitted for Commission approval before initiating construction activities, measures such as construction schedule adjustments or other means to prevent disturbance of marbled murrelets and northern spotted owls during construction of the recreation facility improvements on the Dry and Copper Creek trails, along Staircase Road, at the FS Big Creek Campground, and at LCSP.

- Develop, in consultation with NPS, LCDC, and WDFW, and submit for Commission approval within 6 months of license issuance, a plan to provide for monitoring and enforcement of environmental protection measures and land use and activity restrictions on NPS exchange lands, enhancement parcels, other project lands, and LCDC lands.

- Develop, in consultation with NPS, and submit for Commission approval within 1 year of license issuance, a plan to eliminate or control reed canary grass growing on ONP exchange lands.

- Within 2 years of license issuance, acquire the title or development rights (easements) to all lands within the 40-acre Simpson-owned site adjacent to Deer Meadow, the Northern Lower North Fork parcel boundaries recommended by the agencies, the Southern Lower North Fork parcel, and the Purdy Creek boundaries proposed by WDFW.

- In consultation with FWS, FS, WDFW, the Tribe, and any affected landowners including Simpson Timber Company and Skokomish Farms, Inc., develop a final plan that includes specific goals, objectives, and standards for measures to enhance native plant and wildlife populations on the transmission line ROW, reservoirs, and the Westside, Dow Mountain, Deer Meadow, Northern Lower North Fork, Southern Lower North Fork, Purdy Creek, and Nalley Ranch parcels. This plan shall be submitted to the Commission for approval within 1 year of license issuance and amended as needed to include subsequently acquired parcel lands. This plan should include but not be limited to the following recommended measures.

    — Build six nesting and eight osprey perching structures on the project reservoirs, as proposed by Tacoma.

    — Measures to identify all suitable bald eagle and osprey perching, roosting, and nesting trees along the lower North Fork and to protect them from inadvertent cutting or damage.

    — To protect and enhance forest stands on the parcels, the plan should include: cutting patches no larger than 0.25 acre and covering no more than 4 percent of the area in Class 1 and 2 stands; thinning trees only in Class 1 and 2 stands; and monitoring snags in all forest stands and maintaining at least 0.17 snags greater than 21 inches dbh per acre and using alternative snag-creation methods in stands with low densities of large trees.

    — Perform scarifying, herbaceous plant seeding, shrub planting, and other measures necessary to successfully remove and revegetate roads not needed for parcel maintenance. Roads needed for maintenance but not for approved recreation access should be gated.

- Develop, in consultation with the Corps, EPA, FWS, NMFS, WDFW, WDNR, and the Tribe, and submit to the Commission for approval within 1 year of license issuance, a plan to remove dikes, re-establish former tidal channels, and restore estuarine conditions at Nalley Ranch. This plan shall include, but not be limited to, measures to monitor estuarine habitat and population changes in cooperation with highly qualified university or other research institution investigators for no less than 5 years after beginning dike removal, and measures to assess the amount of large woody debris in the estuary and to augment large woody debris if warranted.

For land use, recreation, aesthetics, and socioeconomics we recommend the following.

- Proceed with efforts necessary to exchange lands with NPS and with FS (sections 1.2 and 4.6.1.2).

- Operate Lake Cushman no lower than 738 feet during the peak recreation season (Memorial Day weekend to Labor Day weekend) to maintain the land use, recreation, aesthetic, and socioeconomic value of the shoreline (sections 4.7.8, 4.8.8, and 4.9.8).

- In consultation with FS, improve undeveloped portion of FS Big Creek Campground for organized group overnight and day-use, and improve five existing casual shoreline access sites in the Staircase Road Recreation Area converting existing informal camp sites to day use only (sections 4.7.1.2 and 4.7.4.2).

- In consultation with FS, relocate the Dry Creek Trailhead to a location near Copper Creek to join with the Copper Creek Trail and provide improvements to that trailhead and the Mt. Rose Trailhead (4.7.1.2).

- In consultation with WSPRC improve LCSP for day use, organized large groups, camping, and boating (section 4.7.1.2).

- Provide improvements at Hood Canal Recreation Park, Bear Gulch Access, and Lake Cushman Viewpoint and improve recreation access and opportunities at Lake Cushman by acquiring and developing Lake Cushman Resort for pubic recreational use (sections 4.7.1.2, 4.7.4.2).

- Construct recreation facilities to comply with the Americans with Disabilities Act of 1990.

- In consultation with the Washington SHPO, paint the Cushman No. 2 penstocks a less obtrusive color to reduce their visual impact (section 4.8.8).

For cultural resources we recommend the following.

- Provide a qualified archeologist to periodically monitor McTaggert Creek and the North Fork while the flows are being increased and until stream channels are re-established to ensure against inadvertent scouring of currently undetected archeological sites.

- Consult with the Tribe regarding proposed recreation enhancements to ensure that they do not affect properties of historic or present cultural value to the tribe.

- Design Powerhouse No. 3 and associated facilities to be compatible with existing historic structures.

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