Federal Power Commission
Bureau of Power

FINAL ENVIRONMENTAL IMPACT STATEMENT

ROSS DEVELOPMENT OF PROJECT NO. 553 SKAGIT RIVER, WASHINGTON

March - 1974

FEDERAL POWER COMMISSION
BUREAU OF POWER

FINAL ENVIRONMENTAL IMPACT STATEMENT

LICENSE AMENDMENT
ROSS DEVELOPMENT OF
PROJECT NO. 553 - SKAGIT RIVER,
WASHINGTON

Applicant: City of Seattle
Department of Lighting
City Light Building
1015 Third Avenue
Seattle, Washington 98104

Copies of this statement, Number FPC-PWR-553, may be ordered from:

NTIS - U.S. Department of Commerce
Springfield, Virginia 22151

and

Office of Public Information
Federal Power Commission
Washington, D.C. 20426

March - 1974

FOREWORD

The Federal Power Commission pursuant to the Federal Power Act is authorized to issue licenses for terms up to 50 years for the construction and operation of non-Federal hydroelectric developments subject to its jurisdiction, on the necessary condition:

> (T)hat the project adopted . . . shall be such as in the judgement 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, and for other beneficial public uses, including recreational purposes . . . . *

The Commission may require such other conditions not inconsistent with the provisions of the Act which may be found necessary to provide for the various public interests to be served by the project.** Compliance with such conditions during the license period is required. Section 1.6 of the Commission's Rules of Practice and Procedure allows any person objecting to Licensee's compliance with such conditions, to file a complaint noting the basis for such objection for the Commission's consideration.***

* 16 U.S.C. Sec. 803(a).
** 16 U.S.C. Sec. 803(g).
*** 18 C.F.R. Sec. 1.6 (1973).

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FINAL ENVIRONMENTAL IMPACT STATEMENT

SUMMARY SHEET

1. This Final Statement relates to an administrative action.

2. This action consists of consideration of an application by the City of Seattle, Washington for amendment of the license of the Skagit River Project No. 553, located on the Skagit River in Whatcom County, Washington. Approval of the amendment would provide for raising the structure height of Ross dam by 121 feet and raising the normal full reservoir elevation from 1,602.5 feet to 1,725 feet, constructing a new spillway, replacing the existing turbine runners with new turbine runners designed for a higher head, and modifying outlet works, generators and transformers. The existing reservoir surface of about 11,680 acres at elevation 1,602.5 feet would be increased to approximately 20,000 surface acres at elevation 1,725 feet and would affect lands in both the United States and Canada. The U.S. section of the Ross reservoir is within the boundary of the Ross Lake National Recreation Area which is administered by the National Park Service (NPS) of the U.S. Department of the Interior. The existing recreation facilities at Ross Lake would be relocated at a higher elevation in accordance with standards of the NPS. The Ross development, which is the uppermost in a series of three developments of Project No. 553, provides for flood control in addition to regulating the flow for hydroelectric power production.

3. Environmental impacts due to increasing the height of the dam and reservoir and future operation of the project would include: (1) inundation of about 8,300 acres of U.S. and Canadian land which would eliminate a forested wildlife habitat, fish spawning areas and recreational use of the land; (2) elimination of the free-flowing river and free-flowing streams from elevation 1,602.5 feet to 1,725 feet; (3) change in recreational and scenic values of the inundated area from stream-type to reservoir-type; (4) reducing the extent of the maximum drawdown from 127.5 feet with the existing project to 56.2 feet with the High Ross proposal; (5) reducing the average water temperature of the Skagit River downstream from the project with attendant effects on the biota; (6) providing easier access for the public to

reach Ross Lake and thereby increasing the recreational use of the Ross basin; (7) economic benefit to the area resulting from an increased number of visitors to the project area; and(8) increasing the installed capacity of the project by 235,000 kw and the annual generation of energy by a minimum of 315,000,000 kwh.

During the expected 2 year construction period, the reservoir would be lowered and maintained at an elevation below 1,600 feet. Water quality, recreational use, scenic values and fish production would be adversely affected during this period.

4. Alternatives considered include the construction of thermal generating facilities, alternative hydroelectric projects, purchase of power from another source, exotic sources, no action, conservation of energy and denial of the application for amendment of the license.

5.a. Comments on the draft environmental impact statement were requested from the following agencies and organizations. An asterisk (*) denotes those agencies and others from whom timely responses were received. All comments received prior to the printing of this statement are included in Appendix H.

FEDERAL AND REGIONAL

Atomic Energy Commission *
Department of Agriculture, U.S. Forest Service
Department of Commerce *
Council on Environmental Quality
Department of the Army, Corps of Engineers *
Department of Health, Education and Welfare *
Department of the Interior
Department of Transportation *
Environmental Protection Agency *
Department of State
International Joint Commission
Pacific Northwest River Basins Commission

STATE

Department of Ecology *
Office of Program Planning and Fiscal Management
Department of Fisheries *
Department of Game *
Department of Highways
Utilities and Transportation Commission
Department of Natural Resources
State Planning and Community Affairs Agency

Interagency Committee for Outdoor Recreation *
Parks and Recreation Commission
Skagit County, Washington
Skagit County Planning Board
Whatcom County, Washington

5.b. Parties to the Proceeding:

State of Washington, Department of Ecology *
State of Washington, Department of Fisheries *
State of Washington, Department of Game *
R.O.S.S., _et al._, and Davis M. Brousson, MLA *
The Wilderness Society, _et al._ *
The North Cascades Conservation Council *
The City of Seattle, Washington *

6. The final statement was sent to the Council on Environmental Quality and made available to the public on or about March 15, 1974.

FINAL ENVIRONMENTAL IMPACT STATEMENT

ROSS DEVELOPMENT OF PROJECT NO. 553 -
SKAGIT RIVER - WASHINGTON

Introduction

On December 17, 1970, the City of Seattle, Washington, Department of Lighting (Applicant) filed an application to amend its license for the Skagit River Project No. 553. The application contains a proposal to increase the structural height of Ross Dam from a crest elevation of 1,615 feet to 1,736 feet, an increase of 121 feet, and raise the elevation of the normal full reservoir from 1,602.5 feet to 1,725 feet, an increase of 122.5 feet. The reservoir surface area would be increased from about 11,700 acres at elevation 1,602.5 feet to about 20,000 acres at elevation 1,725 feet. The surface of the reservoir at elevation 1,725 feet would measure about 14,800 acres in the United States and about 5,200 acres in British Columbia, Canada. The reservoir at elevation 1,725 feet would extend an additional seven miles into Canada. At the present elevation of 1,602.5 feet it extends about one mile into Canada. The additional land acreage to be covered by the High Ross development would amount to about 4,720 acres in Canada and 3,600 acres in the United States.

The proposed action of raising Ross dam and its reservoir would result in significant environmental impacts in both the United States and Canadian sections of the project area. The Governments of Canada and the United States, on April 7, 1971, requested the International Joint Commission (IJC) to investigate the environmental consequences in Canada of raising Ross Lake. An inquiry by the IJC was conducted in 1971 and included work of a composite team of professionals having expertise in various fiels appropriate to the inquiry and input from the record of public hearings held in the general area of the Skagit River Project. A report entitled "Environmental Consequences in Canada of Raising Ross Lake in the Skagit Valley to Elevation 1,725" was prepared by the IJC in 1971 from information gathered from the inquiry and from the public hearings. An array of significant environmental impacts which could result from raising the reservoir are described in the IJC report, as well as recommendations for mitigation of possible losses to the natural resources. This report is valuable for identifying environmental impacts which would be expected in Canada and is attached hereto as

Appendix F.

Many of the comments on the Draft Environmental Impact Statement (DEIS) expressed concern that the expected environmental impacts in Canada from approval of the proposed action were not fully recognized. Staff has relied heavily on the IJC report for the study reported therein, and the body of the Final Environmental Impact Statement (FEIS) gives full recognition to the environmental impacts in Canada. From a review of the application, including applicant's environmental report, it is obvious that the proposed action would have major environmental impacts in the Canadian section of the Ross basin. This concern was recognized by the governments of both the U.S. and Canada which directed the IJC: (a) "to investigate the environmental and ecological consequences in Canada of the raising of the Ross Lake to an elevation of 1,725 feet above mean sea level, taking into account relevant information about environmental and ecological consequences elsewhere on the Skagit River, and measures being taken or planned to protect and enhance the environment in these areas; (b) in the light of its findings, to report on the nature, scope and impact of these consequences; (c) to make recommendations, for the protection and enhancement of the environment and the ecology of the Skagit River Valley not inconsistent with the Commission's Order of Approval dated January 27, 1942, the Agreement required thereby between the City of Seattle and the Province of British Columbia dated January 10, 1967, and the purposes for which such Order of Approval was granted." The IJC is the appropriate body to consider international environmental matters between the U.S. and Canada resulting from the raising of Ross dam. Examination of the IJC report referred to above indicates that this was done. Therefore, the value of its Skagit Valley report is recognized as displaying the significant environmental effects in Canada for public review. While the IJC report does not follow the format of NEPA, and was not prepared as an environmental impact statement, it does provide a current study of the possible environmental consequences of approval of the proposed action by the only Agency authorized by both governments to investigate this matter. The IJC report should be thoroughly studied by all those interested in the environmental effects which could result from raising the height of Ross dam.

The Applicant has contracted for environmental studies of the Ross basin with the University of Washington, F. F. Slaney and Company, Limited, and others. The following reports prepared by Applicant's consultants are available for review in the Office of the Applicant (City of Seattle Department of Lighting) and in the offices of FPC Staff.

(1) "The Aquatic Fnvironment, Fishes and Fishery, Ross Lake and the Canadian Skagit River" Interim Report Volume 1, November 1972.

(2) "The Aquatic Environment, Fishes and Fishery, Ross Lake and the Canadian Skagit River" Interim Report No. 2, Volumes I and II, May 1973.

(3) "Environmental Investigations, Proposed High Ross Reservoir, Canada", Volumes I, II, III, IV, V, as of March 31, 1973.

(4) "Biotic Survey of the Ross Lake Basin" Report for January thru December 1971.

(5) "Biotic Survey of Ross Lake Basin" Report for January thru December 1972.

Many of the reports generated from these contracts describe the environment of the proposed expanded development in the U.S. and Canada and suggest measures which might be taken to mitigate losses of natural resources in Ross basin. The data in these reports have alos been considered in preparation of this final environmental impact statement because they represent the most recent and comprehensive studies of the environmental resources in both the U.S. and Canadian sections of the development area and are the basis for the conclusion that the IJC Report could properly be used to reflect the environmental issues in the Canadian portion of the Ross basin without paraphrasing it in the format of the conventional environmental impact statement. In using the IJC report for purposes of reflecting the environmental issues in the Canadian portion of the Skagit River Valley, it should be understood that the conclusions of the report have not been adopted. Staff reserves the right to amend and change any environmental recommendation should further evidence be adduced during the hearing call for such action.

1. DESCRIPTION OF THE PROPOSED ACTION

1.1 PURPOSE

The primary purpose of the proposed raising of Ross Lake from its present normal maximum pool elevation 1,602.5 feet (msl) to normal maximum pool elevation 1,725.0 feet (msl) is to increase the power output of the Ross powerplant. Ross development as constructed contains four hydroelectric generating units having an at site dependable peaking capacity of 252 mw during the 42.5-month West Group, Pacific Northwest System critical period (hereinafter referred to as critical period). (The critical period is the period when the limitations of hydroelectric power supply, due to water conditions, are most critical with respect to system load requirements). The critical period dependable capacity of the proposed High Ross development would be 525 mw at site. The increase in power output would be due entirely to the increase in pressure head on the turbines caused by the higher water surface elevation. The existing turbines would remain, but the turbine runners would be replaced with new runners to accommodate the increased pressure head. The usable storage of the reservoir would be unchanged, therefore the hydraulic operation of the proposed High Ross Lake would be essentially the same as the hydraulic operation of the existing Ross Lake. The existing generators and associated transmission equipment would require some modification. Maximum reservoir drawdown would be 56.2 feet for High Ross Lake compared to 127.5 feet for existing Ross Lake. The proposed development would provide additional electric power for the Seattle metropolitan area and also would provide additional bulk power for the West Group of the Pacific Northwest Utilities Conference Committee (West Group).* Power producing members of the West Group are listed in Table 1-1.

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*The "West Group" is composed of 16 utilities in the Northwest power pool which supply bulk power in the entire state of Washington, the panhandle of Idaho, Oregon except for the southeastern part of the state, a portion of Northern California, The Bonneville Power Administration (BPA) and Pacific Power & Light Company's service loads in Montana, and includes the BPA loads and the U.S. Bureau of Reclamation resources in Southern Idaho.

TABLE 1-1

Power Producing Members of The West Group

Public

1. City of Eugene
2. City of Seattle
3. City of Tacoma
4. Chelan County PUD
5. Clark County PUD
6. Cowlitz County PUD
7. Douglas County PUD
8. Grant County PUD
9. Grays Harbor PUD
10. Pend Oreille PUD
11. Snohomish County PUD
12. U.S. Corps of Engineers
13. U.S. Bureau of Reclamation
14. Others

NonPublic

15. Pacific Power & Light Company
16. Portland General Electric Company
17. Puget Sound Power & Light Company
18. The Washington Water Power Company

Applicant's electric generating plants provide 1,257 mw of hydroelectric capacity (critical period capacity) and 62 mw of steam electric capacity.** In addition, Applicant has contracted for 124 mw of hydroelectric capacity from others and purchased additional power from Bonneville Power Administration (BPA), the marketing agency for federal power in the Pacific Northwest. The proposed Ross redevelopment would add 273 mw of at-site dependable capacity and 315,000,000 kwh of at-site annual energy during a repetition of the critical streamflow period. Applicant plans to install, but has not ordered, 60 mw of gas turbines and will have an eight percent allotment (112 mw) from Centralia steam-electric plant available in Fiscal Year (FY) 1981. (A Fiscal Year is defined as the 12 month period from July 1 to June 30 next.) As a preference customer, Applicant plans to purchase from 147 to 236 mw of firm power in varying amounts annually from BPA through FY 1977. With existing generating plants, purchased power, the Ross increment, and other arrangements, Applicant's FY 1977 total net resources will be 2,027 mw critical period capacity and 8,935,200,000 kwh critical period energy (18).

Applicant's 1972 peak demand was 1,456.5 mw on December 7 (FPC Form 12). The estimated FY 1977 peak demand is 1,747 mw and estimated annual energy requirement is 8,908,920,000 kwh. Applicant's estimated capacity resource less estimated demand is 280 mw, which provides a reserve margin of about 16.0 percent. Without the Ross increment and without obtaining the power from BPA, Applicant would have a capacity deficit of 228 mw or about 13 percent and its system would have a critical period energy deficit of 2,338,920,000 kwh, or about 26.3 percent.

Included among the West Group's existing and scheduled resources are: the coal-fired Centralia #1 and #2 generating units; the nuclear-fired Trojan plant scheduled for operation in 1975; and the hydroelectric Grand Coulee powerhouse #3 units which are scheduled over a lengthy period running from February 1974 through September 1993. The estimated incremental output of High Ross is shown in publications of the Pacific Northwest Utilities Conference Committee, including the "West Group Forecast" of February 1, 1973, and "Long Range Projection

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**Hydroelectric plants: Cedar Falls, Gorge, Diablo, Ross, Boundary, and Newhalem. Steam electric plants: Lake Union and Georgetown.

of Power Loads and Resources for Thermal Planning" dated April 9, 1973. Our estimate of the earliest that the power increment due to raising Ross dam could be made available is about January 1, 1977. Therefore, power produced by High Ross will follow Centralia and Trojan and will be concurrent with some of the Grand Coulee Powerhouse #3 units.

It is customary practice for the power systems of the Pacific Northwest to plan the addition of new electric power generation so that the area will not suffer a power deficit, peaking or otherwise. The power increment to be provided by High Ross is part of the planned additions. The addition would be 0.8 percent of total West Group area peaking capability (West Group Forecast 2/1/73) in 1980. High Ross as modified would be 1.6 percent of the area's 1980 peaking capability.

The need for the Ross power increment is shown by the above analysis of Applicant's system as if isolated. However, since the Applicant does not operate singly but as a member of the West Group, which is operated on a coordinated basis, it is the latter operation that is most important. The West Group's power supply is predominantly hydroelectric, and because of this, optimum power output depends upon the optimum use of streamflow. The 42.5-month critical streamflow period for the Pacific Northwest region is not necessarily the critical streamflow period for each stream in the West Group region. The critical period is, however, the basis for determining optimum power production on a coordinated basis and all operating members of the West Group utilize this regional historic water supply to determine dependable capacity and energy.

The West Group's generating plants for FY 1977 with all planned new capacity on schedule would comprise 24,215 mw hydroelectric, including Ross increment, 161 mw imports, 994 mw gas turbines, and 3,990 mw steam-electric and miscellaneous, for a total 29,360 mw of capacity. The estimated critical period energy resource is 15,972 average mw, or 139,915,000,000 kwh for the year. The West Group's estimated total peak demand for FY 1977 is 26,629 mw and the estimated energy requirement is 145,039,000,000 kwh. Subtracting the estimated peak load from the available capacity gives 2,731 mw gross margin for reserve, or about 10.3 percent. Without the Ross increment, the gross margin for reserve would be 2,458 mw, or about 9.2 percent. Subtracting the estimated energy load requirement from the estimated critical period annual energy supply gives an estimated annual energy deficit of about 5,124,000,000 kwh or 3.5 percent. Without the Ross increment, the annual average energy deficit would be 5,439,000,000 kwh or about 3.8 percent.

Staff analyses for the National Power Survey, 1970, (12) showed a national average reserve requirement of about 20 percent of estimated peak demand. Individual analyses varied within a range of 15 to 26 percent, reflecting differences in unit size and types and characteristics of generation. Thus, the West Group reserve margin of about 10.3 percent, with Ross addition, is lower than the reserve margin generally provided.

Ross reservoir is operated to provide 120,000 acre-feet of storage space between elevations 1,602.5 feet and 1,592.1 feet for flood control purposes. According to an agreement with the Corps of Engineers, annual reservoir drawdown must commence no later than October 1, and must be completed to elevation 1,592.1 feet by December 1. After March 15, refill of the reservoir to maximum elevation 1,602.5 is permitted. With Ross Lake raised to normal maximum elevation 1,725.0 feet, the same amount of storage capacity for flood control could be provided between elevation 1,725 feet and 1,719.1 feet. The Corps of Engineers has indicated that on the basis of preliminary studies it may be desirable to increase the total flood control storage provided at Ross reservoir.

Any downstream commercial navigation would be unaffected by the proposed Ross redevelopment, because releases from High Ross powerplant would be reregulated by Diablo and Gorge reservoirs of Project No. 553. Also the volume of water released from the enlarged Ross Lake would be the same as that from the existing reservoir. Consequently, the release pattern through Gorge powerplant after High Ross dam is constructed would be the same as that with the existing Ross project.

The usable storage in existing Ross reservoir is 1,052,000 acre-feet between elevations 1,475.0 and 1,602.5 feet which provides almost complete regulation of the at-site streamflow. Raising Ross Dam would not require changing the amount of usable storage in the reservoir since the inflow regimen would be unchanged and the project operation essentially the same. Raising the reservoir would increase the pressure head on the turbines, thus increasing the ratio of power output per cfs discharge. With the reservoir at a normal maximum pool elevation of 1,725.0 feet, the hydraulic capacity of the turbines at full plant output (529 mw) would be about 13,500 cfs. This compares to the existing turbine hydraulic capacity of about 15,000 cfs at full plant output (450 mw) with Ross Lake at normal maximum pool elevation 1,602.5 feet. The maximum hydraulic capacity of the turbines with High Ross reservoir at minimum pool elevation 1,668.8 feet would be about 15,600 cfs (522 mw) as compared to about 12,600 cfs (218 mw) for the existing development at its minimum pool elevation of 1,475.0 feet.

Average water use during the 42.5-month critical period, the lowest streamflow period of record (i.e., August 16, 1928 - to February 29, 1932), would be about the same for both the existing and proposed high dam developments, since no spill is anticipated during this period. The average regulated power discharge during this period would be about 2,800 cfs (2,000,000 acre-feet per year), of which about 2,390 cfs (1,700,000 acre-feet per year) would be from streamflow and 410 cfs from the 1,052,000 acre-feet of usable storage which would be released over the 42.5-month critical period.

A proposed recreational development plan for High Ross Lake reservoir has been included in the application for amendment of license. In general the plan calls for replacement of existing facilities that would be inundated by the higher reservoir. The replacement campgrounds would be constructed to substantially higher standards than those found at the existing sites. In addition, day-use, over-look, and reservoir access facilities would be provided near the dam. The recreation plan, modified to include development of the reservoir access area at the dam, satisfies minimal initial development needs as defined by the Secretary of the Interior (letter to licensee dated December 20, 1972). Also, since the reservoir is within the Ross Lake National Recreation Area, all recreation facility design, site locations and construction require National Park Service (NPS) approval. All recreation facilities provided by the Applicant at Ross Lake will be owned, operated, and maintained by the NPS.

1.2 LOCATION

The Ross development is located on the Skagit River in eastern Whatcom County, Washington. The upper reach of Ross reservoir crosses the international boundary and extends about one mile into the Canadian Province of British Columbia (see Figures 1-1 and 1-2). Raising Ross Reservoir to elevation 1,725 feet would inundate

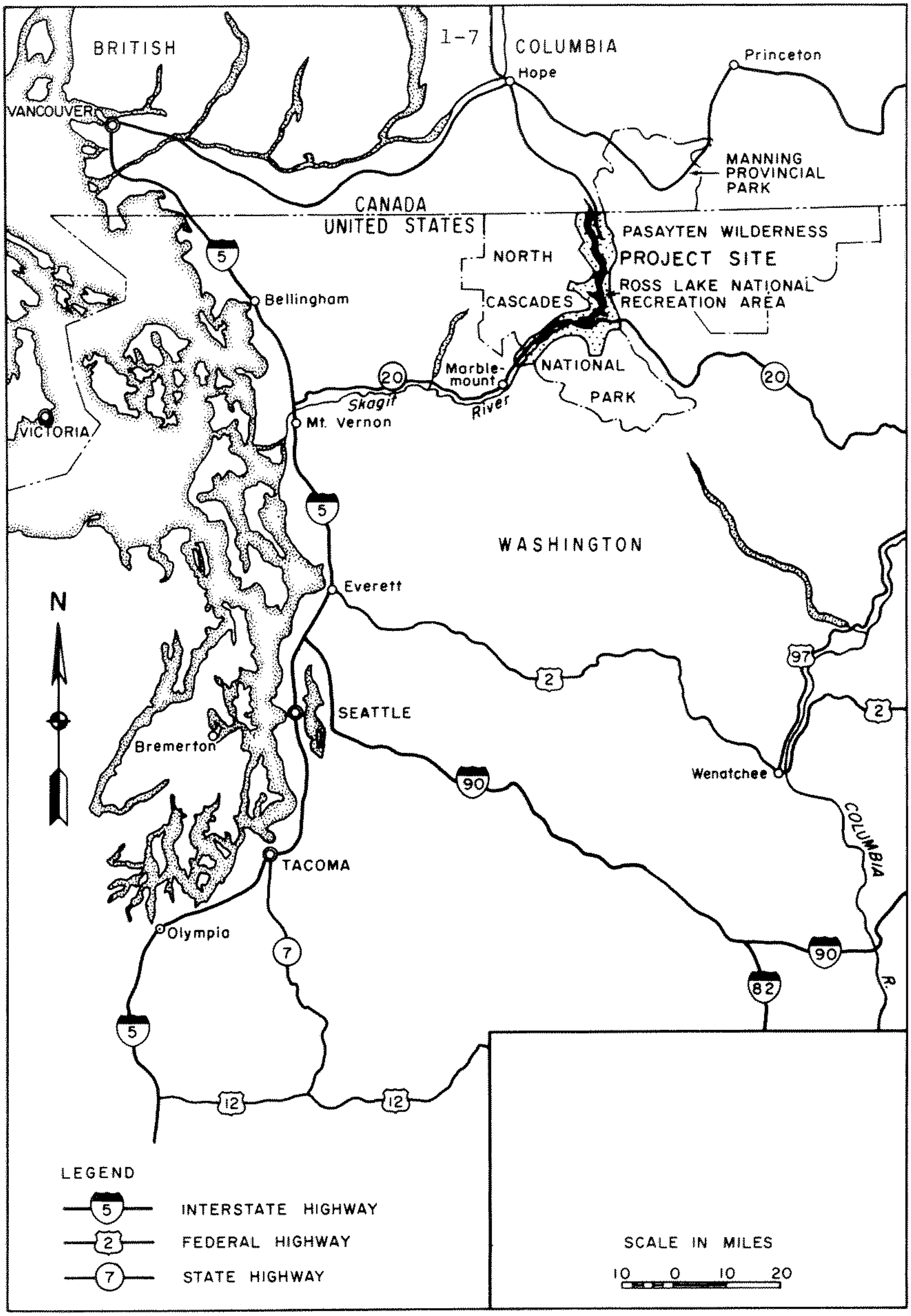


Figure 1-1. PROPOSED HIGH ROSS PROJECT (FPC No. 553), LOCATION MAP

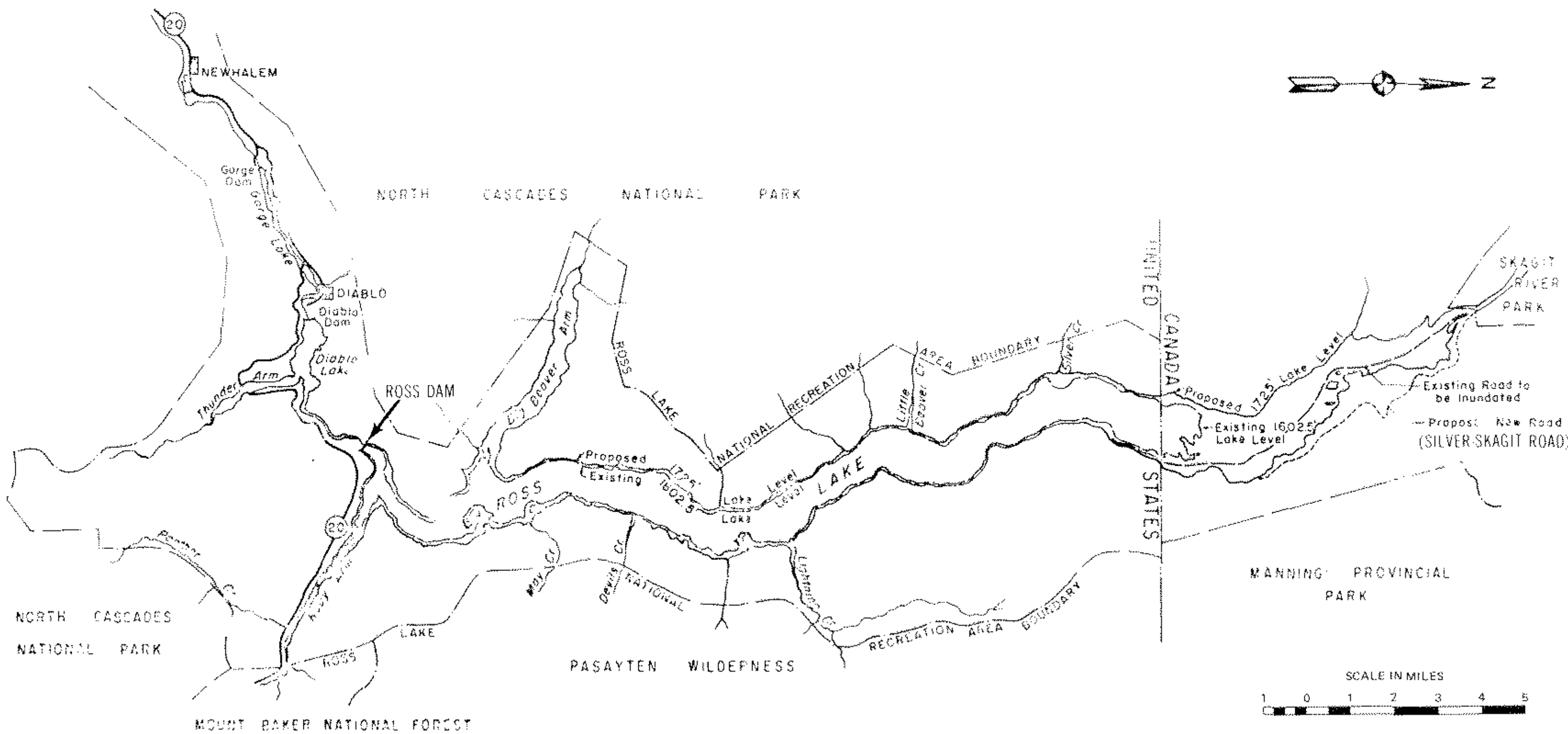


Figure 1-2. PROJECT AREA

approximately 7.4 additional square miles of the Skagit River Valley in British Columbia and 5.6 square miles in Washington.

The Ross development is an integral part of an overall hydroelectric scheme known as the Skagit River Project, licensed by the Federal Power Commission as Project No. 553. The Skagit River Project also includes the Diablo and Gorge developments located in series immediately downstream from Ross. The main features of the Diablo development are a concrete arch dam approximately 386 feet maximum height above river bed and a powerhouse containing two main and two auxiliary generating units having a dependable capacity of 159 mw during the critical period. The main features of the Gorge development are a concrete arch dam approximately 270 feet maximum height above river bed and a powerhouse containing four generating units having a dependable capacity of 175 mw during the critical period. All of Project No. 553 within the U.S. is within the Ross Lake National Recreation Area, created by Act of Congress in 1968 (P.L. 90-544).

The village of Marblemount, Washington, is located on State Route 20 about 28 miles southwest of Ross dam. The nearest Canadian community, Hope, British Columbia, is located 40 miles northwest of Ross Lake.

The location of the High Ross development in relation to the existing Diablo and Gorge power developments, and other power developments in the Skagit River Basin, is shown on Figure 1-3.

1.3 PROPOSED FACILITIES

1.3.1 <u>Project Works</u>

The principal item of construction described in the application for amendment of license for Project No. 553 would consist of raising Ross dam an additional 121 feet to a crest-roadway elevation of 1,736 feet (Figures 1-4 and 1-5). This would permit the storage of water in Ross reservoir to an elevation of 1,725 feet. In addition, the existing power intake structure would be modified (Figure 1-6), the spillway would be reconstructed at a higher elevation, and the powerhouse turbine runners would be replaced. Applicant also would construct new recreation facilities, including an access road and trails (Figure 1-7).

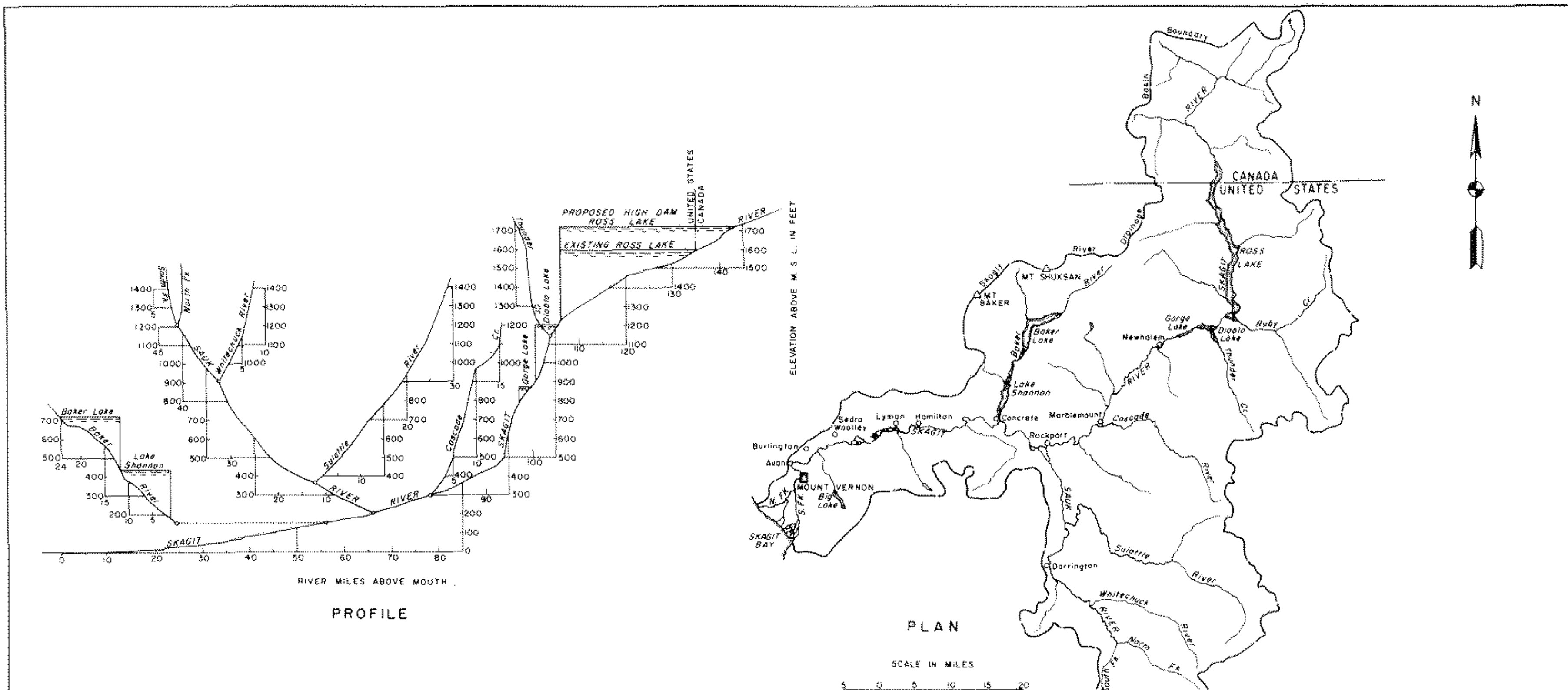


Figure 1-3. SKAGIT RIVER BASIN PLAN AND PROFILE

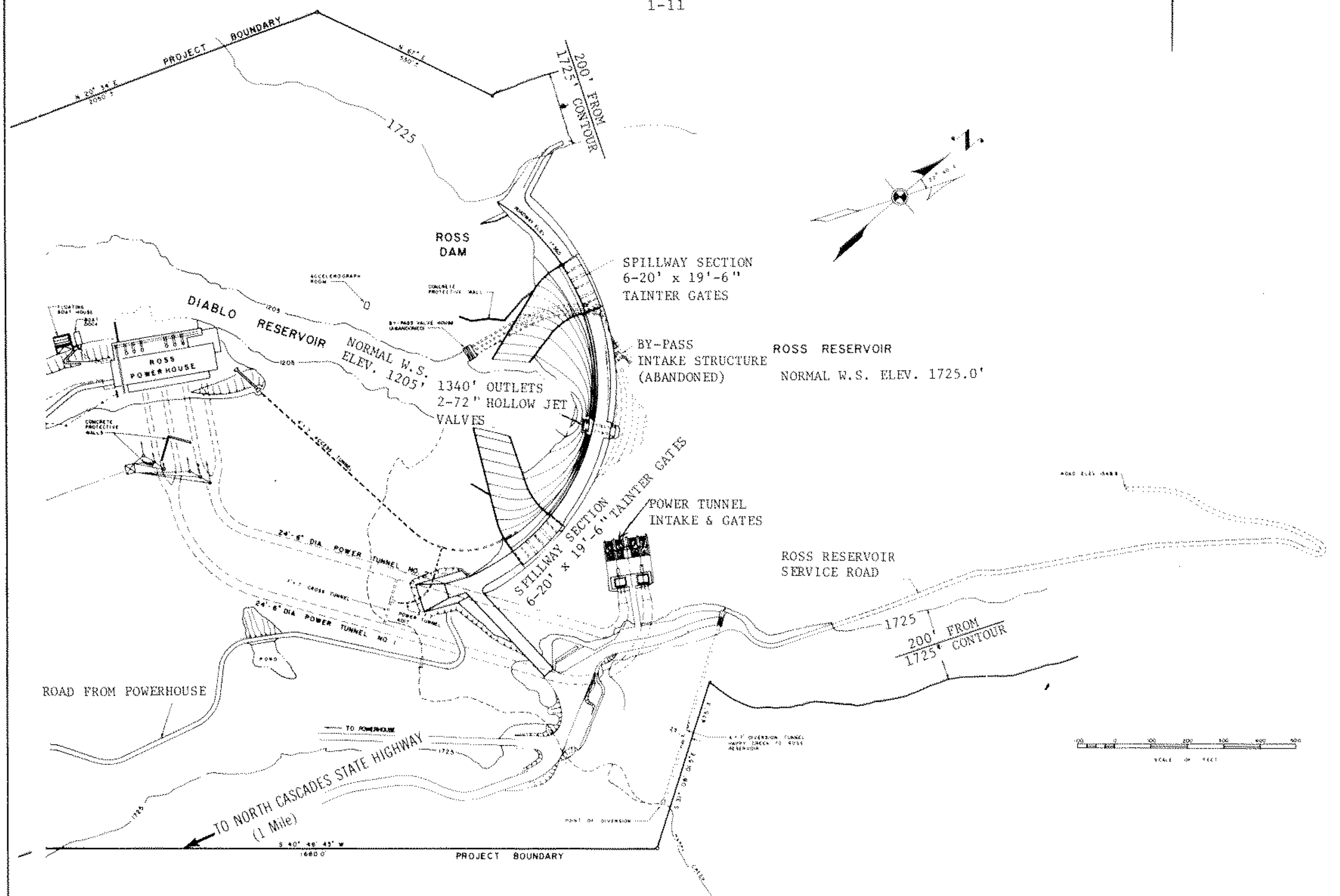
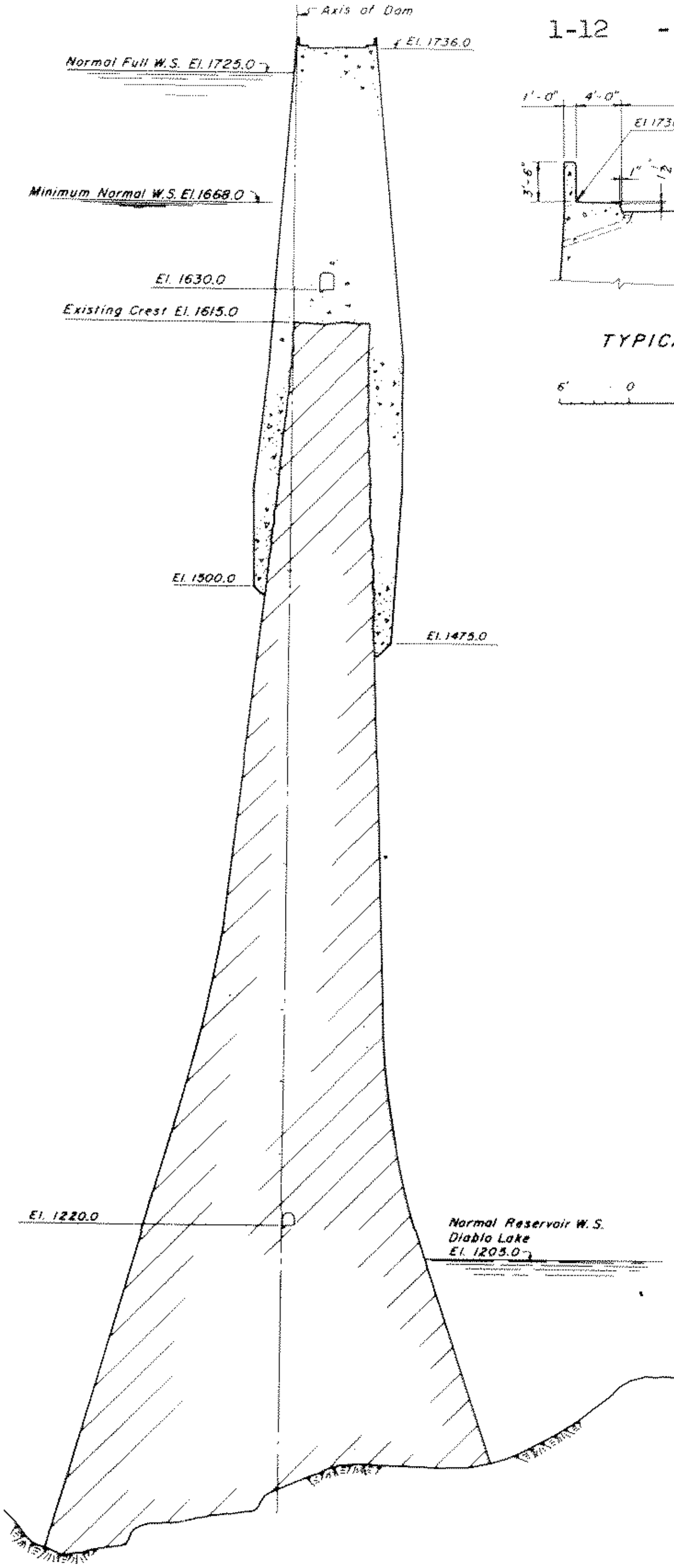


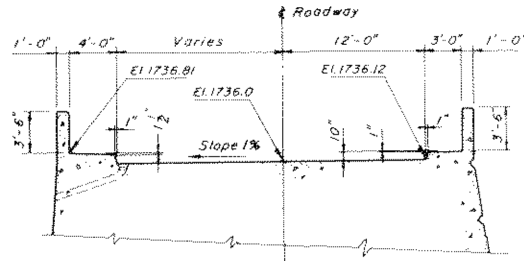
Figure 1-4. MAP OF ROSS PROJECT, GENERAL ARRANGEMENT AND PROJECT BOUNDARY AS PROPOSED



MAXIMUM SECTION

Scale: 1" = 30'-0"

20' 10' 0 20' 40' 60' 80' 100' 120' 140' 160'



TYPICAL ROADWAY SECTION

Scale: 1" = 6'-0"

6' 0 6' 12' 18' 24' 30'

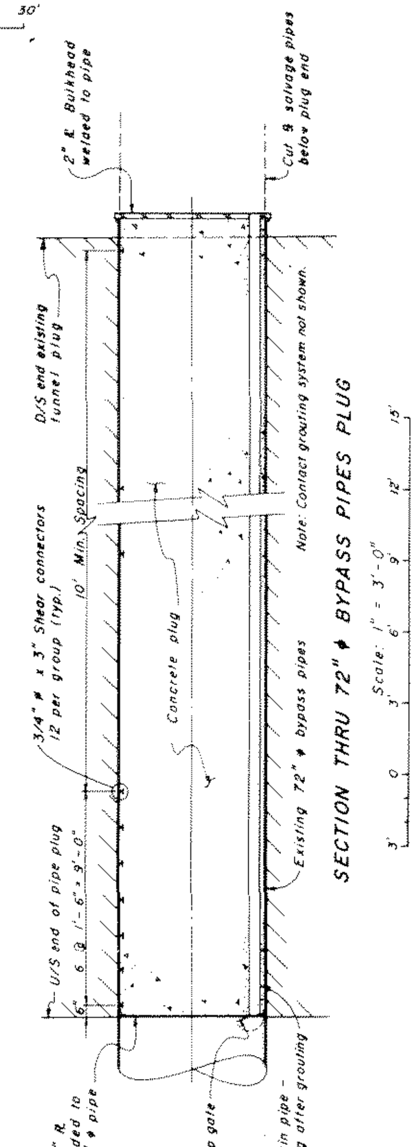


Figure 1-5.

PROPOSED HIGH DAM (TYPICAL SECTION)

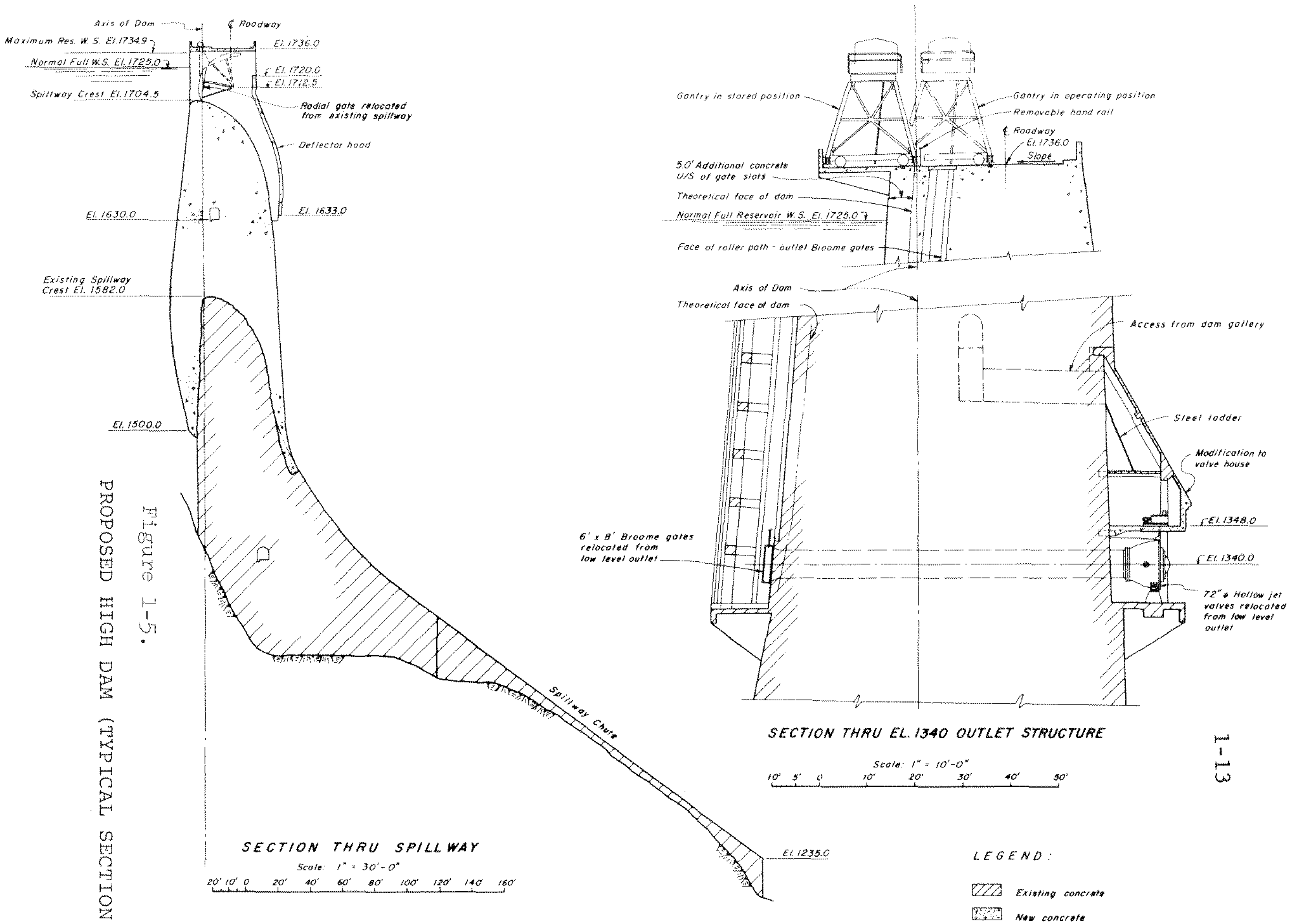


Figure 1-5.
PROPOSED HIGH DAM (TYPICAL SECTION)

Continued

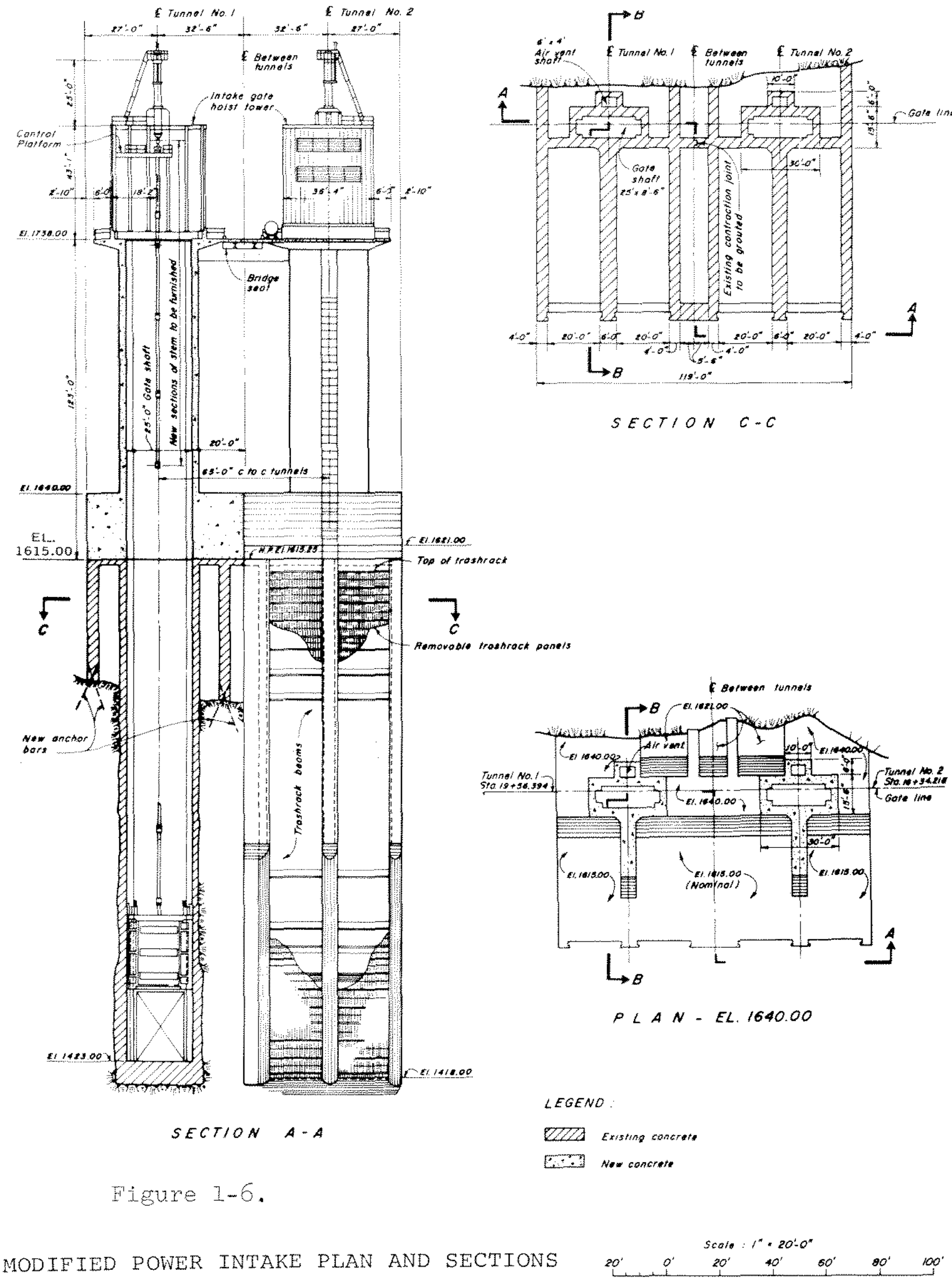


Figure 1-6.

MODIFIED POWER INTAKE PLAN AND SECTIONS

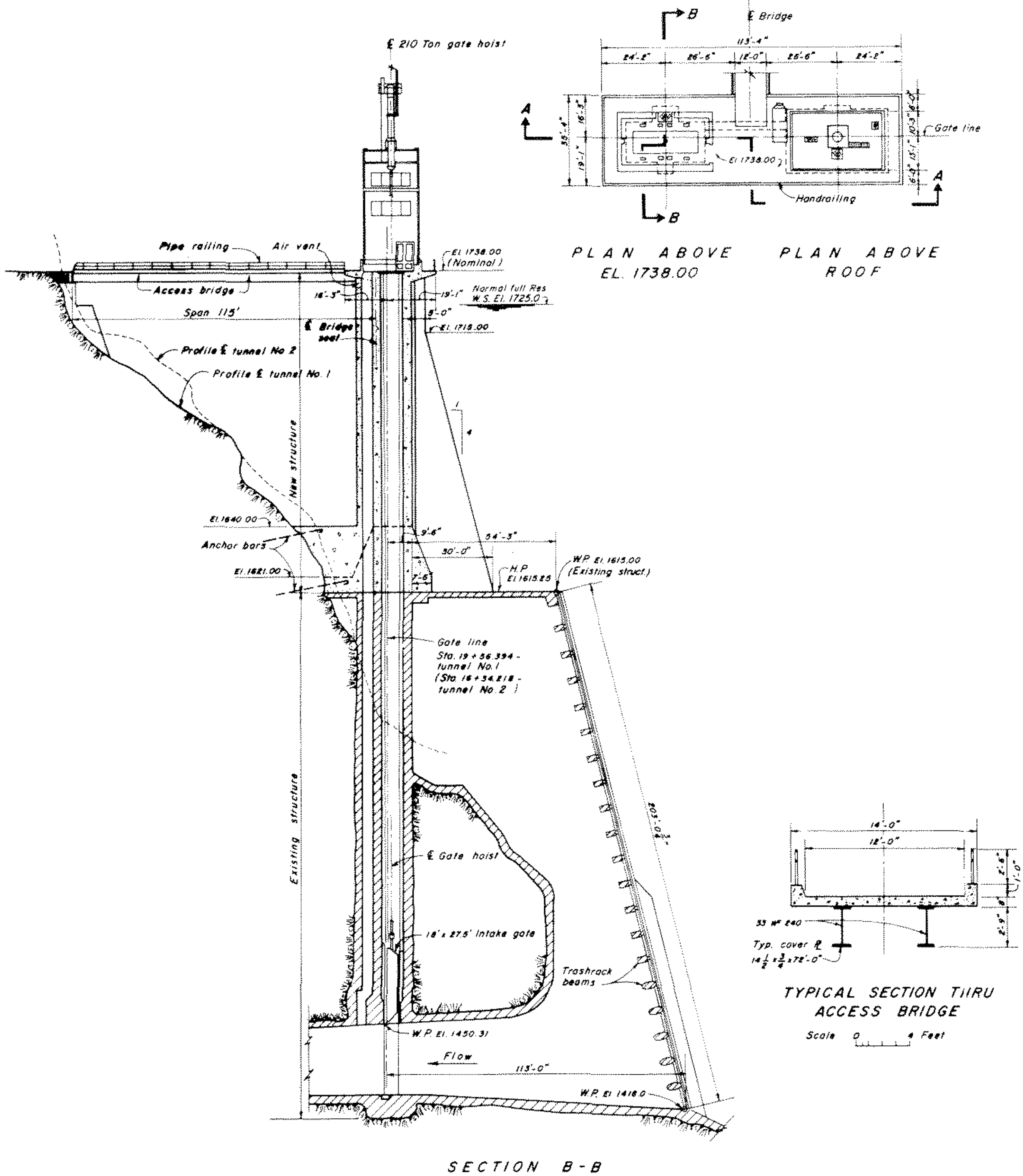


Figure 1-6. MODIFIED POWER INTAKE PLAN AND SECTIONS

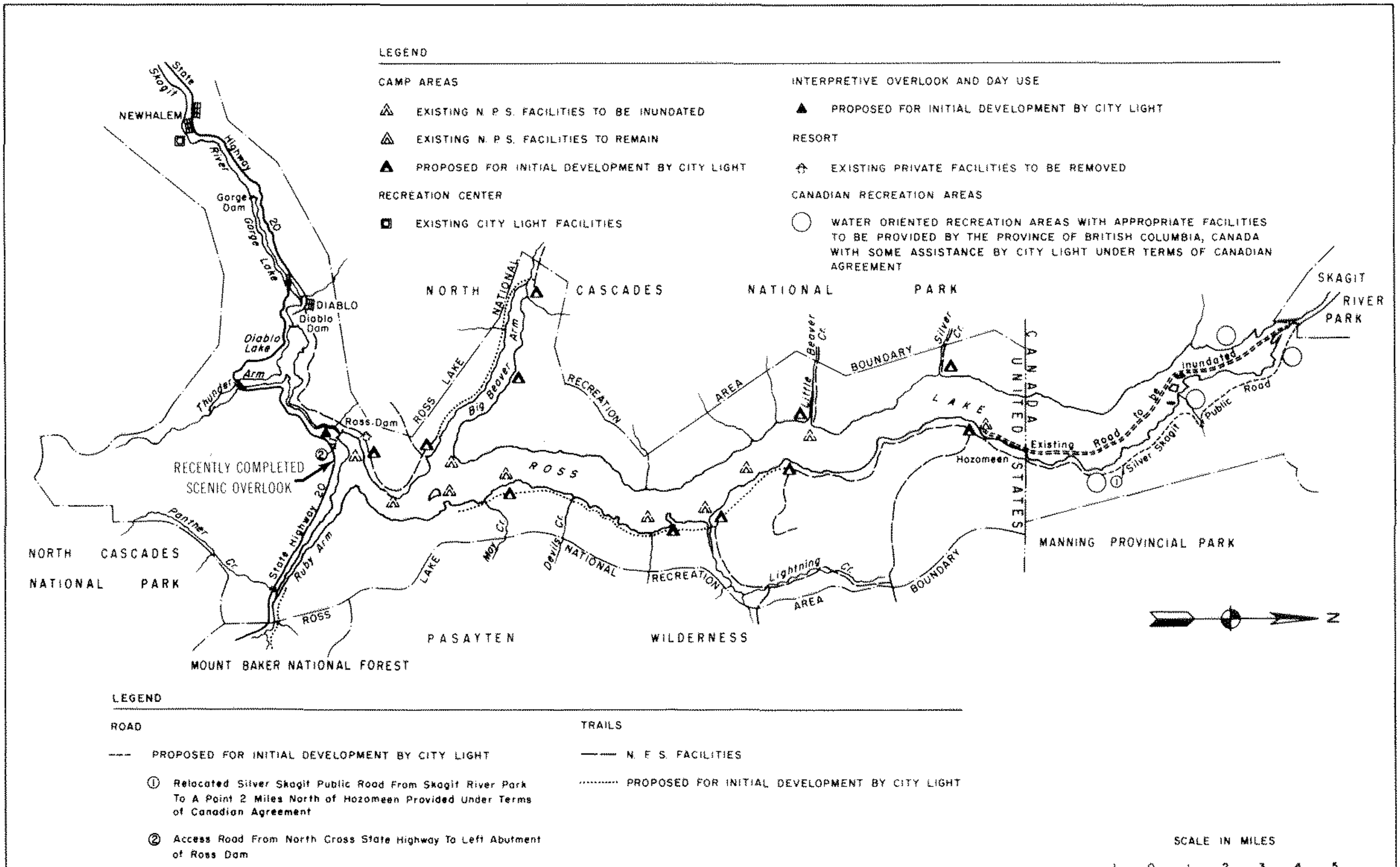


Figure 1-7. APPLICANT'S RECREATION DEVELOPMENT

In raising the existing Ross dam the general arch geometry of the existing structure would be maintained. A concrete thrust block and a 300-foot-long gravity section would be constructed to extend the proposed high dam to the left abutment. The proposed design would permit vehicular access to the crest roadway. Two new spillways, which would retain the configuration of the existing structures, would be constructed at a higher elevation. The twelve radial gates now used to control spillway discharges would be relocated to the new spillway section. Power intake gate hoist machinery and appurtenant enclosures now in use would be relocated to the new intake structure.

Original plans for Ross dam provided for the addition of concrete to the entire downstream face whenever the dam would be raised from elevation 1,615 to its ultimate height. Hence, in initial construction stages, a waffle-shaped pattern of square and vertical keys was formed on the downstream face to bond the old concrete with the planned new concrete. Model studies, stress analyses, and material testing programs indicate, however, that the dam could be safely raised by bonding new concrete to the existing dam only from elevation 1,500 feet to elevation 1,615 feet on the upstream surface, and from elevation 1,475 feet to elevation 1,615 feet on the downstream surface, then continuing the geometry from the top of the dam from elevation 1,615 feet to elevation 1,736 feet.

1.3.2 Recreation Facilities

Enlarging the reservoir would inundate approximately 15 miles of trails and 13 public campgrounds ranging in size from one to 59 units, all operated by the National Park Service. The inundated campgrounds would be replaced by ten new campgrounds having a total of 100 campsites. Each new campground would have improved water and sanitary facilities and a boat access dock. Nineteen miles of new trails would replace those inundated. In addition, Applicant would construct an overlook, including interpretive exhibits, and a modest picnic area near the left abutment of the dam (Figure 1-7). A four-lane concrete boat launching ramp together with a courtesy dock, fish cleaning station, restrooms, and paved parking area for 341 car-trailer units, would complete development at this location (Figure 1-8). These new facilities at the dam would allow an additional 46,300 visitor access to the reservoir each year. Assuming a recreation day value of $1.95, the additional facilities at High Ross

Figure 1-8. ARTIST'S CONCEPTION OF HIGH ROSS DEVELOPMENT

would increase annual recreation benefits by $90,300. Conversely, annual costs for these facilities is estimated to be $110,400 at an interest rate of 5-3/8 percent.

1.3.3 Reservoir

The proposed construction of High Ross dam would raise the maximum level of Ross Lake by 122.5 feet to elevation 1,725 feet and increase the length of Ross Lake from 22 miles to 29 miles. A comparison of physical characteristics of the existing reservoir with those of the proposed reservoir is shown in Table 1-2.

Total inflow and discharge from the proposed, enlarged reservoir would not change. Fluctuations in reservoir elevation, however, would be less than at present because of the relationship between reservoir drawdown and capacity.

Water surface elevations of the proposed, enlarged reservoir would fluctuate annually a maximum of 56.2 feet (between elevation 1,668.8 and elevation 1,725 feet), as compared to the 127.5 feet fluctuation of the existing reservoir.

Table 1-2

ROSS RESERVOIR
COMPARATIVE PHYSICAL DATA

	Existing Reservoir	Enlarged Reservoir
Elevation, maximum	1,602.5 feet	1,725.0 feet
Elevation, minimum	1,475 feet	1,669 feet
Storage, maximum	1,435,000 AF*	3,456,000 AF
Storage, minimum	383,000 AF	2,404,000 AF
Area, maximum	11,700 acres	20,000 acres
Area, minimum	4,400 acres	16,300 acres
Shoreline, maximum	64.5 miles	95.0 miles
Shoreline, minimum	37.4 miles	82.3 miles
Length (full pool)	22 miles	29 miles

*AF = Acre-foot (43,560 cu. ft.)

When the existing reservoir is drawn down to elevation 1,540 feet and lower, several acres of uncleared snags are either exposed or their tops become a hazard to boating. Applicant's clearing plan for the enlarged reservoir proposes clearing above elevation 1,650 feet, which would be more than 18 feet below water surface elevation at maximum drawdown.

The existing low level outlet works consist of two 72-inch diameter steel pipes passing through the dam at elevation 1,340 feet. Each pipe is equipped with a butterfly valve located in a valve house on the downstream face of the dam. The butterfly valves were not designed to operate under the increased head of the proposed high reservoir. However, the hollow-jet valves which were installed in the diversion tunnel for low-level bypass during first step construction would be suitable replacements. The two hollow-jet valves would be relocated from the bypass to the existing valve house and would replace the two butterfly valves. In turn, the two 6-foot diameter steel bypass pipes would be plugged with concrete. The intake for the 72-inch outlet pipes would be replaced by gates of the same size and type, which now serve the low-level bypass and which are suitable for the ultimate head. The gate guides would be extended up through the concrete of the raised dam and a new operating deck would be provided at elevation 1,736 feet.

The existing power intake is a reinforced-concrete structure located at the upstream end of the two power tunnels. This structure now extends from elevation 1,418 feet, at the sill of the trashracks, to elevation 1,615 feet, at the top of the operating deck. Hydraulic gate hoists and steel-frame hoist towers are located above the operating deck.

The modified intake structure would consist of two concrete towers formed by extending the walls of the existing gate shafts upward to elevation 1,738 feet. The modified towers would be connected at the top by a cantilevered concrete deck and a 14-foot wide bridge would provide access. The hoist houses and accessory equipment from the existing installation would be installed on the new concrete deck at elevation 1,738 feet.

1.3.4 Tailwater Features

There would be no significant changes in tailwater elevations as a result of raising Ross dam.

1.3.5 Transmission Facilities

The additional power output that would result from raising Ross dam would be transmitted over existing transmission lines. No additional lines are required or proposed. Existing transformers would be modified to step up the voltage of the additional project power.

1.4 LAND REQUIREMENTS AND USE

Land rights within the United States necessary for operation of Ross Lake reservoir at a water surface elevation of 1,725 feet were granted to the City of Seattle in 1937. Applicant obtained similar rights to flood lands in British Columbia in 1967. On the American side of the international boundary, the project boundary is defined by a line located 200 feet (horizontal measurement) upslope from, and parallel to, the 1,725-foot contour. On the Canadian side, Applicant's flood easement is delimited by a cadastral survey line that encloses the 1,749-foot contour.

All reservoir lands below elevation 1,727 feet would be cleared. Clearing operations would generally be confined to that area within the proposed flood zone; however, there would be some clearing required in portions of the proposed campground areas which would lie outside of the project boundary. The proposed recreation facilities at the left abutment of Ross dam would require some development of non-project lands, but in all instances such development would take place on Federally owned lands administered by the NPS.

Development of High Ross would require construction of an access road from State Highway 20 to the left abutment of the dam. The general alignment of this proposed one-mile-long road is shown on Figure 1-8. Sufficient right-of-way over U. S. lands within the Ross Lake National Recreation Area would be needed to allow for construction of this 20-foot-wide road. Following construction, this road could become the main public access to High Ross Lake reservoir in the United States.

Land for the relocation of 8.5 miles of the Silver-Skagit road at the upper end of the reservoir in Canada would also be required if High Ross Lake reservoir is raised. A proposed alignment on Crown properties is shown on Figure 1-2. This relocation would permit Canadian access to the higher reservoir.

Applicant proposes to obtain the necessary concrete aggregate from a borrow area, known as Crane Gravel Bar, adjacent to the Skagit River about 3 miles below Newhalem and shown on Figure 1-9.

It is proposed that gravel necessary for construction of the mile-long dam access road would be obtained from one of two existing local gravel pits. One pit is near Colonial Creek, a tributary to the Thunder Arm of Diablo reservoir; the other adjacent to Goodell Creek near Newhalem (Figure 1-9).

No additional non-project lands would be affected by construction of High Ross dam.

1.5 CONSTRUCTION PROCEDURES

Raising Ross Lake to an elevation of 1,725 feet would require the relocation of a portion of the Silver-Skagit Road in British Columbia, 13 campgrounds, and about 15 miles of trails.

The lowermost 10.3 miles of the Silver-Skagit Road would be inundated, including a one-mile extension from the international boundary to Hozomeen campground in Washington. The Applicant proposes to relocate 8.4 miles of this road along a new alignment established by Provincial authorities. At the request of park officials from both countries, the new road would terminate at a point on the reservoir about 2 miles north of the international boundary to eliminate cross-boundary vehicular traffic.

Some existing recreation facilities such as salvageable picnic tables and certain trail bridges would be relocated to new sites above elevation 1,725 feet. Relocation of these facilties would be completed before reservoir clearing is commenced.

In Canada, merchantable timber harvested from the area to be cleared would be sold at public auction by the British Columbia Forest Service. Reservoir clearing in Canada, using a Canadian work force, would follow marketing of timber and be carried forth according to specifications established by the British Columbia Forest Service. Reservoir clearing work in Canada would be completed before filling of the reservoir.

In the United States, it is proposed that the reservoir be cleared in the following manner: All trees

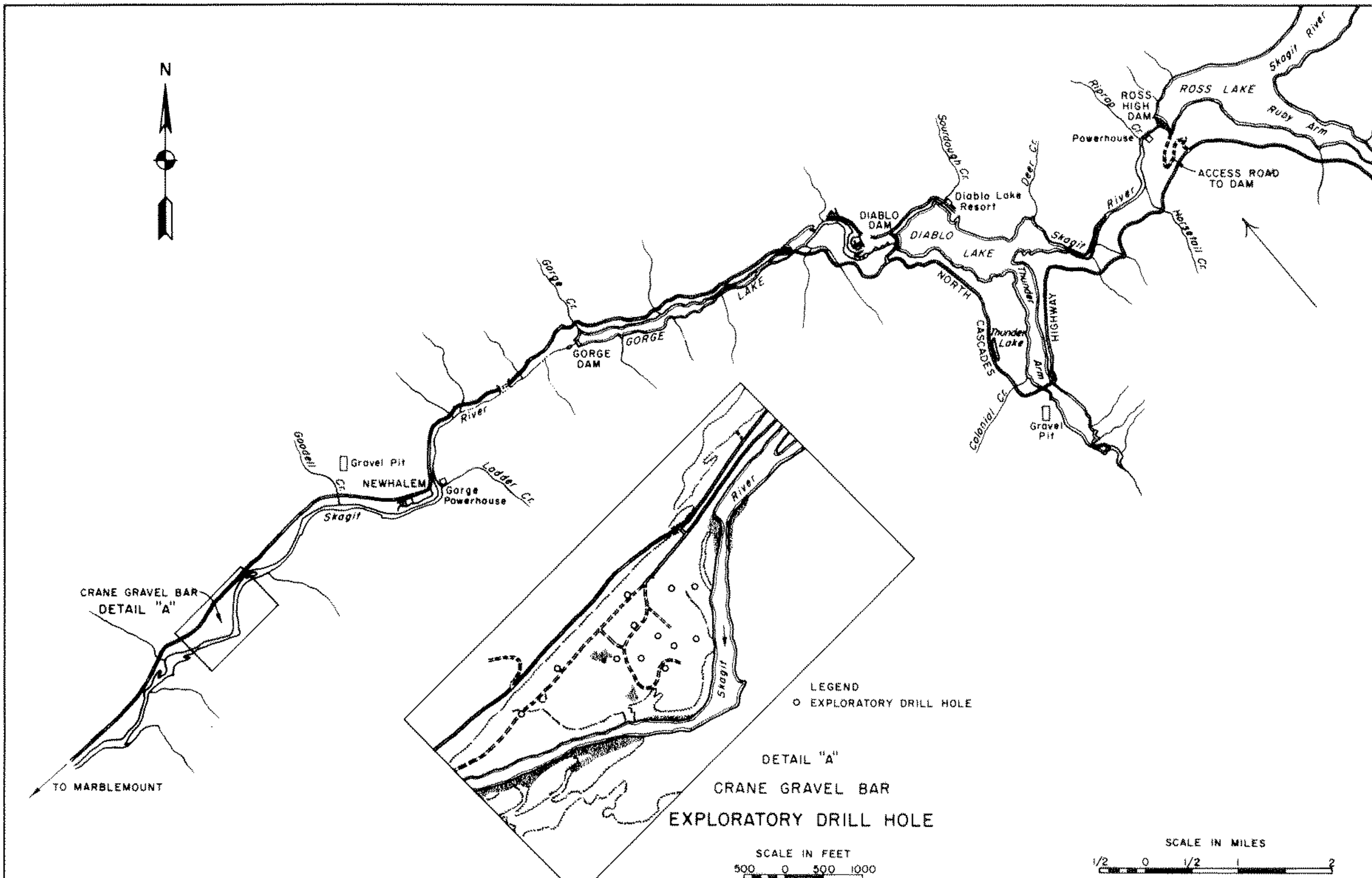


Figure 1-9. PROPOSED AGGREGATE BORROW AREA

and brush below elevation 1,727 would be felled in accordance with specifications approved by the National Park Service. The felled material would then be floated as the higher reservoir is filled. Commercially valuable timber would be retrieved, cut to length, and transported through Canada, under bond, to outlets in Washington State. The remaining debris would be stockpiled on shore, below elevation 1,725 feet, and disposed of. Disposal would be in conformance with State and local ordinances.

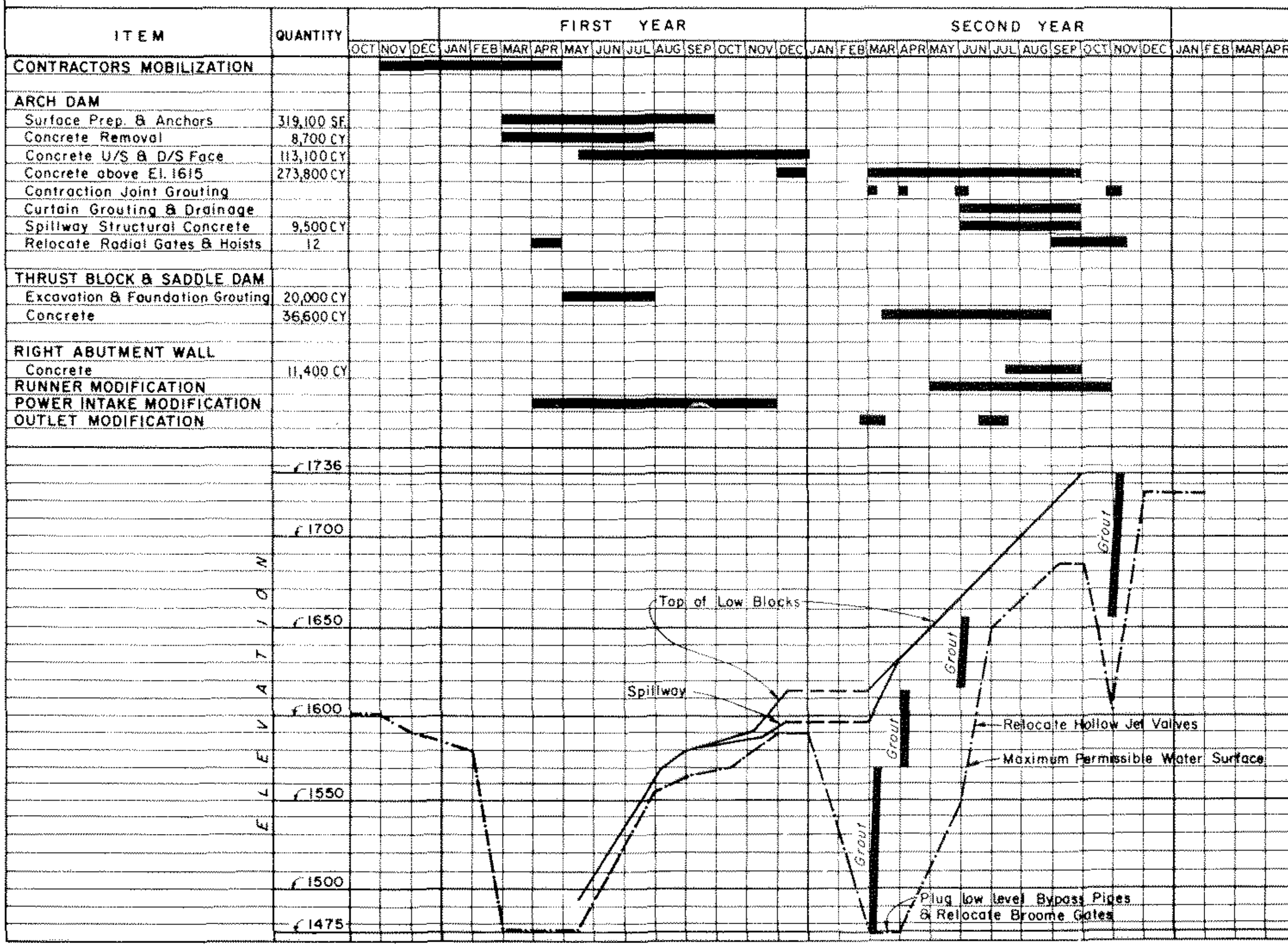
The maximum drawdown necessary for construction of the proposed high dam during the late winter months would be 127.5 feet. The pool level of the existing Ross Lake would be down to minimum pool elevation 1,475.0 for only a few months of the 2-year construction period, and it is highly unlikely that this would occur during the 42.5 month critical period. Hence, no loss in dependable peaking capacity would occur, since other Columbia system plants could provide any deficiency in the peaking capacity of the Seattle system. However, there would be an estimated loss in energy of approximately 1.24 billion kwh. Since the City of Seattle is a preference customer, this replacement energy could be purchased from the Bonneville Power Administration.

There would be no significant effect on streamflow during the construction period of High Ross Dam. Peak power releases from the Ross plant during this period would be somewhat smaller than during normal periods, because the project would be operating under lower heads than it normally would. However, Diablo and Gorge would reregulate these releases.

All land surveys necessary to determine the area needed for the proposed High Ross Lake reservoir were completed in 1930. Rights to flood these lands were obtained from Canada in 1967 and from the United States in 1937.

<u>Schedule</u>. It would take approximately 2 years to complete the construction required to raise Ross dam to elevation 1,736 feet, including necessary modification to the intake structure, spillways, and generating units. (See Figure 1-10 for complete project construction schedule.) An additional 2 years could be required to fill the reservoir and to complete reservoir clearing in the United States.

ROSS HIGH DAM
CONSTRUCTION SCHEDULE



ROSS HIGH DAM

CONSTRUCTION SCHEDULE

Figure 1-10

1.6 OPERATIONAL PROCEDURES

Ross Lake is the principal water storage reservoir for the City of Seattle's Skagit River Project 553 and in addition, provides 120,000 acre-feet of flood control storage capacity. While raising High Ross reservoir would increase the total storage capacity from 1,435,000 acre-feet to 3,456,000 acre-feet, the maximum storage withdrawal under historical low streamflow conditions would not exceed the present maximum permissible storage withdrawal of 1,052,000 acre-feet. With the larger reservoir, storage releases would be similar to those of the existing reservoir.

Since 1953, when the existing Ross reservoir was filled, the maximum yearly drawdown has varied from 30 feet to 108 feet. A maximum drawdown of 127.5 feet could have occurred, however, with a repetition of the lowest streamflow period of record (August 16,1928 to February 29, 1932). With Ross reservoir raised to normal full pool elevation of 1,725.0 feet, equivalent storage withdrawals would produce yearly drawdowns varying from 16 feet to 52 feet, with a maximum of 56.2 feet for the driest period of record.

Operation of the project works with Ross Lake at elevation 1,725 feet would be basically the same as that with Ross Lake at elevation 1,602.5 feet. Drawdown and refill of the reservoir would be governed by a rule curve based on regulation studies made for hydraulically coordinated operations of all projects controlled by the parties to the Pacific Northwest Coordination Agreement, to which the City of Seattle is a signatory.

Monthly river flow variations into Ross Lake for a typical wet year, an average year, and for a typical dry year are shown in Table 1-3:

The 42.5-month period, August 16, 1928, to February 29, 1932, was determined by the U.S. Army Corps of Engineers in cooperation with BPA to be the critical period of water supply in the Pacific Northwest. Estimates of firm energy and dependable peaking capability are based on operation studies made using the recorded streamflows for this period. The average streamflow for the critical period at Ross dam is about 2,400 cfs.

TABLE 1-3

Monthly River Flow Variations

Month	Wet Year (1921) (CFS)	Average Year (1927) (CFS)	Dry Year (1926) (CFS)
January	1,790	1,290	1,250
February	2,570	909	1,220
March	2,320	1,060	1,460
April	2,740	2,530	3,900
May	8,830	6,130	3,770
June	13,500	11,500	2,870
July	5,790	4,360	1,290
August	2,650	2,140	1,290
September	1,720	2,320	818
October	3,060	3,250	1,980
November	2,840	3,150	1,190
December	5,250	2,790	1,710
AVG: cfs	4,422	3,452	1,948
AVG: 1,000 acre-feet	3,202	2,499	1,410

Source: U.S. Geological Survey

Figure 1-11 is a graph showing the Skagit River inflows to Ross reservoir plotted against percent of time. This is a 40-year flow duration curve which shows the relative durations of different rates of discharge.

1.7 MAINTENANCE

The city of Seattle makes regular systematic inspections of all project facilities and schedules preventative maintenance on project works and generating equipment at times when project operations are least affected. If High Ross is developed, this same maintenance program would be continued.

Similar maintenance procedures are followed relative to the existing transmission facilities. The lines are inspected periodically, and when deficiencies are found they are corrected. During outages, system needs can be met by transfer of project power via interconnections.

Maintaining the proposed High Ross reservoir surface clear of floating debris would require substantial effort initially. Thereafter, periodic cleaning would be necessary to maintain a clear surface.

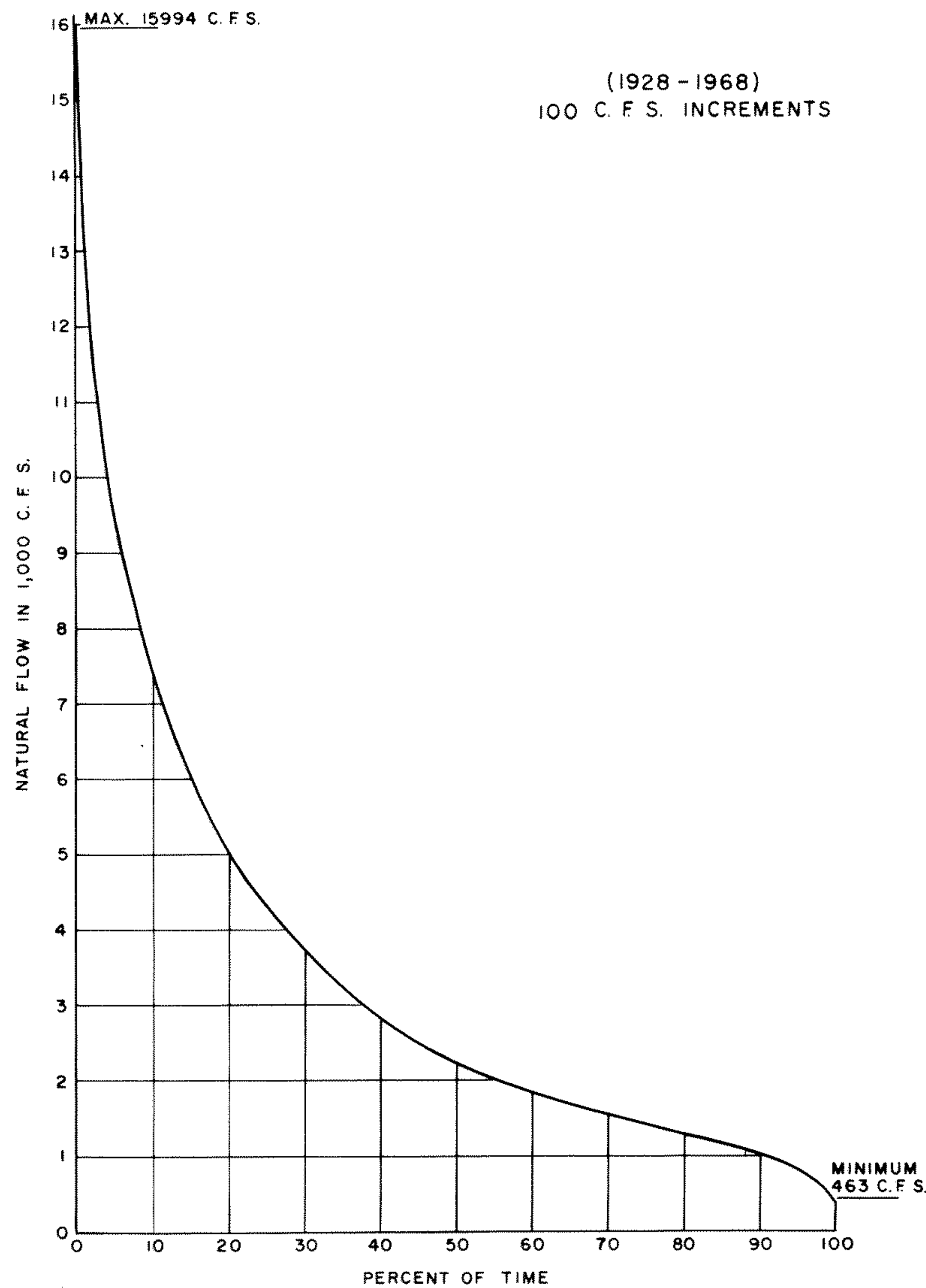


Figure 1-11. FLOW DURATION CURVE (SKAGIT RIVER)

All new recreation facilities within the United States would be maintained by the NPS.

1.8 UNUSUAL PROBLEMS

There is nothing to indicate that unusual problems would be encountered during construction and operation of proposed High Ross. Foundation rock is adequate to support the higher dam and reservoir. Inspection of reservoir slopes has not disclosed any potential landslide areas. Most of the higher reservoir slopes are rock with localized areas of soil mantle. Where soil mantle is present, the depth is relatively shallow. Only minor soil restabilization along the new shoreline would be expected, but the readjustment should not be to a degree which would affect new recreational developments or detract in a meaningful way from natural aesthetic values. The spillway capacity at High Ross dam would be 85,000 cfs at normal pool elevation and 140,000 cfs at maximum flood surcharge (the flood of record at the site is 46,000 cfs) staff estimates that a flood having a magnitude of 85,000 cfs would have an occurrence interval of 150 years. It is estimated that the probable maximum flood would surcharge High Ross reservoir to an elevation of approximately 1,741.3 feet, 1 foot above the top of the parapet wall. Overtopping flow would be equivalent to about 4 inches of water for 24 hours and would not adversely affect the safety of the structure. A probable maximum flood would have a recurrence interval greater than 10,000 years. Applicant could continue to provide 120,000 acre-feet of flood storage from December 1 to March 15 each year, in accordance with an agreement between the City of Seattle and the U.S. Army Corps of Engineers and as provided for by Article 36 of the existing license for Project 553. However, the Corps of Engineers indicated that on the basis of preliminary studies it might be desirable to increase the total flood control storage space provided at Ross Reservoir.

1.9 FUTURE PLANS

Applicant has made a reconnaissance-type investigation of the possibility for expanding hydroelectric output at High Ross, Diablo, and Gorge reservoirs as well as constructing a reregulating development to be known as Copper Creek, located on the Skagit River about 10 miles downstream from Newhalem. The investigation considered construction of a second powerhouse in the vicinity of each of the existing plants. Water would be drawn from the existing Gorge and Diablo reservoirs and from proposed

High Ross reservoir. The Copper Creek development would require construction of a new dam, powerhouse, and all related facilities. Applicant has not undertaken more definitive follow-up studies to determine the feasibility of any scheme outlined in the reconnaissance report. Any, or all, of the considered schemes would be compatible with High Ross.

1.10 COMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS

All applicable state and federal health and safety standards would be complied with during construction and operation of the proposed High Ross development. The proposed construction would result in a dam structure that would be safe against floods, earthquakes, and normal operating forces.

Applicant has applied for or has received the following permits:

1. Surface Mining Operating Permit No. 10762 - Issued May 23, 1972, by Whatcom County Issued July 1, 1972, by Washington State Department of Natural Resources.

2. Shoreline Development Permit for the Surface Mining of Crane Gravel Bar. Issued September 25, 1972, by Whatcom County

3. State Flood Control Zone Permit - Not required (Washington Department of Ecology letter August 28, 1972)

4. Reservoir Permit No. 135 - Issued by State of Washington - December 11, 1943, Request for extension of effective time now pending before State Department of Ecology

5. Surface Water Permit No. 181 - Issued April 7, 1921, and No. 13280 - Issued December 17, 1963, Requests for extension of time for construction now pending before State Department of Ecology

6. State Water Quality Certification - An Application, filed on June 18, 1973, is now pending before the State Department of Ecology

2. DESCRIPTION OF THE EXISTING ENVIRONMENT

2.1 LAND USES

The land area covered by the existing Ross Lake at maximum pool elevation is 11,680 acres, 480 acres of which are in Canada. In October 1968, Congress passed an act creating the Ross Lake National Recreation Area (RNRA) which encompasses the project area. Thus, no private lands are included within the development boundary since all of the land immediately surrounding the U.S. portion of the reservoir is federally owned and is managed by the Department of the Interior. Only one commercial development, consisting of a marina and floating group of cabins near Ross dam, is located within the development boundary. No other commercial buildings or private dwellings exist in the development area within the U.S.

Approximately 60 miles of shoreline encircle the development in the United States portion of the reservoir. Several large tracts of federally owned land, administered by the Interior and Agriculture Departments, surround the Ross development. North Cascades National Park (505,000 acres), Lake Chelan National Recreation Area (62,000 acres), and Ross Lake National Recreation Area (107,000 acres) are administered by the Department of the Interior's National Park Service. The Pasayten Wilderness of 500,000 acres and Glacier Peak Wilderness of 468,000 acres (Figure 2-1) are administered by the U.S. Forest Service and are classified as non-developed acreage. National Forests such as Mount Baker and Okanogan, also managed by the U.S. Forest Service, include not only recreation but also mining and timber harvesting as management objectives.

There are 13 campgrounds, managed by the National Park Service and one commercial cabin and boat rental development leased by the NPS within the Ross Lake National Recreation Area and associated with Applicant's development. Public access to these facilities is by boat, a series of connecting foot trails, and a short section of roadway entering from Canada and terminating at the Hozomeen campground area (Figure 2-2). There are also two suspension foot bridges located on the trail along the east side of the reservoir. Recreational sites are listed and sited on Figure 2-3.

Prior to October 1968, Applicant's Ross Reservoir was situated within Federal lands administered by the U.S. Forest Service. Recreation facilities developed around the reservoir were maintained by the U.S. Forest Service. The

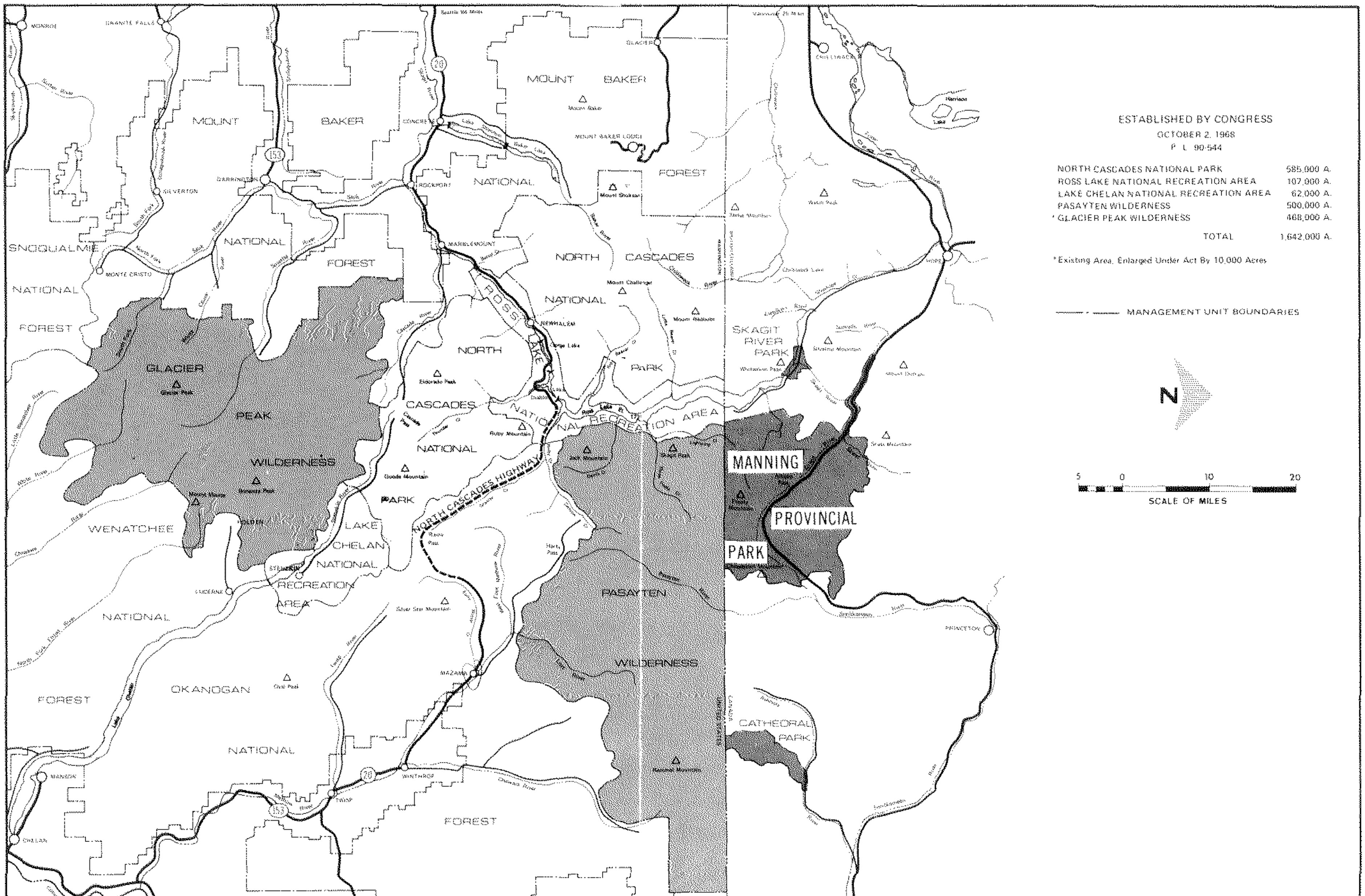


Figure 2-1. NORTH CASCADES MANAGEMENT UNITS

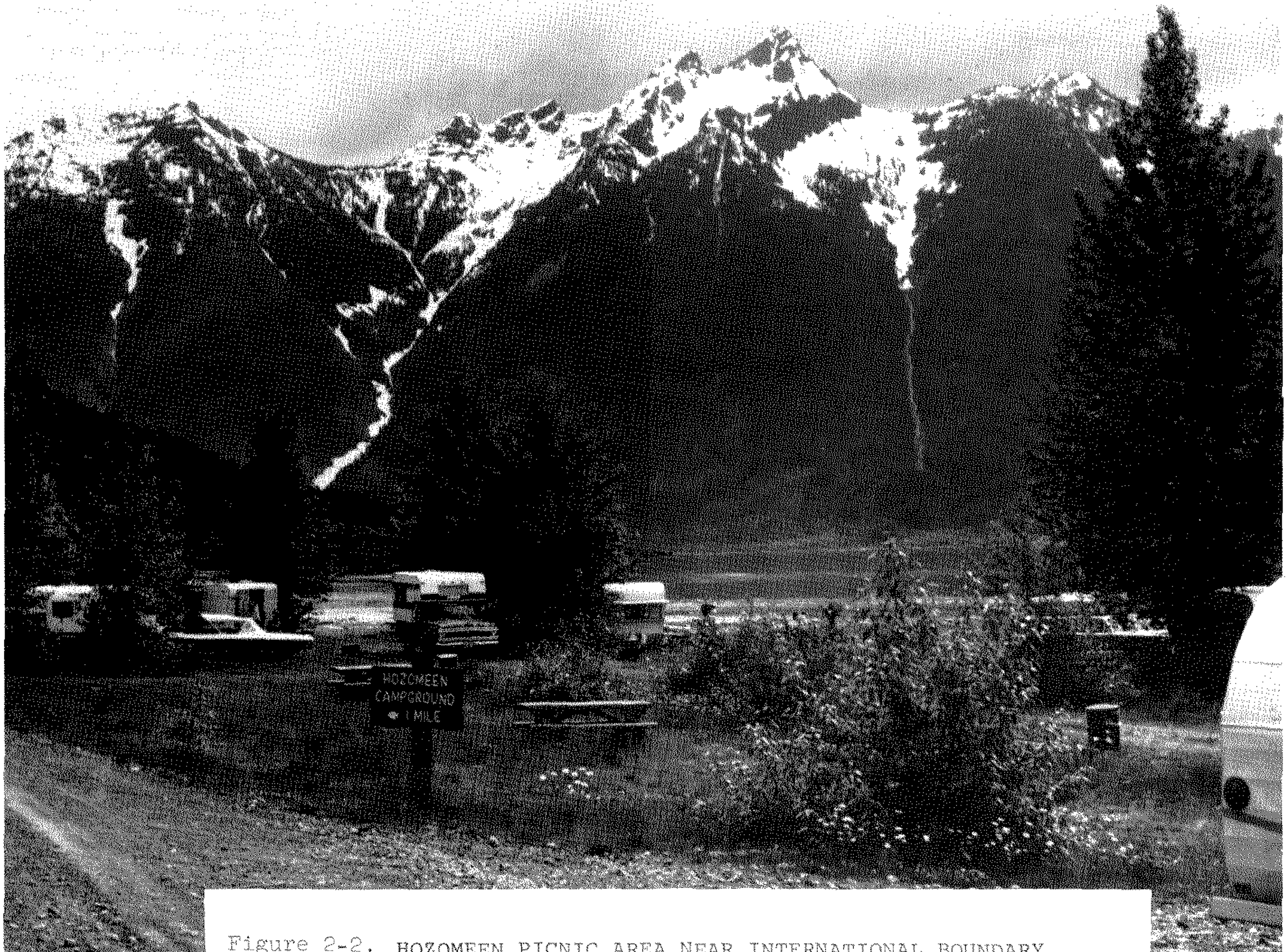


Figure 2-2. HOZOMEEN PICNIC AREA NEAR INTERNATIONAL BOUNDARY

CAMP AREAS

EXISTING N.P.S. FACILITIES TO BE INUNDATED

1. Rainbow Point
2. Lightning Creek
3. Cat Island
4. Little Beaver Creek
5. Big Beaver Creek
6. Roland Point
7. Ten Mile Island
8. Cougar Island
9. Green Point

EXISTING N.P.S. FACILITIES TO REMAIN

1. Hozomeen
2. Colonial Creek

PROPOSED FOR INITIAL DEVELOPMENT BY CITY LIGHT

1. Green Point
2. Upper Beaver Creek
3. Middle Beaver Creek
4. Lower Beaver Creek
5. Rainbow Point
6. Dry Creek
7. Lightning Creek
8. Jack Point
9. Little Beaver Creek
10. Silver Creek

RECREATION CENTERS

EXISTING CITY LIGHT FACILITY

Newhalem - Food Service, Picnicking, Viewing Area, Comfort Station, etc

PROPOSED FOR FUTURE DEVELOPMENT BY N.P.S.

1. Newhalem - Visitor Service, Lodging, Picnicking, Camping, Boat Launching, etc.

INTERPRETIVE OVERLOOK & DAY USE

PROPOSED FOR INITIAL DEVELOPMENT BY CITY LIGHT

1. Ross Dam - Interpretive Exhibits, Viewing Area and Picnicking

PROPOSED FOR FUTURE DEVELOPMENT BY N.P.S.

2. Ruby Arm - Interpretive Exhibits, Viewing Area and Picnicking

RESORTS

EXISTING PRIVATE FACILITIES TO BE REMOVED

Ross Lake

EXISTING PRIVATE FACILITIES TO REMAIN

Diablo Lake

BOAT LANDING AREAS

EXISTING CITY LIGHT FACILITIES TO REMAIN

1. Diablo Lake
2. Diablo Lake
3. Diablo Lake

HOSTELS

PROPOSED FOR FUTURE DEVELOPMENT BY N.P.S.

1. Dry Creek
2. Lightning Creek
3. Hozomeen

TRAMWAYS

PROPOSED FOR FUTURE DEVELOPMENT BY N.P.S.

1. Ruby Creek
2. Arctic Creek

LIFTS

EXISTING CITY LIGHT FACILITY TO REMAIN

1. Diablo Dam

PROPOSED FOR FUTURE DEVELOPMENT BY CITY LIGHT

2. Ross Dam Overlook To Ross Dam Power Station

GUARD STATION

EXISTING N.P.S. FACILITY TO BE REMOVED

Ross Dam

SUSPENSION FOOT BRIDGE

PROPOSED - TO BE RELOCATED BY CITY LIGHT (Initial)

1. Lightning Creek
2. Devils Creek

LOG STRINGER BRIDGES

PROPOSED FOR INITIAL DEVELOPMENT BY CITY LIGHT

1. May Creek
2. Dry Creek
3. Crater Creek
4. Pierce Creek
5. "X" Creek
6. Big Beaver Creek
7. Riprope Creek

BOAT RAMPS

EXISTING N.P.S. FACILITIES TO REMAIN

1. Thunder Arm

EXISTING CITY LIGHT FACILITIES TO REMAIN

2. Gorge Lake

ROADS

EXISTING N.P.S. AND B.C. ROAD TO BE INUNDATED

Silver Skagit Public Road From Skagit River Park To Hozomeen

EXISTING STATE HIGHWAY

NORTH CASCADES HIGHWAY (WASHINGTON STATE 20)

PROPOSED FOR INITIAL DEVELOPMENT BY CITY LIGHT

2. Relocated Silver Skagit Public Road From Skagit River Park To A Point 2 Miles North Of Hozomeen (Provided Under Terms Of Canadian Agreement)
3. Access Road From North Cross State Highway To Left Abutment Of Ross Dam

TRAILS

N.P.S. FACILITIES

Trail System Through Ross Lake National Recreation Area

PROPOSED FOR INITIAL DEVELOPMENT BY CITY LIGHT

1. West Side Of Big Beaver Valley
2. Roland Point To Jack Point
3. South End Of Ruby Creek
4. Ross Dam Right Bank Downstream

BOUNDARIES

RECREATION AREA BOUNDARY

PROJECT AREA BOUNDARY

U.S. - CANADIAN BORDER

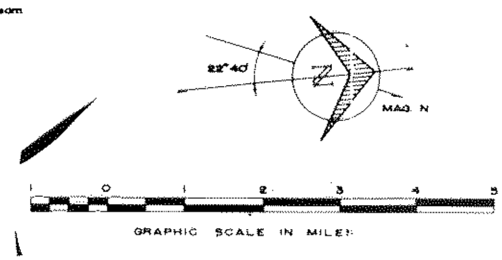


Figure 2-3. EXISTING AND PROPOSED RECREATIONAL FACILITIES

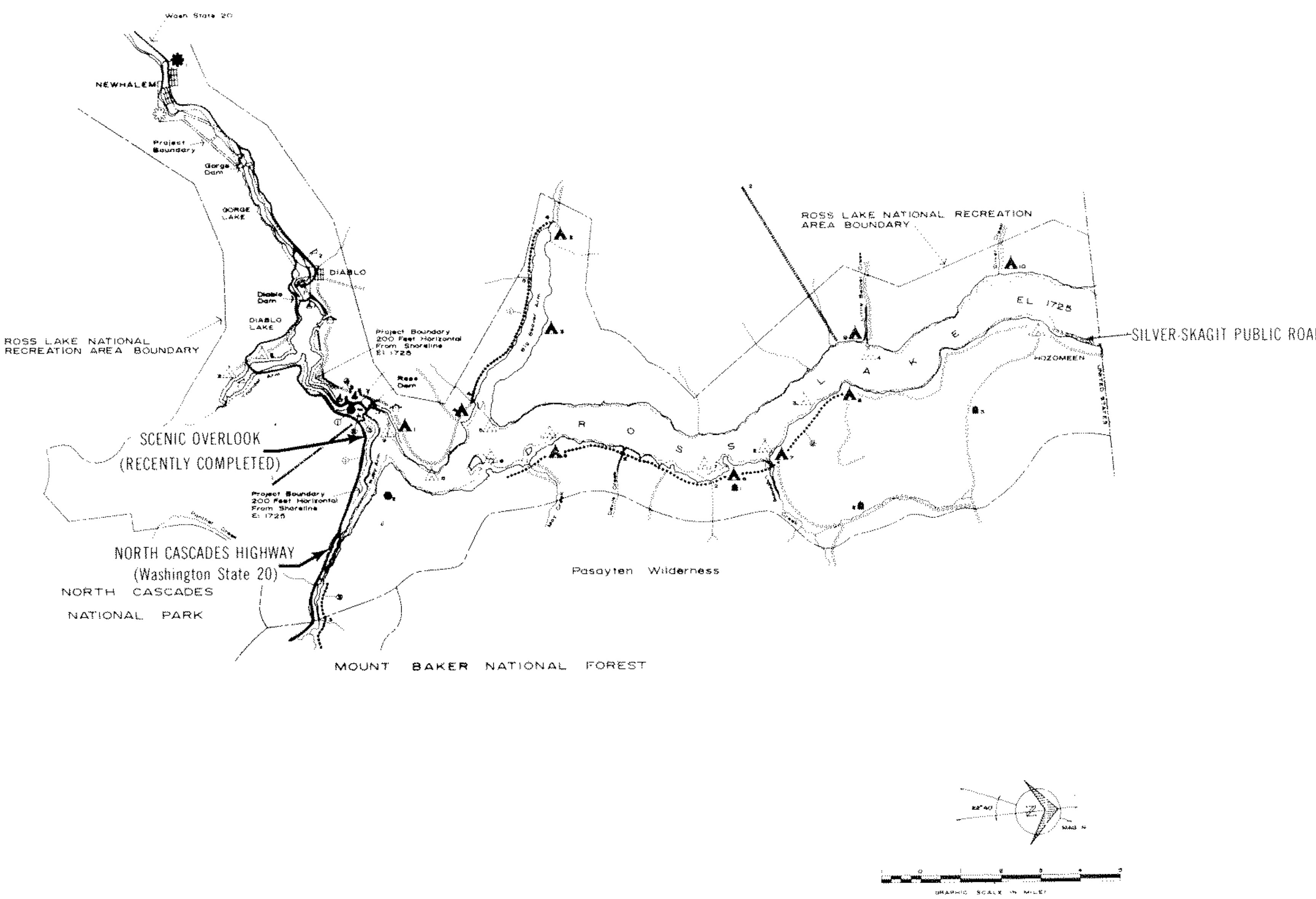


Figure 2-3. EXISTING AND PROPOSED RECREATIONAL FACILITIES

emphasis was on camping and hiking and very limited access was provided for boating on the 22-mile long reservoir.

Management of the area which includes the Ross Lake National Recreation Area was transferred from the Forest Service to the NPS for administration and maintenance. This change of administration and land use policy, coupled with the opening of the eastern segment of Highway 20 (North Cascades Highway), has changed the general trend of development of Ross Lake from one of limited access, minimal facility development, to a recreation area featuring increased access and improved facilities. Recreational facilities which are proposed to be constructed by the Applicant would be operated and managed by the NPS.

2.2 TRANSPORTATION AND ACCESS

Project recreational facilities are available to the public from the east and west via Route 20 (North Cascades Highway). Recent completion of the eastern portion of Route 20 from the vicinity of Ross dam to the small town of Mazama (est. 1973 population 20) provides a new access route, previously unavailable, from the south and east sides of the project. Interstate Highway No. 90 is a major route between Seattle and Spokane, Washington. Several connecting highways from Interstate 90 eventually lead to the project. Highway No. 2 connects Everett, on the west, with Spokane on the east, and also connects with access routes to the north providing a cross-state access route to the project. The primary access corridor stems from the west, and connects with the coastal cities of Tacoma, Seattle, Everett, Mt. Vernon, and Bellingham, Washington. Route 20 interconnects with Interstate Highway No. 5 near Mt. Vernon, Washington, west of the project.

There is no public transportation available from the coastal areas to Newhalem. From Newhalem, the Applicant provides transportation to the project area through the "Skagit Tour" which allows the general public to visit the Applicant's Skagit River developments. The Applicant provides transportation from Seattle to Newhalem for persons desiring to take the tour. For persons other than those participating in Applicant's tour, a private vehicle is the only means of reaching the project area. Members of Applicant's tour and others wanting to visit the Ross development can travel to the Ross powerhouse on Applicant's tour-boats or tugboats which leave from Diablo reservoir. A steep gravel road extends from the powerhouse to Ross Lake and is intended for use as a project service road. However, the Ross Lake resort operator provides transportation for fishermen over the road by a truck. This service is available to the public for a nominal fee. Other transportation facilities in the region include an Amtrak line that serves the Mount Vernon-Burlington area and small airports in Sedro Woolley, Darrington, Mount Vernon and Concrete which provide access for small, private aircraft. Transportation corridors and principal cities are shown in Figure 2-4.

2.3 TRANSMISSION LINES

Transmission line facilities consist of two existing 230 kv lines on a single set of towers, extending from Ross powerhouse to Diablo switchyard and one existing 26 kv line extending from Ross powerhouse to the Ross Substation, thence to Diablo. The 26 kv line is a station service tie line between Ross and Diablo powerhouses for the purpose of station reliability. The 230 kv lines interconnect with Applicant's primary transmission system at the Diablo switchyard.

2.4 TOPOGRAPHY, PHYSIOGRAPHY AND GEOLOGY

Ross dam is located on the Skagit River in the Northern Cascade Mountains of Washington, about 20 miles south of the Canadian Border. The Northern Cascades in the vicinity of Ross dam are characterized by sharp, jagged peaks and steep canyons which show the effects of alpine glaciation (see Figure 2-5). Within the Ross dam and the Skagit Peak U.S.G.S. quadrangles, relief is greater than 5,000 feet. A striking feature of the Skagit River Valley, particularly downstream from Ross dam, is the abundance of large rock masses that appear to be nearly detached from the canyon walls along steep joints. These rock masses, where locally undercut by the Skagit River, tend to develop rock slides. The slopes above Ross Reservoir, however, are stable and not prone to sliding.

There are a number of low-level glacially carved valleys in the Northern Cascades. Big Beaver Valley, west of Ross Reservoir is one such example. The floor of Big Beaver Valley is gently sloping, and the existing soils and organics have reached a point of stabilization. Water courses through the valley meander due to the flatness of the valley floor.

Although most of the Cascade Range in Oregon and Washington is underlain by andesite, basalt and associated pyroclastic rocks, the Northern Cascades comprise mainly pre-tertiary intrusive, sedimentary and metamorphic rocks (Figure 2-6). The rock underlying Ross dam is the

Figure 2-5. AESTHETIC QUALITIES OF ROSS LAKE

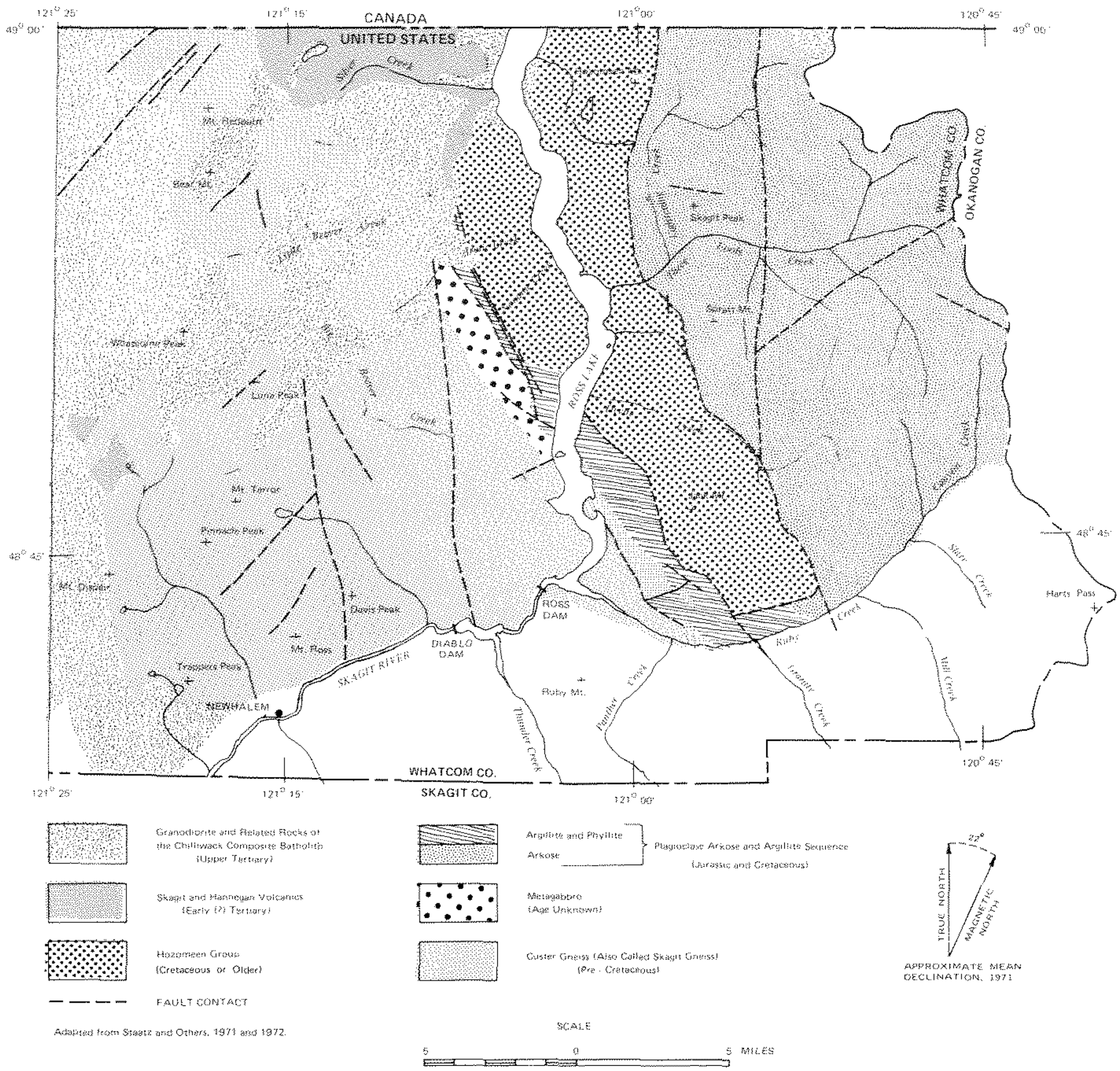


Figure 2-6. GEOLOGY OF THE ROSS LAKE AREA

Custer (or Skagit) Gneiss. It is the oldest known rock unit in the area, Cretaceous and older in age. The Custer Gneiss is exposed for about 4 miles north of the dam along Ross Lake. Custer Gneiss is basically a quartz-biotite-gneiss containing scattered aplite and amphibolite dikes. The Custer Gneiss is generally characterized by alternating light and dark bands which give the rock a gray color. The light bands are composed of quartz and feldspar and the dark bands contain biotite and hornblende.

The Hozomeen Group (Cretaceous) forms the canyon walls along much of the lake from about Devils Creek to the Silver Creek area. It consists of slightly metamorphosed mafic lavas (greenstones) with subordinate chert, phyllite, argillite and mafic intrusives.

The remainder of the rocks in the Ross Lake area are referred to as the Lower Tertiary Skagit Volcanics and the Tertiary Chilliwack composite batholith which comprises granodiorites, diorites, and related rocks.

The rock at the damsite is cut by a system of joints which can be classified into primary, secondary, and tertiary systems. The primary or regional joint system strikes generally N 40 degrees E and dips 65 to 70 degrees northwest. The secondary system strikes N 60 degrees W and dips approximately 45 to 60 degrees northeast. The tertiary system strikes between N 30 degrees and N 75 degrees E and dips approximately 30 degrees southeast. Gouge-filled shear zones are found in association with some of the primary joints.

The core of the Olympic Mountains, the Cascade Range, and the Okanogan Highlands (northeastern Washington) is highly unfavorable from the standpoint of hydrocarbon potential because of the rock types that occur. Because of the cover of volcanic rocks that mask the sedimentary strata, the Columbia Plateau in southeastern Washington is very difficult to assess for oil and gas potenital. Over 40 wells have been drilled in this area, but only an estimated 70-500 mcf of natural gas were found even at the best field, the Rattlesnake Hills. No oil has been found east of the Cascade Range in Washington. The best hydrocarbon potential is located west of the Cascades in the Puget lowlands, Willapa Hills, and the coastal and offshore zone.

The mineral resources of the North Cascades Park-Ross-Lake Pasayten Wilderness areas have been surveyed by the U.S.G.S. (30) and Bureau of Mines (31). Numerous deposits of copper, molybdenum, and several of gold occur in the northern part of the North Cascade Mountains. Several hundred lode and placer claims in the general project area have been recorded. No ore, however, has ever been shipped from any mining property in the park area west of Ross Lake, and mineral production to the east has been small and limited to only a few areas.

Survey teams have found only two "showings" west of Ross Lake rich enough in mineral content for commercial production. One was about 1.5 miles west of Ross Lake along Silver Creek. A zone measuring 200 by 240 feet contains iron, copper, and molybdenum sulfides. While the mineral concentration within this zone is rich enough to be mined on the basis of metal content, total reserves are insufficient to economically justify exploitation, since the cost of mining would be over twice the value of the mineralized material. In addition, its location within the National Park boundary would preclude its development. Detectable quantities of various minerals were found in most tributaries to Ross Lake.

About 149,700 ounces of gold valued at over $4 million (46) have been recovered from the Slate Creek-Azurite mining district which lies several miles east of Ross Lake. Ruby Creek at the southeast end of Ross Lake drains the Slate Creek-Azurite district, and gold has been recovered from placers along the stream as far west as the part now flooded by Ruby Arm of Ross Lake. The district also produced somewhat less than 10,000 ounces of silver and less than 10,000 pounds of zinc and lead.

Non-metallic minerals which occur farther down the Skagit Valley (some of which have been utilized in the past) include graphite, limestone, mica, pumice, and silica.

The site of Ross dam and its reservoir is considered to be in zones 1 through 3, outside the most active seismic zones of western Washington (9), but earthquakes are not uncommon. Rasmussen (23) has characterized the Ross dam area as being within a generalized intensity zone which has sustained minor damage in the past. Hozomeen Mountain, immediately adjacent to the east side of Ross Lake, was the location of an earthquake of unrecorded intensity in 1960. Diablo dam was the site of an intensity IV earthquake in 1958. Marblemount experienced an intensity IV earthquake in 1946. In 1935 and 1937, the town of Darrington, about 40 miles southwest of Ross dam was the location of minor shocks. Other small earthquakes have been recorded in adjacent regions in the more distant past. For damage potential of various earthquake intensities see

Table 2-1.

Although some faults have occurred in the geologic past in the Ross area, no surface faults have developed as a result of any historically recorded earthquakes in western Washington (25). Because of the general lack of planes of weakness in the igneous and metamorphic rocks in the area along which shearing would occur, major landslides should not develop.

Mt. Baker volcano, which has an active gas vent, towers approximately 5,000 feet above the lower elevations of the surrounding North Cascade Range and about 10,000 feet above the Skagit River Valley 17 miles to the south. Roughly one fourth of this 80 square mile andesite cone is covered by glaciers. Some of Mt. Baker's flows were evidently quite fluid compared to those of the other large volcanoes in Washington, the longest one having extended about 10 miles down Sulphur Creek to its confluence with the Baker River, which is tributary to the Skagit River near the town of Concrete. Normal explosions and eruptions, primarily from the central crater, were recorded in 1843, 1854, 1858, 1859, and 1870 (8).

Any renewed volcanic activity from Mt. Baker could have an impact on lands in the Ross dam project area; however, the consequences of most of these processes should be confined to areas farther down the Skagit Valley or in the Nooksack River Drainage basin to the north of Mt. Baker. Ash fall, because of the prevailing west winds, however, could affect the Ross dam area by hindering visibility, clogging streams with silt, blocking roads, killing vegetation and fish, and by secondary effects including mud and debris flows and flooding (9).

2.5 SOILS

Specific details concerning the composition of soils in the project area are unavailable.

The University of Washington (UW) Study Team described the parent soil materials as being extremely variable. Because of extensive glaciation, the soils derived from the various glacial materials differ widely depending on whether they developed from indurated till, loose outwash, morrainal materials or fine textured lacustrine deposits. Lithosols and rocklands are common on steep slopes.

TABLE 2-1

MODIFIED MERCALLI INTENSITY SCALE OF 1931

(ABRIDGED)

I. Not felt except by a very few under specially favorable circumstances. (I Rossi-Forel Scale.)

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel Scale.)

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor-cars may rock slightly. Vibration like passing of truck. Duration estimated. (III Rossi-Forel Scale.)

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel Scale.)

V. Felt by nearly everyone, many awakened, some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale.)

VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale.)

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor-cars. (VIII Rossi-Forel Scale.)

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed. (VIII+ to IX--Rossi-Forel Scale.)

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. (IX+ Rossi-Forel Scale.)

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel Scale.)

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

Source: Eppley, R. A., Earthquake History of the U.S. - Part I, Stronger Earthquakes of the U.S., U.S. Department of Commerce - Environmental Science Service Administration Coast and Geodetic Survey, 1965.

Although soil maps for the basin have not been prepared, information from the UW reports suggests that broad soil groups such as podzols, brown podzol, and lithosols are present along with other less abundant groups scattered throughout the area.

2.6 BIOTIC COMMUNITIES

Ross Lake basin lies in the *Tsuga heterophylla* zone (55) which is the most extensive vegetation zone in western Washington and Oregon. This zone generally has a wet, mild, maritime climate. However, climatic variations, as the result of latitude, elevation, and location in relation to mountain ranges and peaks, account, in part, for the overlap of vegetative types in the upper Skagit Valley. Douglas fir, western hemlock, and western redcedar are the dominant species of this vegetation zone but climatic influences, particularly precipitation, have altered this vegetative grouping in the upper Skagit Valley. Species representative of both the moist coastal and dry interior forests are found in this region. Precipitation is reduced in the basin by mountain ranges to the west. Hence, slopes to the west of Ross Lake have more coastal characteristics with some continental elements, while slopes to the east exhibit more continental influences.

Species of conifers principally Douglas fir, western hemlock, and western redcedar, dominate the plant communities covering the Ross Lake basin. These communities have been identified as being both climax and subclimax forests. Development of these various plant associations was influenced by a series of extensive fires that altered the landscape approximately 160 years ago and by another major fire that swept the area from Big Beaver Valley to the Canadian border in the late 1920's. Because there has never been logging in the U.S. portion of the basin, fire and local climatic factors are assumed to be the chief forces controlling the biotic evolution of the Ross Lake basin. Following these major disturbances and depending on various site factors such as soil moisture and soil depth, the lake basin supported pioneer species which over time have or will be replaced by other plants to form one or several climax communities.

Principal timber species composing these plant communities include the following:

Lodgepole pine (*Pinus contorta*)
Douglas-fir (*Pseudotsuga menziesii*)
Western hemlock (*Tsuga heterophylla*)

Western redcedar (Thuja plicata)
Western white pine (Pinus monticola)
Grand fir (Abies grandis)
Pacific silver fir (Abies amabilis)
Ponderosa pine (Pinus ponderosa)
Paper birch (Betula papyrifera)
Red alder (Alnus rubra)

Division of the basin flora into plant communities was a part of extensive investigations conducted by the Institute of Forest Products, College of Forest Resources, University of Washington - in cooperation with the City of Seattle, Department of Lighting, and the State of Washington, Department of Game, under contract with the Applicant. Reports were prepared for January-December 1971, and January-December 1972. Specifically, the study focused on those communities that occupy positions below and immediately above the proposed maximum reservoir level. The general description of the present and past floral characteristics of the basin are based primarily on these studies.

The UW survey report published for 1971 divides the flora into eight broad types based on random sampling plots in preselected forest stands. Also, additional data on smaller plant specimens were gathered from microplots sampled within the larger macroplots. These broad categories, with the exception of the rock outcrop type, are either intermediate or climax communities.

The plant types described by the UW and discussed below are as follows:

Hardwood
Douglas-fir - immature and old-growth
brush
lodgepole pine
rock outcrop
hemlock
Douglas-fir climax
high elevation types-Abies lasiocarpa and subalpine.

The hardwood type generally is a seral (intermediate) stage although it may form a physiographic climax on avalanche chutes. Cherry, willows, cascara, birch, red alder, and big leaf maple are the chief species. One stand of aspen (Populus tremuloides), less than one acre, is located near Cougar Island.

The Douglas fir type, subdivided into immature and old-growth stands, generally is considered a seral stage depending on site factors. Stands of young even-aged Douglas fir occur as the result of disturbances, primarily fire, available seed supply, and abundance of desirable sites. Old-growth stands consist of large trees, a closed canopy, and a mixture of Douglar fir, western redcedar, white pine, and western hemlocks. On good quality sites, western hemlock often represents the climax vegetation.

Following fire, some sites have supported a cover of brush composed of willow, cherry, vine maple, and mountain maple. Douglas fir is beginning to dominate some of these brush type areas.

At lower elevations on dry sites, dense stands of lodgepole pine have developed following fires. Representing a seral stage, Douglas fir will eventually form the climax stage.

The rock outcrop type is rock often supporting mats of moss and sometimes herbs and ferns. These sites may have a very shallow layer of soil but will support forests subsequent to the soil developing processes over a long period of time.

Western hemlock, a major climax species, is associated with western redcedar, Douglas fir, and Pacific silver fir. At lower elevations and relatively dry sites, western hemlock is the dominant species in the overstory. On wet sites, for example in Big Beaver Valley, western redcedar forms the dominant species in the overstory. Hemlock generally will not tolerate a high water table. As a result, the western redcedar dominates the bog and swamp sites. However, on drier sites hemlock reproduces better than the less shade tolerant western redcedar. At higher elevations, Pacific silver fir is the primary associate of the hemlock.

Shallow soils, typically dry and rocky, support open stands of mature Douglas fir. Lodgepole pine and ponderosa pine are occassionally associated species. Soil and topography are the chief factors resulting in the permanence of this climax type.

In brief, two vegetation types above 3,000 feet, the Abies lasiocarpa and subalpine, are found in the Ross Lake basin. The former type, consisting of dense stands of subalpine fir intermixed with varying numbers of mountain hemlock (*Tsuga mertensiana*), Fngelmann spruce (*Picea engelmannii*), white pine (*Pinus monticola*), whitebark pine (*Pinus albicaulis*), mountain ash (*Sorbus sitchensis*), willow, and occasionally Douglas fir. Above 5,000 feet the type gradates into subalpine meadow communities. This latter type, above 5,000 feet, comprises subalpine meadows and small clumps of subalpine fir.

In general, the rocky outcrops are covered with lodgepole pine and scattered Douglas-fir. Western hemlock, western redcedar, western white pine, and Douglas-fir are the dominant species on the more humid western slopes and valleys of the Lake while the eastern side, being less humid and more exposed, favors communities dominated by Douglas-fir with scattered stands of grand fir and Pacific silver fir. Scattered sites, usually as the result of fire, support various species of hardwoods. Plant species are listed in Appendix E.

2.7 WILDLIFE

The Institute of Forest Products, College of Forest Resources, of the University of Washington (UW), began Biotic surveys of the Ross Basin in 1971 in cooperation with the Applicant and the Washington Department of Game. Two UW reports for the periods, January to December 1971, and January to December 1972, are the major sources of information for the following discussion.

A diversity of wildlife species exists in Ross Basin. The more common species include deer (blacktailed deer, mule deer, and hybrids of the two subspecies), chickaree squirrels, beaver, bobcat, and numerous species of passerine birds. Black bear and cougar, species which do not form dense populations anywhere in the wild, are well represented. A complete list of vertebrate species known to occupy the Ross Basin is given in the Appendix.

Varied fauna are characteristic of and dependent upon a diversity of plant communities which are the major components of habitat types. The UW team identified eight plant communities in the Ross Basin (Figure 2-7). Each plant community provides the habitat needed by certain wildlife species, (although some species range over more than one plant community in order to find their requirements). Examples in the Ross Basin include the old-growth Douglas-fir community as habitat for blue grouse and chickaree squirrels, the brush community as habitat for deer and ruffed grouse, and the hardwood community (in

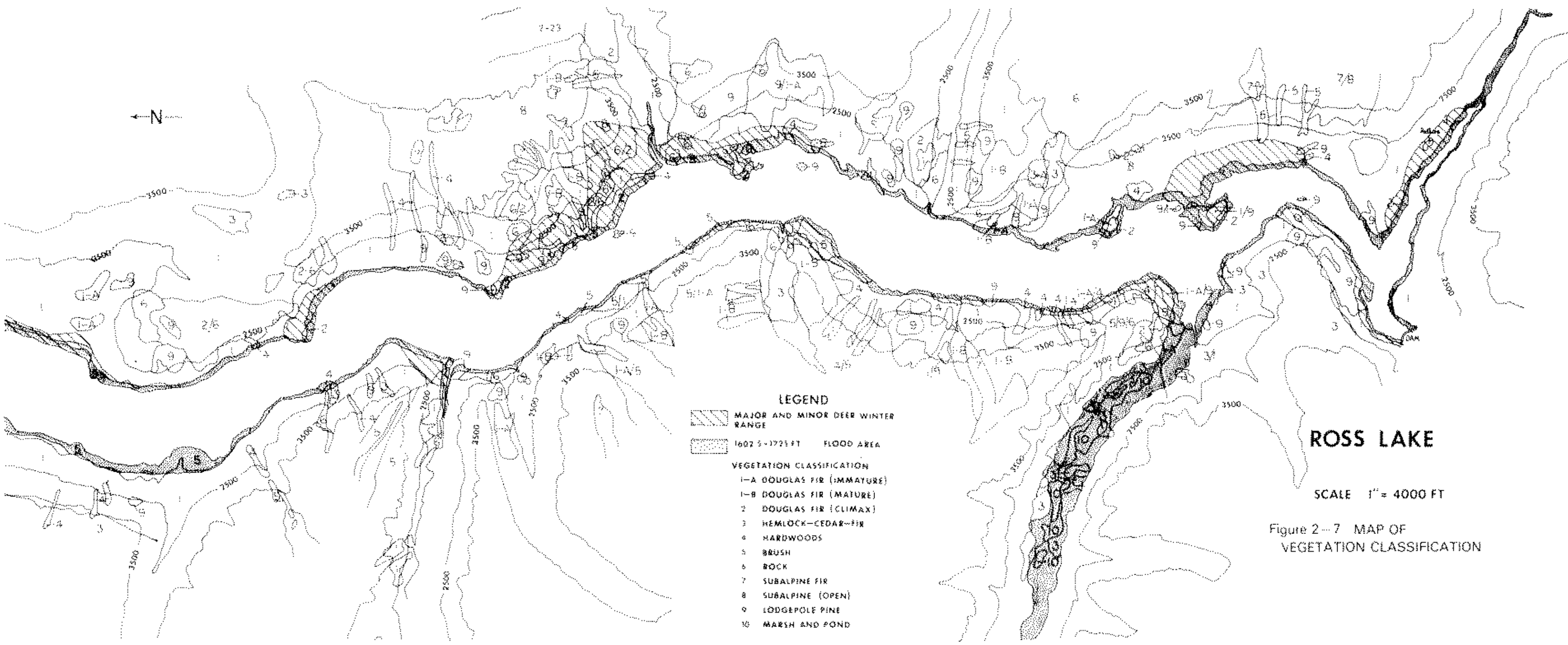


Figure 2-7 MAP OF VEGETATION CLASSIFICATION

the lowlands) as habitat for beaver and orange-crowned warblers.

By knowing habitat requirements of wildlife, it is possible to examine the vegetation classification map (Figure 2-7) and predict reasonably accurately where certain animal species are found during certain seasons. Therefore, the map that depicts plant communities also yields information as to animal diversity and distribution in the Ross Basin.

Plant succession (the eventual replacement of one plant community by another) is bringing about a change in the wildlife populations of Ross Basin. For example, in the brush-type plant communities, herbs, shrubs, and seedlings provide especially good habitat for ground-dwelling mammals such as deer and hares. In the Douglas-fir communities which replace the brush-type communities, conditions favor arboreal mammals and birds such as blue grouse which can thrive on an almost exclusive winter diet of conifer needles. An understanding of the biotic communities in Ross Basin is dependent upon an awareness of ecological succession.

Wildlife diversity in the Ross Basin is also influenced by its geographic setting. The Skagit Valley is within a zone, called an ecotone, that is transitional between the relatively moist coastal region, characterized by Douglas fir forests, and the relatively dry interior region, characterized by scattered stands of pines and true firs. This merging of climatic and vegetational zones, each with its representative wildlife species, results in an increase in animal diversity. For example, blacktailed deer of the coastal forests, mule deer of the drier interior area, and hybrid offspring of these two sub-species all occur within the Skagit Valley ecotone; in the heart of either the coastal zone or the interior zone only one of these sub-species occurs. The UW investigators reported that hybrids of small mammals such as mice and shrews are also rather common in the Ross Basin.

The UW team studied the distribution and abundance of deer by observing them directly; by trapping, marking, releasing, and re-sighting them; by counting deer pellet groups; and by measuring use of browse plants. Inferences about distribution were also made from knowledge that the influx of mule deer is from the north and east, and the influx of blacktailed deer is from the south and west.

The UW investigators estimated deer numbers in the Ross Basin at 400 to 600 in 1971 and 250 in 1972. The team stated that most deer around the lakeshore are hybrids showing obvious blacktail characteristics and that these deer are year-round residents of that vicinity.

Deer winter ranges as identified by the UW team are shown in Figure 2-7a. The Washington Department of Game, in its response to the draft environmental statement, identified Roland Point, Cougar Island, and the shoreline hillside behind Cougar Island as areas that should be considered major instead of minor ranges as shown on the map. The Department of Game also believes Rainbow Point is an important deer winter range.

Deer in Ross Basin are scattered and have ample food and cover during late spring, summer, and fall. But during winter, snow restricts their movements and they concentrate to some extent near Ross Lake. Winter is the season when food is in shortest supply and when deer die in the greatest numbers. The terms pinch period and carrying capacity, as used in wildlife management, can be used to describe effects of winter on deer in Ross Basin because winter is a critical time (pinch period) for deer and the quality and extent (carrying capacity) of the winter range are key factors in determining the population level.

Some deer which spend part of the year in the U.S. spend early spring on meadows near the end of Ross Lake in Canada. Whereas good spring habitat is usually not as critical to deer as winter habitat, it is still less available than summer and fall habitat. Deer are browsers during most of the year, but they graze extensively in meadows during the early spring, and turn readily to grass, a good source of protein after a winter of feeding on woody vegetation.

The 1971 UW Biotic Survey report indicates that the black bear is the second most numerous large mammal in the Ross Basin. The main concentrations of bears along the lakeshore were near campgrounds and in avalanche chutes, although bears apparently do not use the lakeshore any more or less than other parts of their range.

The third most abundant large mammal in the Ross Basin is the mountain goat, estimated at 25 to 50 animals by UW investigators. Mountain goats occur on both sides of the Ross Basin, but in such low numbers that they probably are not important to other animals as sources of

Figure 2-7a. DEER WINTER RANGES

food, nor as competitors for food.

The UW investigators estimate that fewer than 10 elk occur in the Ross Basin area within the United States. These elk could be of the Rocky Mountain subspecies which inhabits a large region to the east including eastern Washington and British Columbia, or they could be of the Roosevelt subspecies from the western forests. The relationship between Rocky Mountain elk and Roosevelt elk is analogous to the relationship between blacktailed deer and mule deer.

The UW study team, using helicopters, made a survey of the beaver population in Big Beaver Valley in the late summer and fall of 1971 and estimated a population of 35 beavers. Evidence of beaver in the Lightning Creek drainage was observed in 1972, but it was not determined whether a permanent colony was established there.

Birds far outnumber, both in species and individuals, other vertebrates in the Ross Basin; the UW team reported observing 132 bird species. Traill's flycatchers, chestnut-backed chickadees, and orange-crowned warblers occupy the lowland habitats. The most common upland game bird in the area is the ruffed grouse. (The designation upland game bird is somewhat misleading in this case because the UW team reported finding most of the ruffed grouse in lowland habitat near Ross Lake.)

A variety of water birds (such as herons and grebes) and waterfowl (ducks, geese, and swans) frequent Ross Lake, but none of these species is abundant there. Ross Lake does not support the abundance of aquatic vegetation and invertebrates that constitute a rich food source for waterfowl and it has few shallow areas which are essential feeding areas for wading birds and dabbling ducks.

Little information is available on the amphibians and reptiles of Ross Basin. The UW study team took notes on these animals during the course of their field work.

2.8 FISHERIES

A list of the species of fish found in the Ross Lake basin is given in Appendix D. Recent studies of the status of the fisheries resources of the Ross Basin were conducted by the International Skagit-Ross Fishery Committee. Participating agencies in the committee included:

British Columbia Fish and Wildlife Branch
Bureau of Sport Fisheries and Wildlife
(Department of the Interior)
F. F. Slaney and Company (Consultants)
Fisheries Research Institute, University of Washington
National Park Service (Department of the Interior)
Washington Department of Game

Field studies on Ross Lake and its tributaries were conducted by the Committee during 1971 and 1972. A copy of Volumes I and II, describing its 1971 and 1972 fisheries investigations, have been made available to Commission Staff and copies are available for review in the offices of the Applicant.

Detailed studies of the Ross Lake fishery resources were made in this investigation and voluminous data are becoming available for examination. It is assumed that the factual material in the committee report are the most current available data on the Ross Lake fishery resource. The committee report and comments on the DEIS are the major sources of the following description of the Ross Lake fishery resources.

Ross Lake and its tributaries contain populations of rainbow trout, cutthroat trout, brook trout, and dolly varden char. These species reproduce in streams tributary to the lake and in the lake itself at the mouth of streams or in areas of the lake where there is seepage inflow through gravel. Rainbow trout spawning areas which were identified include the Skagit River above Ross Lake, lower Lightning Creek, Ruby Creek, Canyon Creek, Dry Creek, Roland Creek, and the lake shore in the immediate vicinity of the mouths of Ruby, Lightning, and Roland Creeks. Other shoreline sections which may also provide trout spawning areas are found near the inlets of Pierce, Devils, Skymo, Little Beaver, International, Silver, and Hozomeen Creeks. Ripe cutthroat trout were observed off the mouth of Big Beaver Creek and might have spawned in that location.

The Ross Lake rainbow trout population is self sustaining from natural production and has not been supplemented with hatchery fish in recent years. For this reason, the fishery is considered of special value since it provides a fishing experience for native stock trout and also provides a major fishery without the expense of a hatchery. In addition to the Ross Lake rainbow trout population, there are populations of resident rainbow trout in many of the tributary streams. Spawning areas of rainbow trout in Big Beaver Creek were not identified during stream surveys. Self supporting stocks of cut-throat trout reside in ponds adjacent to Big Beaver Creek and these fish could spawn in the main Creek or its tributaries.

A waterfall located at the mouth of Big Beaver Creek prevents fish from entering that tributary from about November to mid-May. The rising lake level in the spring inundates the falls and permits fish passage throughout the remainder of the year. Little Beaver Creek and Devils Creek are probably not used for spawning by trout from Ross Lake. The most important spawning tributary streams for Ross Lake trout on the U.S. side of the international boundary are Ruby Creek and its tributary Canyon Creek and the lower 1/4 mile of Lightning Creek. In the Canadian section of the Ross basin the most important trout spawning area is the main stem of the Skagit River. There are tributary streams to the Skagit River which are also used by trout for spawning and rearing.

Dolly varden char were observed in Ruby Creek and its tributary Canyon Creek, Lightning Creek and Big Beaver Creek by the study team during the fall of 1971 and 1972. Eastern Brook trout and Dolly Varden char were also observed in spawning areas of the Skagit River above Ross Lake in the fall months.

The 1971 and 1972 field studies indicate that the peak of rainbow trout spawning occurs from mid-May to mid-July. The approximate spawning and hatching times of rainbow trout in the U.S. tributaries to Ross Lake are shown graphically in Figure 2-8. The method of determining the time of spawning is based in part on the use of temperature units. A temperature unit (TU) represents one degree Fahrenheit above 32°F for one day (24 hours); thus, a temperature of 40° for one day would represent eight temperature units.

The spawning time of cutthroat trout and Dolly Varden in the Ross basin was not as well defined as rainbow trout, but normally that cutthroat spawn in the spring months and Dolly Varden in the late fall. Observations in the Canadian Section of the Skagit River by the study team indicated the peak of char spawning takes place in early November.

Age, growth, and fecundity studies of rainbow trout in Ross Lake were also conducted by the Committee. Figures 2-9 and 2-10 show the length-weight relationship and the

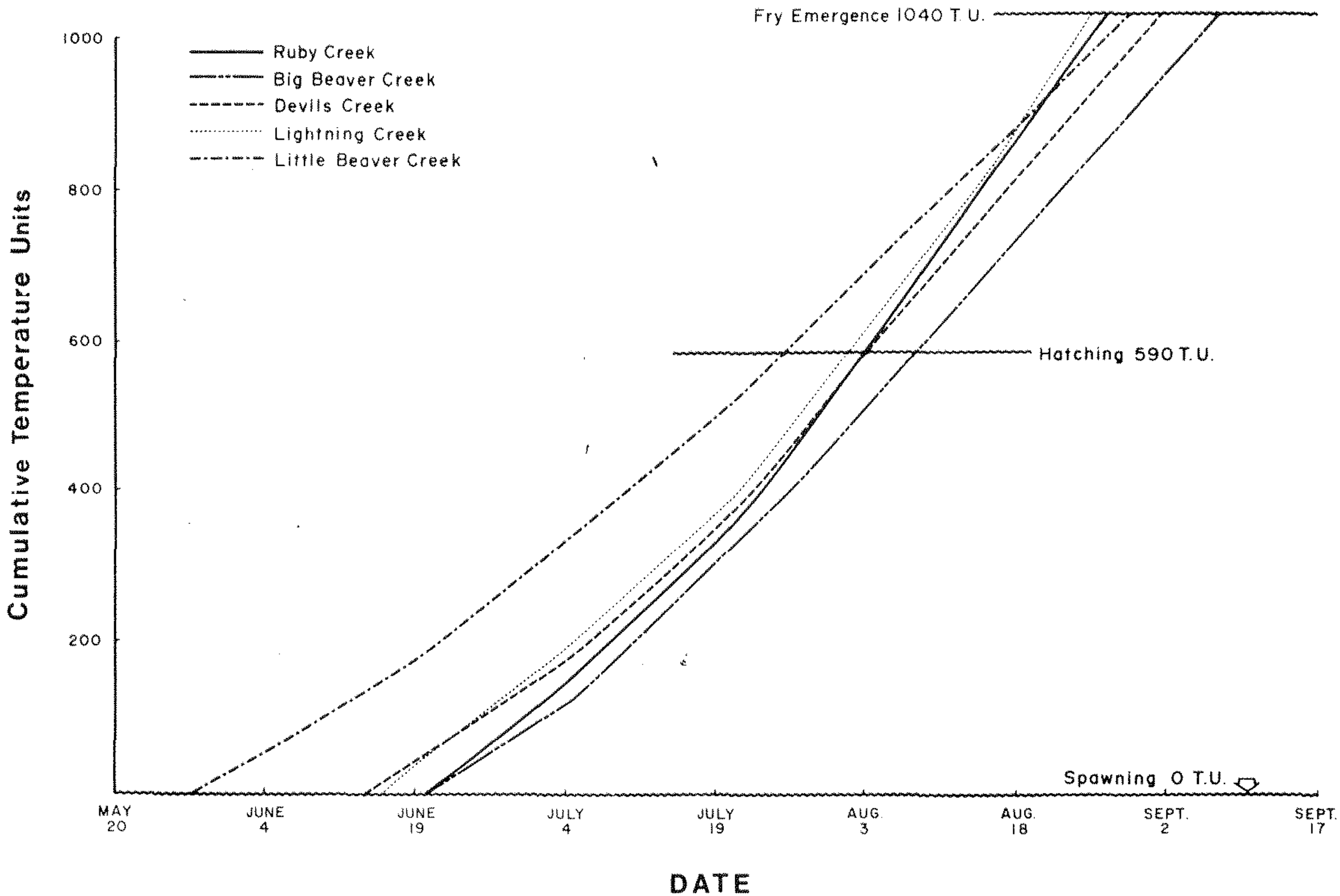


Figure 2-8. APPROXIMATE RAINBOW TROUT SPAWNING AND HATCHING TIMES

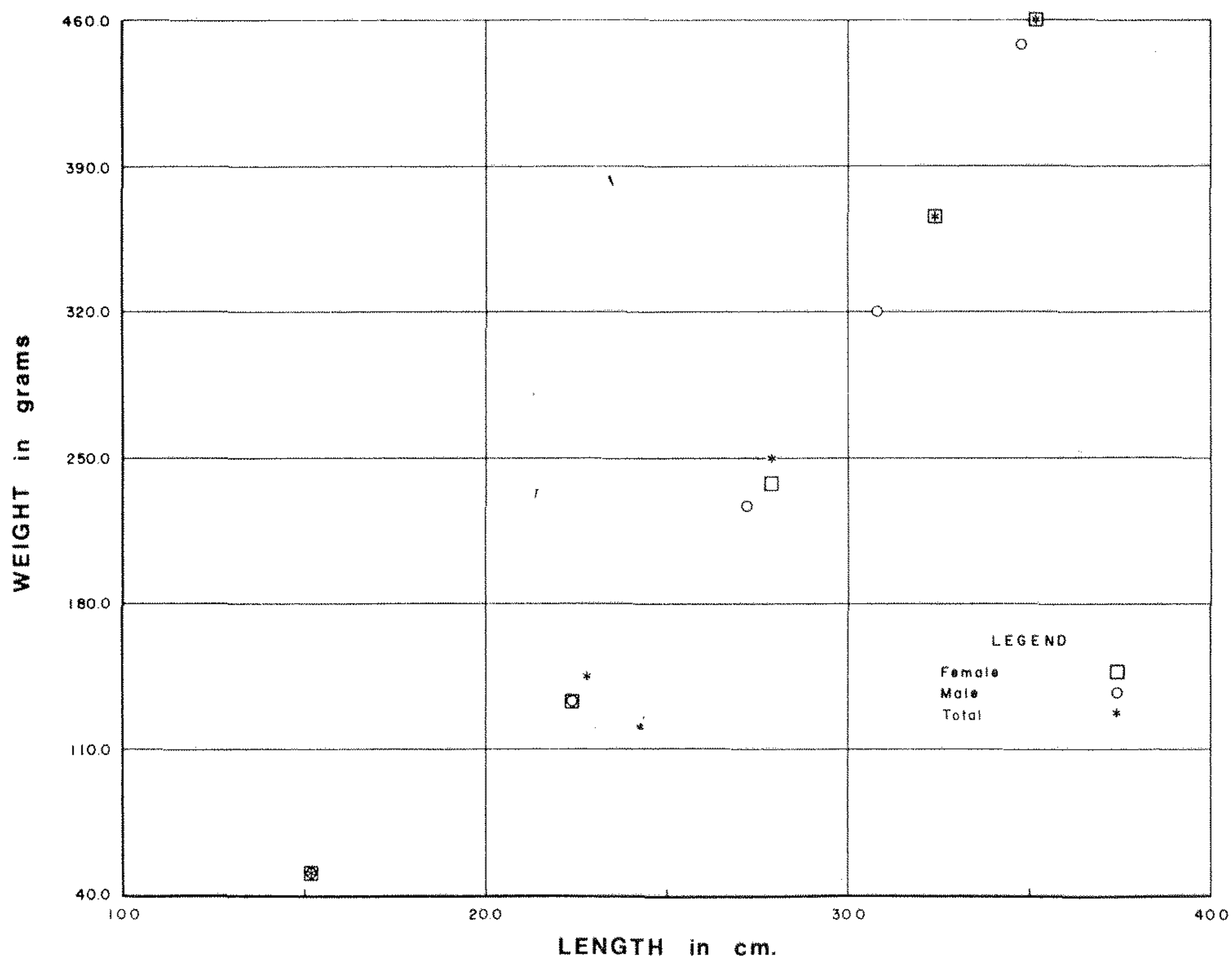


Figure 2-9. LENGTH-WEIGHT RELATIONSHIP (RAINBOW TROUT)

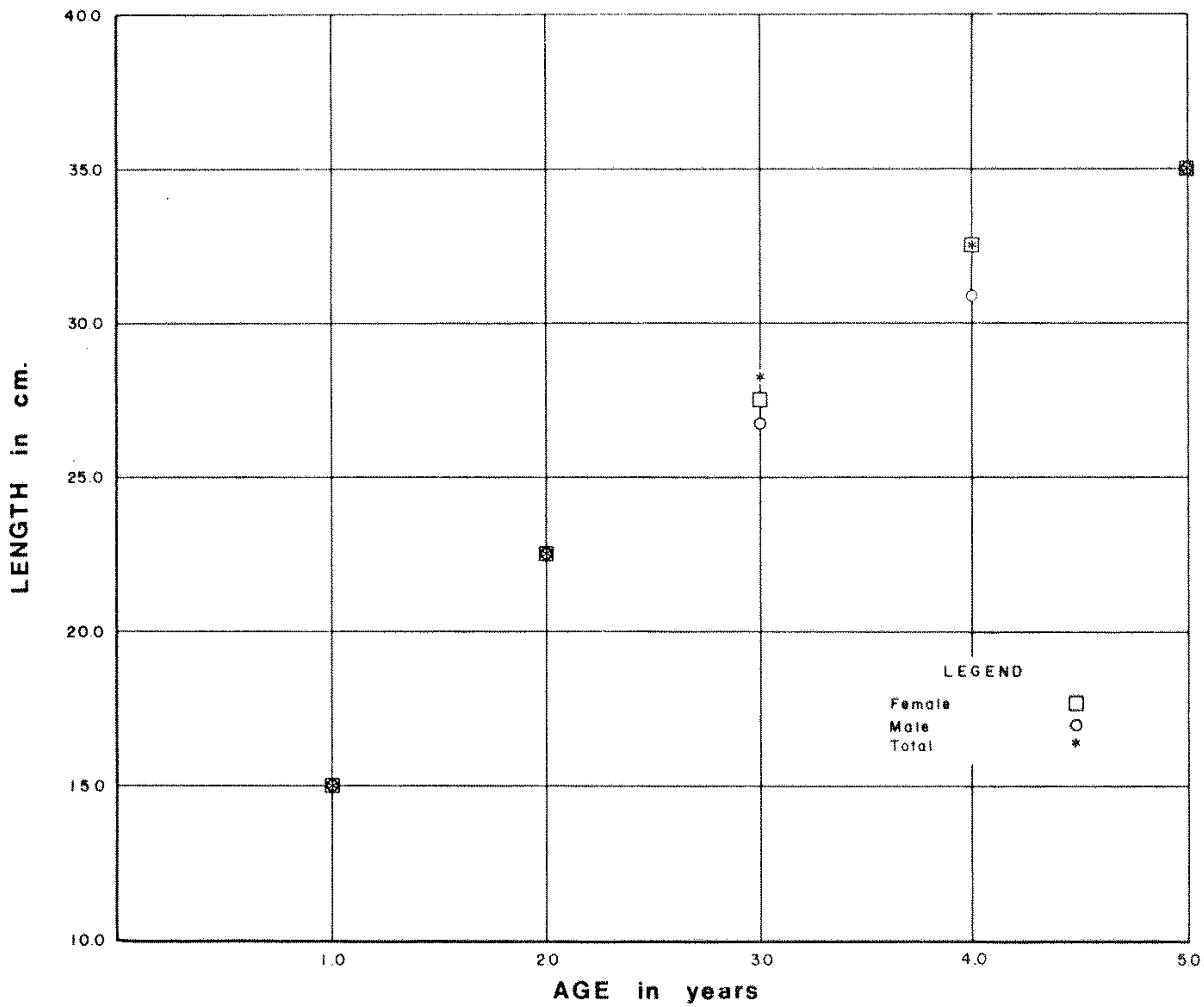


Figure 2-10. MEAN CALCULATED LENGTH (RAINBOW TROUT)

mean calculated lengths of the 1971 samples. Egg counts were made on 44 rainbow trout. The fecundity is depicted in Figure 2-11.

The sport fishery for trout in Ross Lake is regulated by the Washington Department of Game (Figure 2-12). Changes in fishing regulations can occur from year to year. The 1971 report by the Ross Committee quotes the closed waters for that year as follows: "Big Beaver and its entire drainage above closed water markers on Ross Lake; Devils Creek from closed water markers in Ross Lake for one mile upstream; Lightning Creek from closed water markers in Ross Lake for one mile upstream; Ruby Creek from closed water markers in Ross Lake to Crater Creek." The 1971 open season for trout fishing extended from June 19 to October 31 and the catch limit for trout was "Not to exceed six pounds and one fish; provided the numbers taken do not exceed 12 fish."

Creel data from 1941 through 1970 are included in Table 2-2. In describing these data, the Committee report points out that the daily catch limits were reduced twice over this period (1952 and 1961). The report further contains the following reference to the table. "Features of the catch data--as well as conclusions drawn from them, must be qualified in that the manner and frequency with which they were collected was not necessarily consistent from one year to another, or systematic for any single year. They were for the most part collected during, and are representative of, intensive use periods (e.g. weekends, holidays, etc.)." Access to the south end of Ross Lake, where there is no highway access, is more difficult than entry to the north end where there is a good access road. Creel census data from the south end of the lake is probably more accurate, however, since nearly all anglers leave from the resort near the dam where a more complete sample of the catch can be taken.

The total estimated catch of legal sized trout from Ross Lake and the Skagit River above Ross in 1971 was 40,578. Of this total, an estimated 7,789 fish were taken by anglers entering Ross Lake from the south and 28,763 were caught by fishermen entering from the north. The 1971 Skagit River (Canada) total catch was estimated to be 4,026 fish. The 1972 creel census data collected by the study team indicates a total sport fishery catch of 41,441 fish.

Population studies of legal-sized rainbow trout were undertaken by the Committee in 1971 using methods of tagging

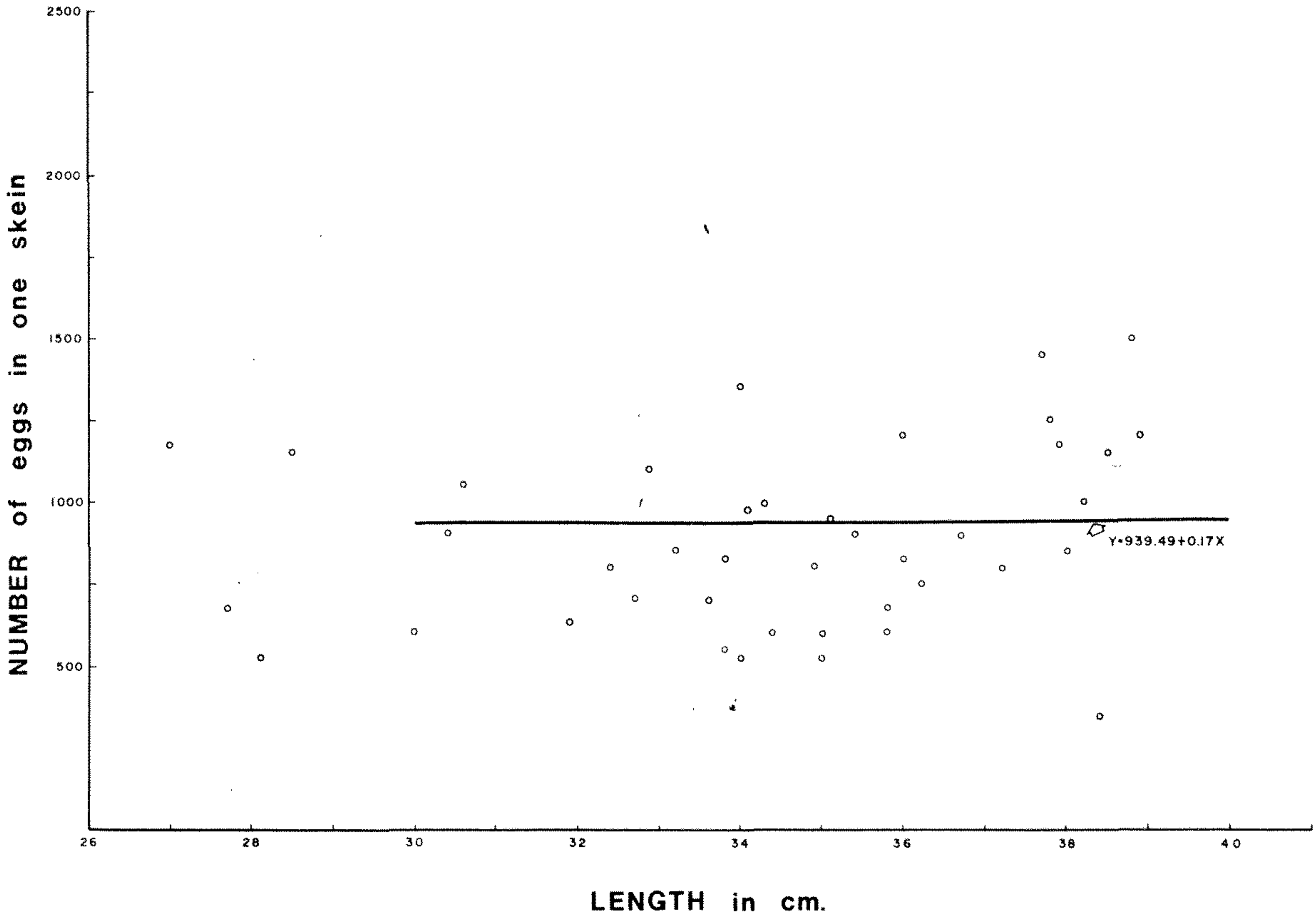


Figure 2-11. RAINBOW TROUT FECUNDITY, SKAGIT RIVER, ROSS LAKE SYSTEM, 1971.

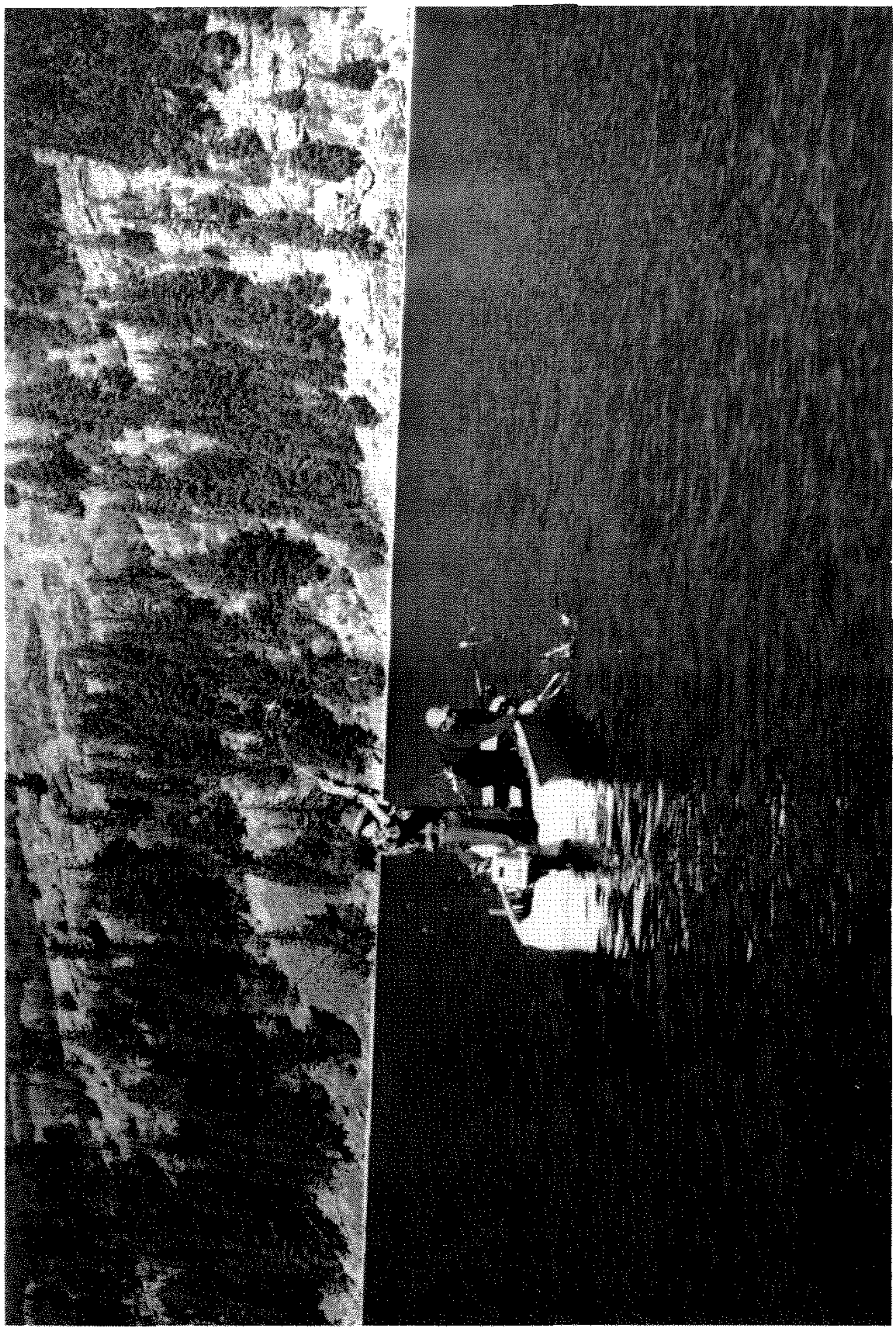


Figure 2-12. RECREATIONAL USE OF ROSS LAKE

TABLE 2-2

CREEL CHECK DATA FOR YEARS 1941 THROUGH 1970 FROM ROSS LAKE

		Recorded Catch					
Year	Number of Anglers Checked	Rainbow	Cutthroat	Eastern Brook	Dolly Varden	Total	Catch Per Angler Day
1941	14	212				212	15.1
1946	12	144			3	147	12.2
1950	364	2213	769	6	159	3147	8.6
1951	160	1371		2	36	1409	8.8
1952	243	1146	46		68	1260	5.2
1953	165	735	58	2	12	807	5.0
1954	277	1413	55	6	27	1501	5.4
1955	261	964	60	26	49	1099	4.2
1956	218	642	88	42	65	837	3.8
1957	64	222	8	39	24	293	4.6
1958	70	323	4	19		348	5.0
1959	290	1933			26	1959	6.7
1960	585	2452	4	40	84	2580	4.4
1961	675	2248	2	17	212	2479	3.7
1962	907	4334	4	81	107	4526	5.0
1963	434	2598		1		2599	5.4
1964	42	87	3		3	93	2.2
1965	162	515				515	3.2
1966	458	1928		63	6	1997	4.4
1967	336	940	1	7	4	952	2.8
1968	520	1392			4	1396	2.6
1969	366	751	6		8	765	2.1
1970	717	2593	5		17	2615	3.6

and angler recovery. The population estimates varied throughout the season and would be expected to vary annually. The estimate of the 1971 Ross Lake rainbow trout population is 146,352, with a 95% confidence interval of 120,263 to 186,898. The 1972 population estimate is 206,185 rainbow with a 95% confidence interval of 174,353 to 252,237. Interpretation of the results of the studies and of the trout population size could vary among analysts. Other population estimates using other methods would be possible.

In the Skagit River downstream from Gorge dam, several species of anadromous and resident fish are found. Chinook, pink and chum salmon and steelhead trout spawn, and their progeny spend early stages of development in the mainstem of the Skagit River before migrating to sea at the smolt stage. Coho salmon spawn in the tributary streams and complete their freshwater period of life in the Skagit River before migrating to sea. Chinook, pink, chum and coho salmon spawn in the fall of the year and steelhead spawn in late spring. In addition to anadromous fish there are several species of resident fish, including rainbow trout, which are part of the valuable fishery resources of the Skagit River.

2.9 UNIQUE BIOTIC RESOURCES

Ross basin, which lies west of the Cascade crest, contains vegetation typically found to the west of the crest mixed with some species commonly found to the east. This influence is most evident on the east side of Ross Lake, where wet, western slope forest gradates to dry, eastern slope forest. For example, Ponderosa pine, lodge pole pine, subalpine fir, and Engelmann spruce, associated primarily with ecosystems east of the crest, are found on slopes east of Ross Lake.

Big Beaver Valley (Figure 2-13) according to the U.S. Forest Service, contains an ecosystem of value for future education and research. The Pacific Northwest Natural Area Committee, a federal inter-agency group that was concerned with indentifying and protecting Research Natural Areas on Federal lands, of which Forest Service personnel were participating members, searched for western redcedar (*Thuja plicata*) stands intermixed with associated plant communities in a major valley bottom. A community mosaic fulfilling the pertinent requirements, those being (1) substantial old-growth stands of western redcedar, (2) other coniferous forests, (3) riparian hardwood forest, and (4) aquatic and semi-aquatic communities, was determined to be a suitable example for a Research

Figure 2-13. BIG BEAVER CREEK VALLEY

Natural Area. This particular grouping of plant communities, (not the communities studied individually) is of keen interest to ecologists for its educational and research values. Western redcedar groves of similar size and age class exist elsewhere in the Cascades but not as a part of this particular valley bottom community mosaic. Big Beaver Valley appeared to be the most complete ecosystem of this type in existence but was excluded from consideration as a designated Research Natural Area because of the High Ross proposal.

The old-growth western redcedar in Big Beaver Valley has aesthetic value in addition to research values but as a species it is duplicated in other parts of the Cascade Range. Being extremely long-lived, it occupies both intermediate and climax stages in plant succession. Western hemlock, depending on site factors, such as soil depth, and soil moisture, will eventually assume dominance in the climax stage. Although western redcedar is very susceptible to pathological agents after several hundred years and generally requires open, exposed areas for successful reproduction, longevity and limiting site factors insure its position as a climax species in many locations.

Applicant has identified areas in Canada below and above 1,725 feet where the rare plant type Rhododendron macrophyllum occurs. The Canadian portion of the Skagit Valley contains a stand of Ponderosa pine which is an unusual example of the transitional character of the plant communities in the Skagit Valley. Ponderosa pine is commonly found in the drier regions east of the Cascade crest but due to climatic and soil factors occurs on slopes east of Ross Lake.

2.10 SOCIO-ECONOMIC CONSIDERATIONS

The Ross dam development is bordered on the west and south by the North Cascades National Park, on the southeast by Mount Baker National Forest, and on the east by the Pasayten Wilderness Area. Other federally owned lands adjacent to the National Recreation Area, which encompass the development, include Glacier Peak Wilderness, Lake Chelan National Recreation Area, and Okanogan National Forest (Figure 2-1). This vast area of federally owned and controlled lands, encompassing in excess of 1,535,000 acres, limits population growth in the immediate project area.

Proceeding 5 miles from Ross dam southwestwardly on State Route 20, the first town is Diablo with an estimated

1970 population of less than 100. Newhalem, 5 miles further west, has slightly over 100 people. Both villages owned by Seattle were constructed for employees of the Skagit River developments and are inhabited by families employed by Applicant. Marblemount, with a 1970 population of 350, is located approximately 15 miles southwest from Newhalem, at the point where State Route 20 turns westward. People entering the North Cascades complex from the west would pass through these small towns.

State Route 20 was recently extended from Diablo, eastward to a point near Mazama, Washington (See Figure 2-4). This extension permits direct access from the east as well as the west. The larger potential demand for project recreational use is from the west where the cities of Seattle, Everett, and Tacoma are located. A lower population density east of the development is evidenced by the first town on State Route 20 which is Mazama, Washington, with a 1973 estimated population of 20. Wenatchee, with a 1970 population of 16,912, is located 100 miles further to the south. In a 50-mile radius from the development center, the estimated 1973 population was slightly over 6,000. In a 100-mile radius, which includes the cities of Everett and Bellingham, over 487,500 people reside.

Estimated 1973 population statistics for Skagit and Whatcom Counties are 53,000 and 89,000, respectively, with dense concentrations in the western sections. Both counties are sparsely populated, with 30.2 persons and 38.5 persons per square mile for Skagit and Whatcom, respectively. In 1970 approximately 2,500 persons lived in the eastern two-thirds of Whatcom County, the site of the development, while the remaining one-third of the county was home for approximately 79,500 people. A similar population distribution pattern is illustrated in Skagit County by drawing a north-south line through the town of Concrete, 15 miles west of Marblemount. In 1970, 1,018 people lived east of the line while 51,363 people resided in the western section of the county.

Marketing data for Skagit and Whatcom counties show that the basic trading area for the two counties is the Bellingham-Mt. Vernon region while the major regional trading area is the Seattle metropolitan area in King County. Large, urban areas from Bellingham south to Tacoma dot the Puget Sound coast. A rough indication of the development's recreation potential can be obtained from 1970 population figures of 1,238,107, and 332,521, respectively, for the urbanized areas of Seattle - Everett, and Tacoma. With the opening of the eastern portion of State Route 20

(North Cascades Highway) the inhabitants of the Spokane urban area (229,620, in 1970) have a direct route to the development area as well as the people of Wenatchee. With improved access, persons living both east and south of Ross dam would place more emphasis on the Ross Lake National Recreation Area for leisure time activities.

Both Skagit and Whatcom counties are equally divided between urban and rural residents. Data for 1970 show that 46.3 percent of the population in Skagit and 51.5 percent of the population in Whatcom was classified as urban. Trends in population growth in the two counties, however, present distinct differences. Between 1960 and 1970, Skagit County's total population increased by two percent while the rural portion declined by 0.7 percent. Whatcom County showed an overall increase of 16.5 percent and an increase in rural inhabitants of 20.2 percent. Urban growth in Whatcom County also surpassed that of Skagit County by about eight percentage points.

2.11 ECONOMIC DEVELOPMENT

Economic data for both Skagit and Whatcom Counties in 1970 show that earnings, which comprised roughly 78 percent of total personal income, amounted to $371 million. The general importance of various economic sectors is shown in Table 2-3.

The private, non-farm sector accounted for most of total earnings. Manufacturing alone accounted for 25 percent of total earnings in the two-county area. Wholesale and retail trade and services made up 28 percent of the total. However, over the 20-year period depicted in the table, government earnings, particularly State and local, surpassed the wholesale, retail, and service sectors in terms of increases in relative importance. The data also illustrate the minor importance of agriculture.

TABLE 2-3

Earnings by Broad Industrial Sectors
(Skagit and Whatcom Counties)

	1950		1962		1970	
	1,000's of Dollars	% Total	1,000's of Dollars	% Total	1,000's of Dollars	% Total
Total Earnings	113,036	100.00	198,125	100.00	371,155	100.00
Farm Earnings	17,113	15.4	17,954	9.06	25,922	6.98
Total Non-Farm Earnings	95,923	84.86	180,171	90.94	345,233	93.02
Govt. Earnings	15,944	14.11	36,822	18.59	78,035	21.02
Federal	3,851	3.41	7,587	3.83	10,256	2.76
State and Local	12,093	10.70	29,235	14.76	67,779	18.26
Private Non-Farm	79,979	70.76	143,349	72.35	267,198	71.99
Manufacturing	27,661	24.47	51,432	25.96	93,328	25.15
Mining	-------	-------	-------	-------	933	.25
Contract Construction	5,853	5.18	12,920	6.52	33,355	8.99
Transportation	6,896	6.10	11,944	6.03	21,225	5.72
Communication and Public Utilities						
Wholesale and Retail	22,310	19.74	33,808	17.06	60,104	16.19
Finance, Insurance, and Real Estate						
Services	11,269	9.97	25,322	12.78	45,276	12.20
Other	2,681	2.37	2,323	1.17	3,399	.92

Source: U.S. Department of Commerce.

Another measure of relative economic importance is the number of employees in the various sectors of the economy as shown in Table 2-4.

Table 2-4. Industry of Employed Persons 1970 - Skagit and Whatcom Counties

Industry	Number of Employees		Percent of Total	
	Skagit	Whatcom	Skagit	Whatcom
Agriculture, Forestry and Fisheries	1,433	2,274	7.9	8.0
Mining	17	66	0.1	0.2
Construction	1,185	1,779	6.5	6.2
Manufacturing	4,254	5,379	23.5	18.9
Transportation, Utilities, and Communications	1,115	1,788	6.2	6.3
Wholesale and Retail Trade	3,641	6,220	20.1	21.8
Banking, Investment, and Finance	594	1,170	3.3	4.1
Services	4,943	5,641	27.5	30.3
Public Administration	873	1,171	4.8	4.1
Total	18,095	28,488	100.0	100.0

Source: U.S. Department of Commerce. General Social and Economic Characteristics. 1970.

Manufacturing, wholesale and retail trades and services provide most of the jobs. Both counties reflect this general employment pattern.

A further breakdown of the manufacturing sector shows that in both counties the lumber and wood products industry along with other wood related industries account for the largest number of jobs.

A general description of income and employment by state and county is shown in Table 2-5.

Table 2-5. Income and Employment, 1969

	State	Skagit	Whatcom
Civilian Labor Force, % Unemployed	7.9%	8.4%	7.5%
Families, Total	862,542	13,833	20,319
Median Income	$10,407	$ 9,407	$ 9,431
Mean Income	$11,511	$10,376	$10,304
% with income of less than poverty level	7.6%	8.6%	8.7%
% with income of $15,000 or more	22.8%	17.7%	16.8%
Per Capita Income of Persons	3,370	$ 3,072	$ 2,960

Source: U.S. Department of Commerce. General Social and Economic Characteristics. 1970.

Elementary school facilities are provided for children of Applicant's employees at Newhalem and Diablo. Approximately 33 miles from Newhalem at Concrete, serving an estimated population of 2,192, is another school district consisting of an elementary and high school. The high school at Concrete is the only one serving the area from the project to Concrete. A decrease in population of the area between Concrete and Marblemount has lessened the demand for educational services and thus, Marblemount and Rockport do not provide such services.

The nearest health services to the development are at Newhalem where a full time nurse and small clinic are available primarily for Applicant's employees and families. Professional services of a physician are available at Concrete, approximately 45 miles from the development. Additional health services are available at hospitals located in both Mount Vernon and Sedro Woolley, about 85 miles and 75 miles from the development area, respectively. According to the Skagit County Planning Commission, helicopters could be made available for emergency evacuations from the North Cascades Complex. The Planning Commission also has advised that an ambulance would be stationed in the town of Concrete.

2.12 CLIMATE

The climate of the area surrounding Ross reservoir can be characterized as maritime. At the lake shore summers are warm and dry with a few days of temperatures above 90°F each year. The winters can be characterized as wet and cold with severe conditions in the mountains surrounding the reservoir.

The average monthly temperatures at the Ross powerhouse, according to U.S. Weather Bureau records over a 10-year period from 1961-1970, range from 32.2° for the coldest winter month of January to 65.8°F. for August, the warmest month. The coldest day was -10°F. on December 30, 1968 and the coldest month was January 1969 with an average temperature of 22.1°F. The entire lake froze over twice during the period of record, in December 1968 and January 1969. The highest recorded temperature at the dam during the 10-year period was 101°F on August 31, 1967. The 1969 yearly average temperature was 48.2°F at Ross dam, 48.2°F at Diablo dam, and 49.4°F at the town of Newhalem. The average maximum and minimum temperatures recorded at Daiblo dam between 1931 and 1960 were 57°F and 40°F. The extremes during the period of record were 106°F and -10°F.

The precipitation pattern in the Ross dam area is essentially maritime with most of the moisture coming during winter and gradually decreasing during spring and summer. Nearly 50 percent of the precipitation normally falls during November, December and January and 75 percent of the total precipitation falls from October through March. Less than five percent of the annual precipitation normally occurs in July and August, the warmest months. Total precipitation figures show a maximum of 9.8 inches in January and a minimum of 0.95 inches in July. During the 1961-70 period of record the lowest yearly precipitation recorded at Ross dam was 43.4 inches while the maximum was 69.9 inches. Precipitation averages about 64 inches during the year at Ross dam. In 1969, the driest year in the survey period, precipitation at Ross dam totaled 43.4 inches whereas the precipitation downstream at Diablo dam and Newhalem was 59.6 inches and 60.4 inches, respectively. This record low precipitation at Newhalem was 17.9 inches below the 30-year average. Losses from lake evaporation average 25 inches on a yearly basis.

Ross Lake receives less snowfall than the Skagit Valley in Canada. In the area around the lake shore, the snow will often be relatively shallow and become abruptly deeper at about 2,500 feet elevation. Plants on the lake shore will develop leaves and flowers about a month earlier than plants of the surrounding area.

The average monthly and yearly snowfall, measured in inches, at Diablo dam during the period of record (1931-60) is as follows: (*)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total
.1	5.1	16.8	23.4	16.5	9.5	5	71.9

* No snowfall was measured from May through September.

Average snowpack in inches of water over 20 years, 1951-1970, from 13 snow measuring stations in the Ross reservoir area ranging in elevation from 1,900 to 6,500 feet are listed in Table 2-6. The data indicate that total snow accumulation has been fairly uniform with the exception of 1954 and 1956 which are the maximum years.

Table 2-6.

Snowpack In Inches Of Water	
1951 - 30.6	1961 - 22.3
1952 - 21.5	1962 - 16.5
1953 - 22.7	1963 - 11.4
1954 - 37.1	1964 - 28.3
1955 - 23.8	1965 - 23.9
1956 - 40.6	1966 - 22.9
1957 - 23.7	1967 - 26.9
1958 - 16.8	1968 - 19.1
1959 - 23.5	1969 - 25.1
1960 - 18.2	1970 - 16.7

The Ross reservoir receives sunshine approximately 20 percent of the daylight hours during the winter, 40 to 50 percent of daytime in the spring and fall, and 60 to 70 percent during the summer.

2.13 WATER RESOURCES

The Skagit River (Figure 2-14) drains 3,105 sq. miles, 400 sq. miles of which are in Canada, into Puget Sound. Approximately 1,000 sq. miles of the drainage area lie above Ross Lake. The basin has an average annual rainfall of 71 inches and an average annual runoff, measured at Marblemount, of about 3,860,000 acre-feet.

The Skagit River contributes more annual runoff into Puget Sound than any other river in the area. About 13 percent of the Skagit River watershed lies in Canada but 94 percent of the runoff originates in Washington State. The shielding effect of the mountain ranges tends to reduce runoff from the upper portion of the Skagit basin. Approximately 30 inches of runoff are produced annually from the upper basin compared to 140 inches annually from the lower basin tributaries.

Much of the precipitation in the upper Skagit basin occurs during winter and is stored as snowpack until spring. The upper Skagit basin has numerous glaciers which help regulate streamflow by contributing runoff in spring and summer and provide a significant part of the lowflow during the dry, hot summer. The highest monthly average discharge of the Skagit River occurs in June. Minimum lowflows occur in the upper basin tributaries in February or March, and on the lower river in September.

Floods in the Skagit basin are caused by a combination of rainfall and snowmelt. Flood control storage in the Ross Reservoir was helpful in controlling the floods of 1949, 1955, 1959 and 1961. On these occasions the Ross powerplant was shut down to hold back the greatest possible amount of water and at such times the City of Seattle borrowed or purchased energy to meet its power needs. During the 1949 flood, enough water was held in Ross Reservoir during flood control operations to cover 116,000 acres to a depth of one foot. As previously indicated, preliminary studies by the Corps of Engineers indicate that it may be desirable to increase the amount of flood control storage provided by Ross Reservoir.

2.14 RECORDING STATIONS

U.S.G.S. monitoring stations record flows and gage heights on the Skagit River near Alma Creek and on Big Beaver Creek. A summary of the data recorded for the period

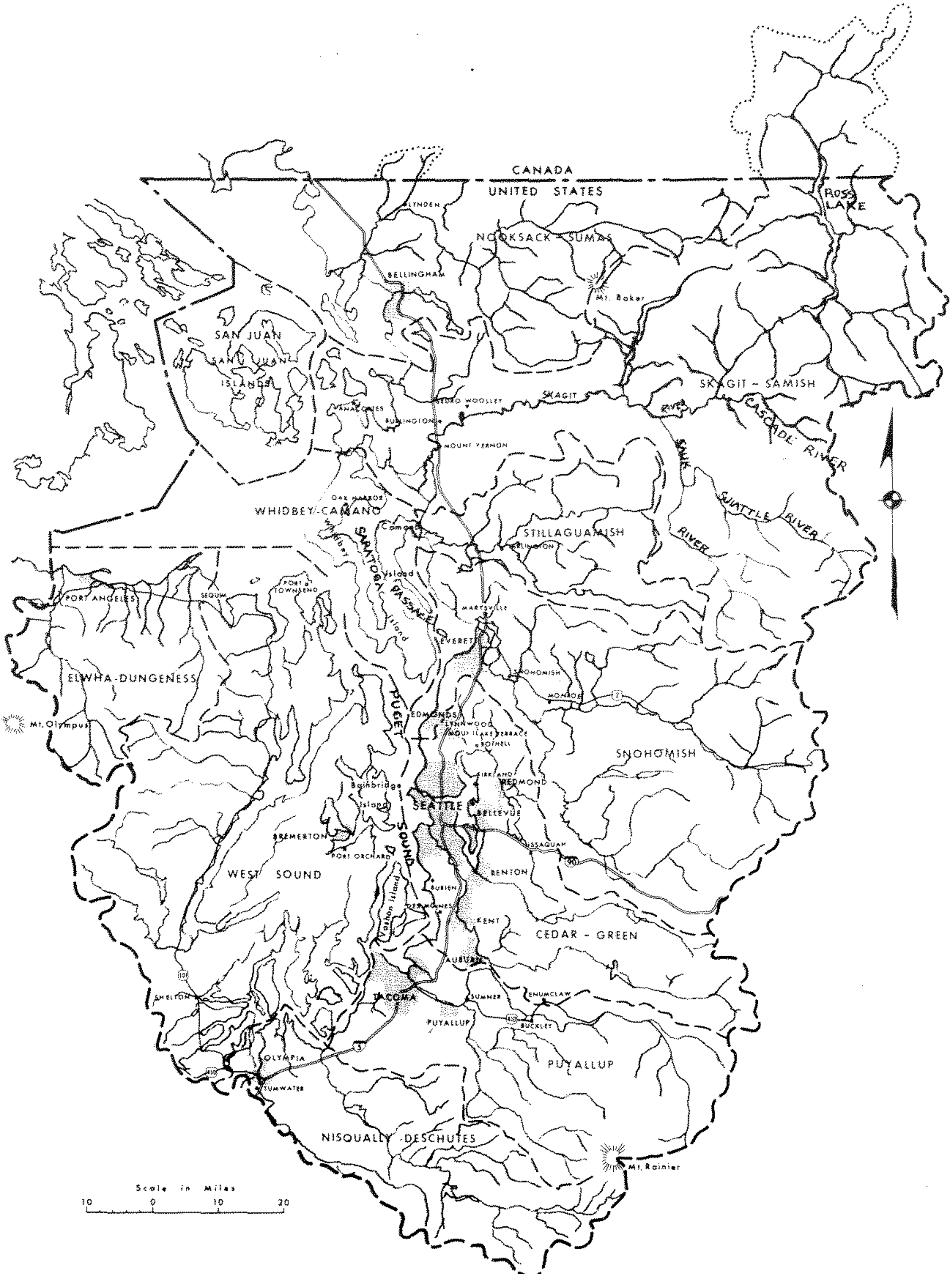


Figure 2-14. SKAGIT RIVER BASIN AND OTHER BASINS IN THE PUGET SOUND AREA

of record is shown in Table 2-7. The streamflow at these stations varies considerably throughout the year. Maximum flows occur from June through September and minimum flows are normally observed from November through April.

Table 2-7. Hydrologic Data from two Gaging Stations near Ross dam

	Skagit River above Alma Creek (1950 to 1972)	Big Beaver Creek near Newhalem (1940 to 1948 and 1962 to 1969)
Drainage Area		
(sq. miles in Canada)	400	
(Total sq. miles)	1,274	63.2
Average Discharge (ac. ft./year)	4,126,000	299,900
Max. Discharge (cfs)	38,500	4,420
Min. Discharge (cfs)	990	64
Mean Annual Discharge (cfs)	5,695	414

The Skagit River gaging station, located 0.6 miles upstream from Alma Creek, has recorded streamflow data from October 1950 to September 1972, as shown in Table 2-8. The drainage area above this station encompasses 1,274 square miles of which 400 square miles are in Canada. All diversions in the river above the gaging station are returned to the river above the station. During the period of record (1950-1972), the maximum discharge was 38,500 cfs recorded in June of 1967. The minimum recorded flow was 990 cfs in December 1957.

The Big Beaver Creek gaging station, located 3 miles north of Ross dam on the left bank of Big Beaver Creek, has a 63.2 square mile drainage area. The period of record is from March 1940 to September 1948 and from October 1962 to September 1969, when operation of the gaging station was discontinued. The maximum discharge at this station was 4,420 cfs in October 1963. The record minimum discharge was 64 cfs in March 1969. The average annual discharge was computed to be 414 cfs (299,900 acre-feet). No regulation or diversion takes place above the station.

At the International gaging station on the Skagit River near Hope, B. C., gage heights have been recorded since December 1953. Flow measurements have not been recorded because the gage is located in the upper reaches of Ross reservoir and the water level measured at this gage is subject to backwater from Ross reservoir. The maximum height shown for the period 1967 to 1972 was 21.37 feet recorded sometime between July 6 and August 23, 1972, whereas the minimum recorded height was 1.25 feet on March 5, 1955. Data collected at this monitoring station and others in the area are available in U.S.G.S. publications issued annually (46).

Water for consumptive uses in rural areas of the upper Skagit Valley is supplied by wells from ground water sources while towns such as Marblemount and Concrete have small water supply systems. Because of the undeveloped character of the Ross basin, many of the small streams are suitable for most domestic water uses.

In the immediate vicinity of the project, waste disposal is handled on an individual dwelling basis by means of septic tanks. The town of Concrete, Washington has a sewage treatment plant. Solid waste is deposited at designated dumping areas.

2.15 WATER QUALITY

The water quality of the Skagit River is considered excellent and suitable for most uses. Much of the sediment in the upper Skagit, a large proportion of which originates as glacial runoff, is captured in Ross reservoir, thereby improving water quality downstream. There is no evidence of significant man-induced pollution entering the basin above Ross dam. Water quality data collected from Ross Lake and adjacent measuring stations are published annually by the U.S.G.S. (47)

Daily water temperatures have been recorded since January 1953 at the Skagit River gaging station 0.6 mile above Alma Creek. Records of this station show the maximum water temperature observed during the period of record to be 56.3°F on July 30, 1961, September 5, 1966, and July 31, 1970. The maximum water temperature recorded in 1971 was 51.8°F, occurring several days in July and August. The minimum water temperature observed during the period of record was 34.7°F. on March 1, 1956, and on several days in January and February 1969. The minimum water temperature recorded in 1971 was 35.6°F, occurring from the 3rd through the 12th of February. The months with the coldest water temperatures are January, February and March, when the water normally ranges from 35.6°F to 41.0°F. The months with the warmest water temperatures are July, August, and September, when the temperature of the water ranges from 46.4°F to 51.8°F. Monthly maximum and minimum water temperatures are listed in Table 2-8.

Table 2-8

Monthly Max. and Min. temperatures in degrees Fahrenheit, Skagit River above Alma Creek - from Dec. 1950 to Sept. 1965.

	Maximum	Minimum
Jan	43	36
Feb	43	36
Mar	44	35
Apr	46	38
May	48	40
Jun	53	44
Jul	56	46
Aug	55	48
Sept	53	47
Oct	53	45
Nov	50	39
Dec	47	39

The Skagit Fisheries Committee report included a reference to water temperature sampling conducted by the Applicant from July 1970 through November 1971. In summary, the report indicates the presence of a well defined thermocline during the summer months. A maximum surface temperature in Ross Lake of 75°F was recorded at Hozomeen on August 1, 1971. Maximum observed water surface temperatures of 65.5°F and 62.5°F were recorded on August 20, 1971, midlake at Devils Creek and on August 19, 1970, at the Ross intake, respectively.

Other water analysis data of Ross Lake are contained in Table 2-9 which is reproduced from the 1971 committee report. This sample, which was taken on May 27, 1971, is included here as a general guide to the existing water quality of the reservoir.

2.16 NOISE AND AIR QUALITY

The project area is sparsely populated and there is no industry in the vicinity. There are no monitoring stations for noise and air quality in the Ross basin.

2.17 UNIQUE FEATURES

The National Register of Historic Places and other sources list no historic or archaeological sites (national or local) which would be affected by the proposed project. The State Office of Archaeology and Historical Preservation has indicated that there are no historic sites in or near the development area. An archaeological survey was conducted by Washington State University for the Applicant and no sites were found.

Big Beaver Valley (Figure 2-15), is valued for its scenery and uniqueness and for providing foot trail access to the Pickett Mountains. The Valley contains a unique ecological relationship according to the U.S. Forest Service, called the Cascade Valley Mosaic Community, which includes the redcedar forest and several other plant communities woven into an ecological complex.

Scenic vistas provide the visitors to this area with views of the rugged Cascade Mountains and the numerous glaciers at higher elevations (Figure 2-2). The existing development is unique in that it is the core of a National Recreation Area and is protected from high intensity, commercial development, because it is surrounded by federal lands managed primarily for their natural resource values.

TABLE 2-9

WATER ANALYSIS - ROSS LAKE

Station # 1 - South End - 25 foot depth
Station # 2 - South End - 100 foot depth
Station # 3 - North End - 25 foot depth
Station # 4 - North End - 100 foot depth

Date Collected
May 27, 1971

Results in milligrams per liter (PPM) except * and BDL - below detectable level

	Sta. # 1	Sta. # 2	Sta. # 3	Sta. # 4
Alkalinity	24.5	25.5	28.4	25.5
Calcium (Ca)	10.4	11.4	11.6	10.4
Free Carbon Dioxide (CO_2)	5.0	2.8	3.7	3.9
Chloride	0.5	BDL	0.5	BDL
Chromium (Cr^{+6})	BDL	BDL	BDL	BDL
Copper	.025	.015	.025	.02
Fluoride	<0.1	<0.1	<0.1	<0.1
Hardness ($CaCO_3$)	32.4	37.0	36.0	32.0
Iron (Fe)	0.05	0.03	0.05	0.03
Lead (Pb)	<0.005	<0.005	<0.005	<0.005
Magnesium (Mg)	1.56	2.07	1.7	1.46
Manganese (Mn)	<0.025	<0.025	<0.025	<0.025
Nitrogen (Ammonia)	—	.03	.015	.015
Nitrogen (Nitrate)	0.25	0.1	<0.05	< .05
Dissolved Oxygen	11.5	11.6	10.9	11.5
Phosphate (PO_4)	.04	.035	.03	.03
Potassium (K)	0.4	0.4	0.45	0.45
Residue (Total)	39	47	24	21
Residue - Filterable	7	8	9	10
Residue - Non-Filterable	32	39	15	11
Silica (SiO_2)	7.0	7.2	7.8	7.0
Sodium (Na)	1.4	1.0	1.5	1.6
Sulfate (SO_4)	4.7	4.3	4.7	3.4
Surfactants	.008	.026	.025	.023
Tannin-Lignin	0.1	<0.1	0.15	0.1
* Color Units	5	5	5	5
* Temperature °C (°F)	7.5 (45.5)	6.5 (43.7)	9.5 (49.1)	6.0 (42.8)
* Turbidity - JTU	1.5	1.0	1.6	0.9
* Secchi Disc	17'		14'	
* pH Units	7.12	7.42	7.31	7.26
* Specific Conductance (μmhos/cm^3)	64	68	70	64

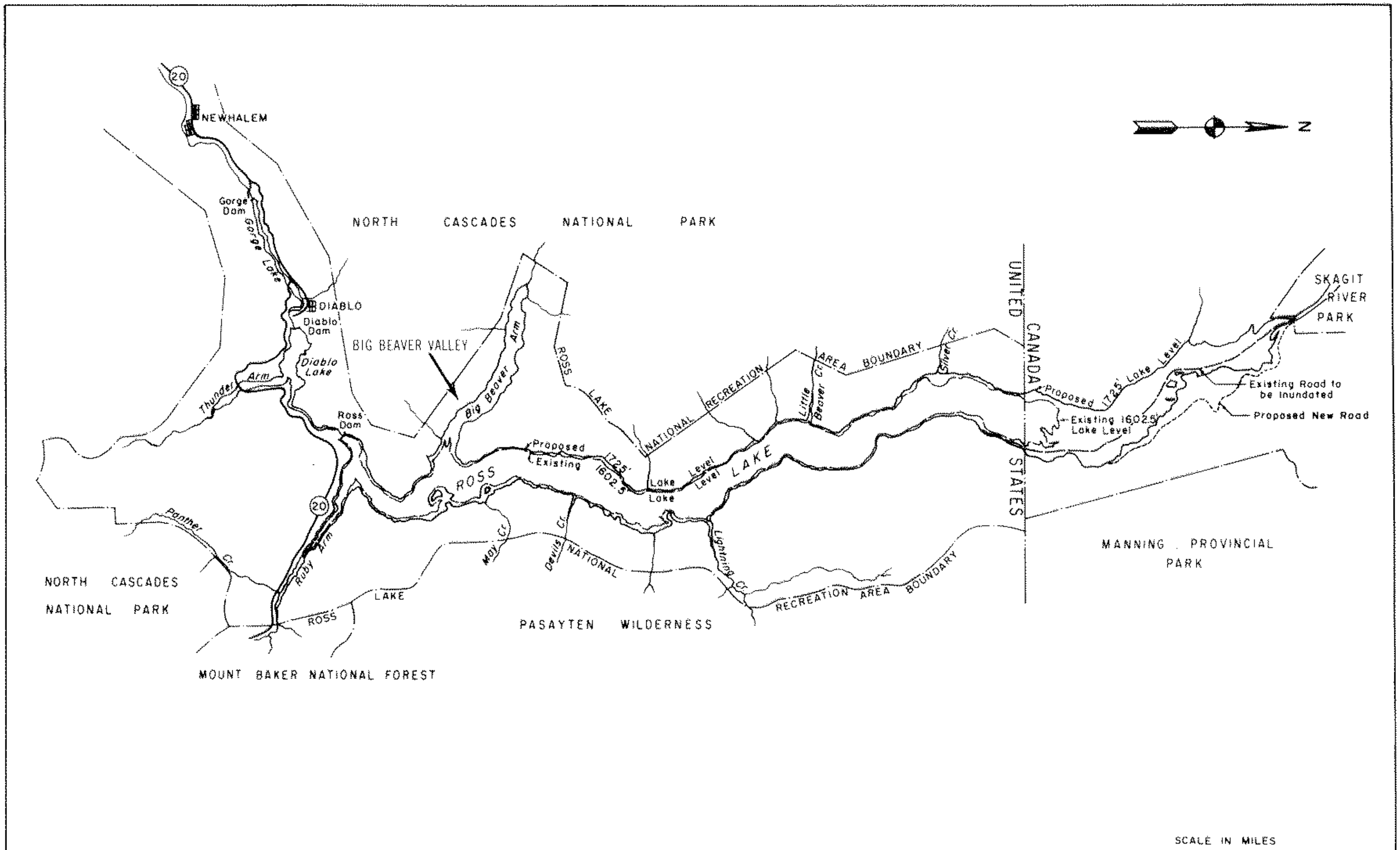


Figure 2-15. PROJECT AREA

3. ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

3.1 ECONOMIC IMPACTS

Raising the level of Ross reservoir 122.5 feet and increasing its maximum surface area in the U.S. by 3,600 acres would cause greater economic impact outside the enlarged development boundary than within the development. Economic development would be greater in the surrounding areas of private land because of the large acreage of federal lands which encompass the development. Any development would be greater in Skagit County than in Whatcom County because the access route to the project from the populated areas to the west passes through privately owned land in Skagit County.

The opening in 1972 of the eastern stretch of the North Cascades Highway (State Highway 20) which connects the Diablo Lake area with the town of Mazama in Okanogan County has had a major impact on the local economy. The completion of this east-west link has resulted in increased traffic and greater demand for related services. Highway 20 is therefore a significant factor which must be considered in assessing future economic trends.

The extent of the economic impact of the proposed High Ross development on populated areas surrounding the federal lands will depend to a large degree on the construction of the proposed recreation facilities. These populated centers include Marblemount, Rockport, Concrete, Lyman, and Sedro Woolley in Skagit County along the North Cascade Highway on the west side of the Cascade Mountains and Mazama, Winthrop, and Twisp in Okanogan County on the east side of the Cascades. A limited selection of lodging, food, and supporting services is available to visitors in these towns. The recreation season extends from approximately June through September. During winter the North Cascades Highway is closed to through traffic. Additional motels and restaurants would probably havt to be operated on a seasonal basis. Construction of additional recreational facilities at Ross would increase the demand for motel accommodations by non-camping visitors and would stimulate the construction of other public service facilities.

Employment resulting from the proposed action would be increased. It is estimated that a two-year period would be required for construction of the dam with reservoir clearing operations and construction of recreation facilities extending about four years beyond this initial construction phase. During the first two years, an average of approximately 250 workers would be employed at the development. A work force of about 325 would be required during the last 16 months of that two-year period. A shortage of local housing and services may force some workers to commute long distances. However, the employees classified as truck dirvers and laborers, which is estimated to compose 62 percent of the work force, may already live in the surrounding communities. On the other hand, following completion of the dam, the size of the work force would drop rapidly from 325 to 50 and finally to 15 in the last two years of reservoir clearing operations. The rate of emigration of younger people might be temporarily reduced by dam construction job opportunities as well as by the demand for labor and management help associated with construction and operation of tourist and other service facilities.

3.2 RECREATION

Two impacts need to be considered in a discussion of the environmental impact of recreation at the Ross development. First is the impact from the proposed changes in the dam and the larger reservoir to be created; the other results from the NPS administration of lands surrounding the project as a National Recreation Area for high-intensity public use.

The Applicant's proposal to raise the height of Ross dam would increase the total reservoir surface area by about 8,300 acres of which 3,600 would be in the U.S. Of the lands to be flooded in the U.S., 1,250 acres would be in the Big Beaver Valley, a roadless valley containing a stream, marsh, and forest. This valley, accessible only by foot, extends from the west shore of Ross Lake into the north portion of the adjacent North Cascades National Park (Figure 2-15) and is used mainly by hikers and backpackers.

The other U.S. lands to be flooded are adjacent to Ross Lake and extend to the Canadian border. There are thirteen campgrounds on these lands, all of which, along with existing connecting trails and foot bridges, would be inundated by the higher reservoir. Applicant proposes to replace facilities at a higher elevation.

The numbers of boats and boat trips on the Diablo Lake excursion to Ross dam were increased in the past year. A restaurant and lounge are proposed for construction adjacent to the departure point on Diablo Lake. In addition, a visitor's reception center and interpretive center is planned to be provided immediately below Ross dam. An application for approval of construction of this facility is pending before the Commission.

The NPS originally proposed to develop an access road and recreation development at Roland Point (See Figure 3-1). Further consideration of this plan by the NPS found it to be infeasible and an alternative access route from State Highway 20 to Ross reservoir is now being considered. The NPS recommends using the Applicant's construction access road for permanent access to Ross reservoir.

A proposed road connecting Ross Lake with the North Cascades Highway would provide for boat launching and a convenient entrance for large numbers of vehicles and persons. At present the project reservoir is accessible by car at only one point from Canada. Boat launching facilities near the dam would make access a simple matter for some individuals who otherwise would not venture into the area. Impacts caused by improved access would carry over into other parts of the reservoir through increased use by boaters. Noise, air and water pollution would increase from added boating and vehicular traffic.

3.3 PLANT COMMUNITIES

In reservoir clearing operations, large quantities of timber and other plant material would be removed or burned. Estimates prepared by Applicant's consultants indicate that the volume of timber between elevations 1,602.5 feet and 1,727 feet approximates 70 million board feet on an area of 3,600 acres in the U.S. The largest tract of land would be in Big Beaver Valley where extensive stands of old-growth western redcedar, western hemlock and Douglas fir occur. Applicant states that merchantable timber will be felled and floated offsite. Depending on reservoir drawdown at the time of the harvesting operations, water and air quality would be affected differently. More debris entering the reservoir at full elevation would have a temporary effect on water quality. Disposal of slash by burning would adversely effect the quality of the air but such effects could be rapidly dissipated due to a lack of other sources

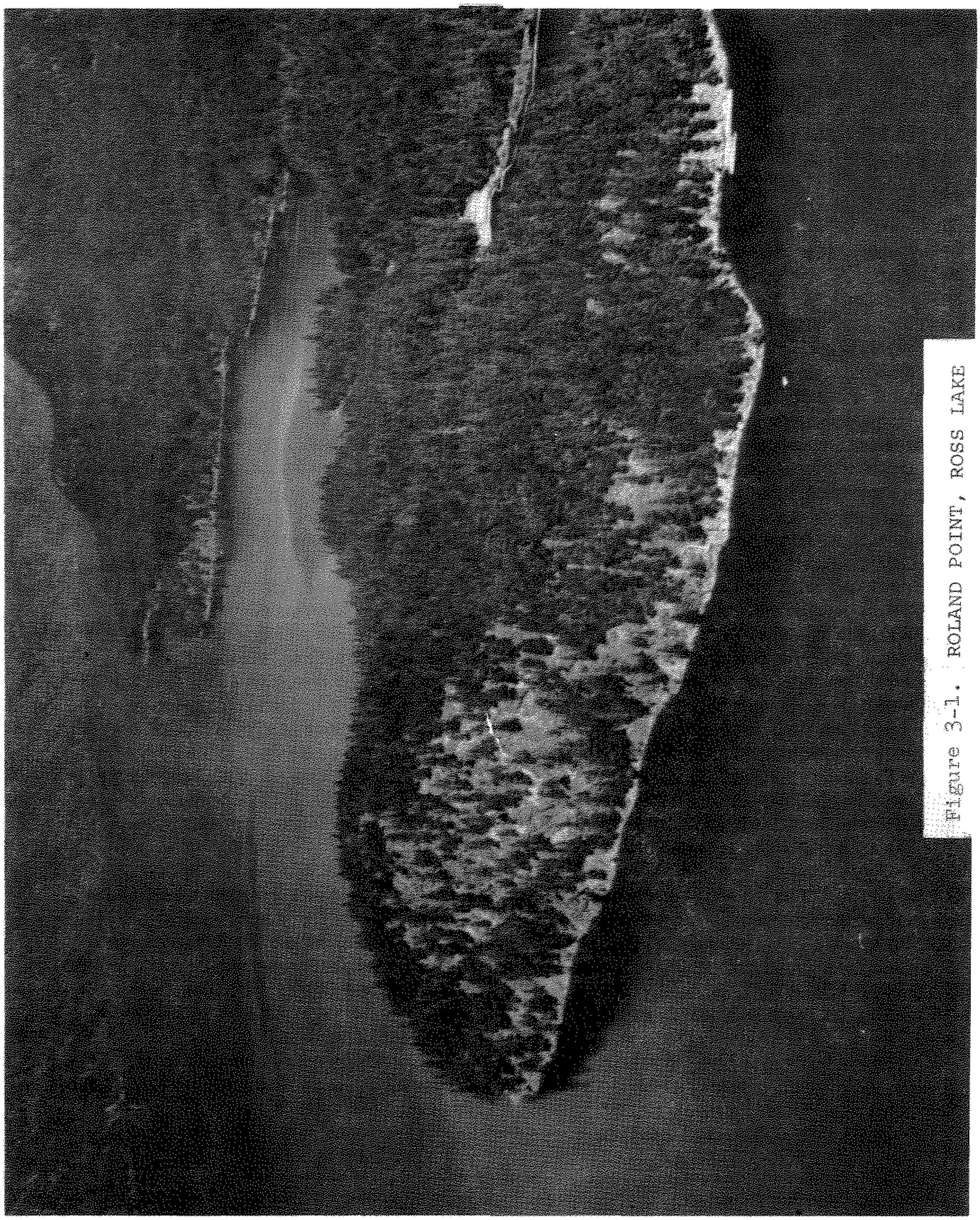


Figure 3-1. ROLAND POINT, ROSS LAKE

of air pollution in the vicinity.

Much of the perimeter of the Lake is characterized by steep, rocky, slopes, and the proposed higher reservoir level would eliminate 2,350 acres of shoreline and its existing biotic communities between elevation 1,602.5 feet and 1,725 feet. Thus, this area would be transformed from a terrestrial habitat to an aquatic zone. In Big Beaver Valley alone, about 1,250 acres would be inundated, almost 35 percent of the total inundated acreage in the U.S. At reservoir elevation 1,725 feet broad, flat Big Beaver Valley would become an arm of Ross Lake approximately 5 miles long. This new waterway would provide boaters a convenient access to North Cascades National Park and the magnificent Pickett Mountain range. On the other hand, the valley bottom community mosaic, evaluated as being of unique research and educational value by certain ecologists, would be lost. The eight broad plant types described previously are found elsewhere in the Cascades region or would not be affected by the higher reservoir level. What would be lost in Big Beaver Valley is the old-growth western redcedar stands in association with other valley bottom communities. After raising the reservoir level, old growth redcedar stands would still exist in the upper end of the valley and elsewhere in the Cascades but different site factors develop different successional patterns of vegetative development from those now found in Big Beaver Valley.

The biotic communities immediately above 1,727 feet would be affected to a slight degree by the removal of adjacent vegetation and the closer proximity to a large body of water. Because several plant types have specific site requirements, alteration of the microclimate adjacent to the reservoir would have some minor effects on plant succession. Removal of vegetation below 1,727 feet would destroy a source of reproductive material such as seeds and stump sprouts.

3.4 WILDLIFE

The clearing of vegetation from elevation 1,602 up to elevation 1,727 and the subsequent inundation up to 1,725 would adversely affect the wildlife of all sections of the Ross Basin in both the U.S. and Canada. The extent of the impact on each species would depend on factors both intrinsic and extrinsic to the species. Intrinsic factors include the species mobility, behavior, and requirements for space, food, and cover. Factors extrinsic to the species include the season or seasons it inhabits the area proposed for inundation and its distribution and abundance inside and outside the are.

The UW team reported that about 25 to 35 percent of the entire deer winter range and consequently about 25 to 35 percent of the winter food supply would be inundated by enlarging Ross Lake. The extent of the impact cannot be predicted with a high degree of accuracy. However, because of the behavior of deer and the nature of their habitat, it is probable that the population would be reduced by more than 25 to 35 percent.

Deer which would normally winter below elevation 1,725 would be forced to move to adjacent areas and compete with established animals. During most winters, these deer ranges are at carrying capacity. Hunters do not harvest enough deer to lower population levels below carrying capacity, and no event other than hunting can be expected to reduce the populations below carrying capacity on a regular, annual basis. Low hunting harvest is expected to prevail even if more hunters come to Ross Basin.

The number of deer which would die during one of the first few winters after clearing would approximate the number of displaced deer, no matter how mortality were distributed among the displaced deer and the deer incumbent to the land above highwater. Adverse impacts other than direct die-off could be low reproductive success of the undernourished survivors and damage to the vegetation caused by overbrowsing. Carrying capacity would be lower until the vegetation could recover, an event which might take several years.

The UW team reported field data which indicate that additional water surface in the higher reservoir could have a warming effect on the land. The reports suggest that the higher reservoir could cause the snow-melt or shallow snow zone to recede to a higher elevation thereby creating new winter habitat for deer. The predicted results from this possible warming trend seem too optimistic. It is not likely that the warming effect produce either a shallow-snow zone, or an early change in plant associations, sufficient to be of material benefit to deer.

One means of assessing the effects that the proposed increased impoundment could have on deer populations in Ross Basin would be to examine what happened after Ross Lake was enlarged by the raising of Ross Dam in 1948. The following quotation is from pages

4 and 5 of the 1971 UW report: "By 1948 the lake was formed and the total amount of deer winter range reduced substantially. The extensive flat of Little Sahara, for example, was now under water. In 1952 a Forest Service observer stated, 'Since then (1946) we have had about four severe winters with many deer carcasses found in the spring.'

"No doubt the loss of winter range due to flooding resulted in competition between deer for the remaining winter forage, with consequent range over-use and starvation. Only a few deer were found in 1952 (three seen and twenty estimated) where 125 had been seen in 1946."

If the 1948 enlargement of Ross reservoir warmed the adjacent land in winter, apparently it was not sufficient to provide new deer habitat during severe winters. The additional water surface in High Ross reservoir might bring about a milder microclimate at a particular elevation, however, it is questionable whether this effect would offset the colder conditions which deer would have to endure if their winter range were displace 80 feet, for example, further up a mountainside.

The UW team reported that bear do not use the lakeshore zone any more or less than other parts of their habitat. They judged that a higher reservoir would affect bear by only slightly reducing their total range.

The 1971 UW survey indicated that about 35 beaver occupy Big Beaver Valley and about 50 percent of their habitat would be flooded. Because of the shape of Big Beaver Valley, no new beaver habitat would result from raising the reservoir and the population would be reduced by approximately 50 percent. Beaver ponds provide habitat for animals such as cutthroat trout, wood ducks, and muskrats, and consequently such species would be adversely affected.

Lowland habitat adjacent to Ross Lake and the Skagit River in Canada below elevation 1,725 feet would be inundated. Loss of these small areas of sedges, willows, and cottonwood would be loss of habitat, particularly nesting habitat, for passerine birds such as flycatchers, orange-crowned warblers, and warbling vireoes.

Pond and river habitat would be decreased for species such as hooded mergansers, wood ducks, harlequin ducks, and mallards. However this loss could be offset by the increased amount of lake-edge habitat provided by the longer shoreline.

Some small animals such as lizards, snakes, frogs, and shrews have small home ranges thus the entire habitat for some populations would be eliminated. These species exist outside of Ross Basin and none of them are considered rare or endangered.

The replacement, relocation, and expansion of recreation facilities such as campgrounds, parking areas, and day-use areas would damage wildlife habitat. Construction activities with attendant dust, nosie, and traffic would frighten wildlife and cause them to avoid parts of their range. Reproductive success of some wildlife species would be lessened.

3.5 FISHERIES

The impact of High Ross reservoir on the fisheries resource can be evaluated best by considering separately the phases of construction, reservoir filling and the completed project.

Construction period: It is expected that construction of High Ross would require at least 2 years. The proposed construction schedule indicates that the lake would be lowered in the fall of the first year to permit the start of construction and that the water surface elevation would remain below 1,600 feet for a 24-month period. The reduction of the lake level for construction would expose more stream areas than under normal conditions and would result in more silt and debris from the exposed stream deltas being carried downstream into the reservoir. Increased turbidity levels of the lake and of the lower reaches of the affected tributaries would be expected. Spawning areas of trout in the tributary streams and along the selected lake shore areas could be altered, especially during the first construction year when the lake is at its lowest level. While more stream area might be available for spawning during the time the reservoir is at a low level, the falls on Big Beaver Creek and Lightning Creek would prevent trout from upstream movement beyond such barriers. The time of year that trout spawn should not change during the construction period. Water quality would be expected to be changed, due to increased turbidity and run-off from additional exposed shore area. Siltation in tributary streams where spawning occurs could adversely affect egg incubation and hatching success in those areas. Spawning conditions in sections of streams not affected by construction should not be altered. The fishery for trout in the lake could be adversely affected, especially during the first year when access to the lake and mobility on the lake would be significantly restricted. These conditions would improve in the second year when the lake level is higher.

Filling period: Filling Ross Lake to the 1,725 foot elevation is expected to require at least 2 years. Former stream spawning areas would be inundated within the filling zone. The falls on Lightning Creek, which blocks upstream trout passage, would be flooded by mid-June of the first year of fill making available to Ross Lake trout new stream areas for spawning.

The stream sections above the existing migratory range of trout from Ross Lake contain populations of native trout. It is not known how many trout from Ross Lake would migrate to the newly accessible areas or how their spawning and rearing in these areas would impact on the existing trout populations.

During the filling period, existing spawning areas would be inundated and trout now using these locations would have to move upstream if suitable area is available or find other streams in which to spawn. The success of trout in making this type of adjustment cannot be predicted.

The beaver ponds in Big Beaver Valley below elevation 1,725 feet would be inundated resulting in a displacement of cutthroat trout contained therein. The major spawning areas of these cutthroat has not been located, therefore, it is not known whether sufficient spawning area above elevation 1,725 feet is available to accommodate both the resident trout in the upstream area and those displaced from inundation.

Public access to the lake would improve as the reservoir fills. Boating on the lake would also be safer after removal of stumps from the shore areas.

The time of trout spawning during the filling period should remain unchanged and water quality conditions for egg incubation, hatching, and rearing should be favorable. The Ross Fisheries Committee is continuing studies on effects of inundation on egg incubation and hatching.

A schedule of downstream releases from Ross reservoir during the filling period has not been provided. Low streamflow during the spring of the year could affect emergence and survival of salmon fry, particularly in the Marblemount area. This problem is currently under study and would need further examination if lowflow discharges are necessary for filling the reservoir.

Completed Project: When the reservoir is raised to its full operating level, the net amount of available tributary spawning area would probably be less than the area available under existing conditions. Some newly accessible trout spawning areas particularly in Lightning Creek, would be made available through the flooding of falls and other barriers. To improve spawning areas in some streams, it may be desirable to remove log jams or take other stream improvement measures. There should continue to be spawning areas along the reservoir shoreline at inflowing streams or seepage areas. The reduction of the range of reservoir fluctuations should facilitate trout in reaching their spawning areas. A reduction in the depth of inundation of stream areas following the spawning period should also benefit survival of eggs and fry. When Ross Lake was raised to its present elevation, there was an apparently successful adjustment by rainbow trout to the new stream conditions. To maintain the fishery, it will be necessary for trout to adjust again to the conditions to be created by the higher reservoir elevation. The ability of the existing Ross trout population to successfully accomplish this further adjustment is unknown. To determine the net effect of the increased reservoir elevation on the trout production in all areas of the Ross basin would require a post-flooding study.

Physical conditions in the lake for the growth of trout have not been fully analyzed. The effect of increasing the area of the reservoir on the aquatic habitat of Ross Lake is under study and may be more predictable when those investigations are completed and the results are analyzed.

Forecasts of temperatures of the Skagit River downstream from the project, measured at a point six miles below Newhalem, have been prepared by the Applicant and Staff. These studies indicate a reduction of mean temperatures of the Skagit River with the High Ross development. Lower water temperatures can delay the date of spawning of anadromous fish and the rate of incubation of their eggs. The expected reduction of mean water temperatures, by even a few degrees, could delay the time of year that anadromous fish spawn and would extend the time of egg incubation and hatching in that section of river in which these lower water temperatures would prevail. Chinook salmon, for example, spawn in the fall of the year. The expected water temperature at that time of year following completion of the project would be about $4^{\circ}F$ lower than existing conditions. This effect could delay the time of spawning, extend the time of egg incubation, and delay emergence of the fry from the gravel. A critical period exists when young fish begin feeding. Colder temperatures could adversely effect this timing and cause a significant loss of production. Delayed rearing and growth could also adversely affect the timing of downstream migration. Steelhead trout, which spawn in the late spring, would encounter less of a temperature change at that time of year, but the impact of delayed spawning, egg and fry development and migration of that species could also be significant.

3.6 ENVIRONMENTAL QUALITY

The proposed action would have little effect on the air quality of the project area. There would be some added air pollution of a temporary nature during the proposed construction period from dust and emissions. A certain amount of air pollution, mostly dust and noise, would be created by development of recreation facilities in the project area. Development of a proposed auto access point from the North Cascades Highway would increased vehicle emissions in the project area. Construction of recreation facilities would result in additional solid wastes which would require disposal. The Applicant proposes to construct sealed vault-type restroom facilities at its campgrounds to avoid water pollution. Noise, particularly from added pleasure boat operation, would be a factor following construction and filling of the reservoir, and could have an adverse effect on the wilderness aspects and values of the Ross Lake area. NPS estimates that approximately 10,000 visitors per day could be expected in the area; thus, degradation of the environment could occur through overuse of the land or some of the facilities.

Depending on the extent of commercial development and the scope and type of sewage treatment and solid waste disposal methods that are used, water quality should not be altered significantly.

Some siltation from new construction would be unavoidable but this effect should be short term.

About 600,000 cubic yards of gravel to be used for construction of the added height of Ross Dam would be mined from the Crane Gravel Bar located adjacent to the Skagit River about 1.3 miles south of Newhalem. The application for permit states that "the land will be retained in its natural state to be used as a portion of a proposed future reservoir." Existing ponds near the gravel pit are being used for rearing salmon by the State Department of Fisheries. The pond created by gravel removal would also be made available to the State for salmon rearing.

Heavy visitor use of the area would generate additional amounts of trash for which additional treatment and/or disposal would be required. Using figures from the U.S. Public Health Service it is estimated that a 400-unit (assuming three persons per unit) campground alone could generate approximately one ton of refuse per peak use day. Procedures for processing sewage effluent and for trash disposal will be included as part of a proposed NPS master plan, and are expected to follow the Service guidelines.

The average temperature of the water released from Ross Lake would be colder and would affect the aquatic habitat of the Skagit River below Gorge dam for an undetermined distance downstream.

An increase in the use of motorboats on the lake would cause an increase in the amount of water pollution to some unknown, but minor degree.

3.7 IMPACT ON WATER QUALITY

The discharge from Ross Lake passes through the Diablo and Gorge developments before continuing down the Skagit River. The effect of a larger Ross reservoir on downstream water quality are being studied by the Applicant and the reports will be part of the hearing proceedings. It is expected that the mean water temperatures of the Skagit River from Gorge dam downstream for 6 miles below Newhalem generally would be colder with the Ross reservoir at elevation 1,725 feet than at its present full level.

Under present operating conditions the Ross powerhouse intake invert is located about 184 feet below normal full pool elevation 1,602.5 feet. The powerhouse discharge water temperatures would begin to increase in May from about 39°F and approach 50° in July. The discharge temperatures would then decrease steadily through December until the reservoir temperature at the intake elevation stabilizes at about 37°F to 39°F until the following May. With an increased normal full pool at elevation 1,725 feet, the powerhouse discharges would remain around 39°F through June then begin to increase in July, attaining a peak of about 43°F in October and November as the reservoir temperature becomes more uniform, due to the fall turnover which starts in September.

The increased height of the Ross reservoir with resulting lower powerhouse discharge temperatures would cause the existing water temperatures at a point six miles below Newhalem to be depressed as much as 3°F to 4°F during the summer and fall months, as indicated on Figure 3-2. This depression could be much greater, except that the downstream Diablo and Gorge reservoirs are not highly stratified. The temperature gradient between the 5 and 200-foot depth of the Diablo reservoir averaged about 2.7°C. (4.9°F) and 3.4°C. (6.1°F) from June through September of 1971 and 1972, respectively.

The Diablo powerhouse intake structure is located about 120 feet below the normal full pool elevation 1,205 feet. The powerhouse discharge temperatures are expected to be similar to the reservoir temperature at the intake elevation. The Diablo powerhouse discharge temperatures would continue to increase slightly before the flow reached a point 6 miles below Newhalem due to natural warming conditions and mixing action with intervening tributary flow; however, it would remain below the present river temperature.

Additional studies by Applicant show that if the High Ross reservoir had been in operation in 1971, the Skagit River temperature at Alma Creek would have been reduced about 2.54°F, 3.26°F, and 3.55°F in August, September and October, respectively. These studies also show similar reductions for a simulation of the 1972 temperature regimen.

Staff conducted a heat budget analysis of the Ross reservoir with normal water surface at elevation 1,725 feet, using the Corps of Engineers Hydrologic Engineering Center's "Reservoir Temperature Stratification - Generalized Computer Program 723-X6-L2410." Staff also computed the resulting temperatures in the Skagit River at a point 6 miles below Newhalem. Comparison of measured temperatures under present conditions and computed temperatures with Ross reservoir at full normal pool at elevation 1,725 feet are shown in Figure 3-2.

ROSS RESERVOIR
Normal Water Surface Elevation 1,725 Ft.

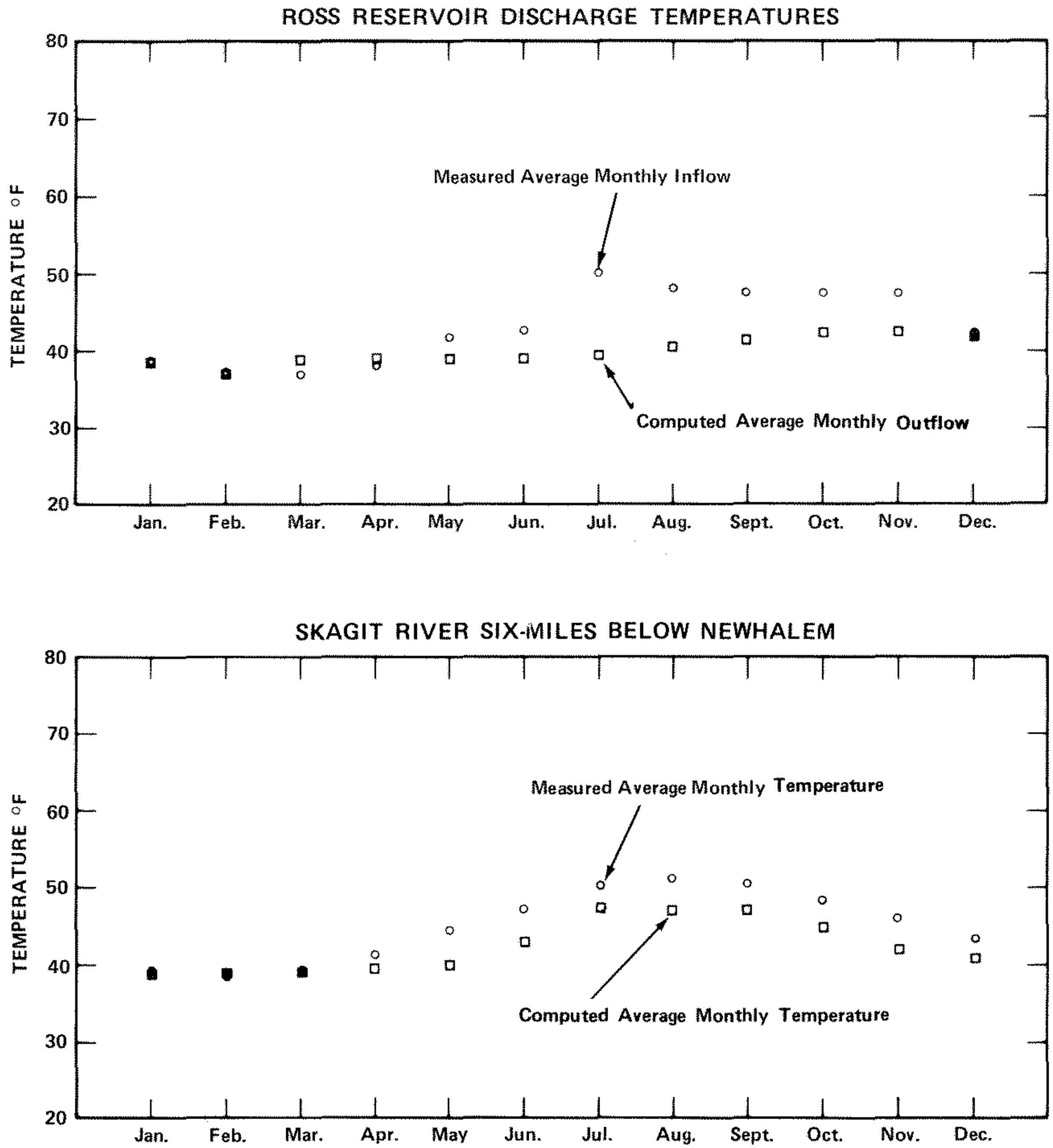


Figure 3-2. COMPARISON OF EXISTING AND PROJECTED WATER TEMPERATURES (FPC STAFF COMPUTATIONS)

Raising Ross reservoir to elevation 1,725 feet would increase the surface area in the U.S. and Canada to a total of 20,000 acres. It is expected that the initial flooding of this land would cause a temporary increase in water turbidity in the reservoir. This should not be severe because the lands that would be flooded have been glacially scoured and the residual soils consist mainly of gravelly alluvial deposits. Much of the material that would move into suspension along the expanding shoreline should settle out as it moves down the reservoir. Additional settling of suspended soils would occur as waters move through Diablo and Gorge reservoir. During construction, when the reservoir is being maintained at a sustained lower level, it is expected that the turbidity of the Skagit River downstream from the project would be increased for short-term periods.

4. MEASURES TO ENHANCE THE ENVIRONMENT OR TO AVOID OR MITIGATE ENVIRONMENTAL EFFECTS

Raising the elevation of Ross Lake would inundate 3,600 acres of land in the U.S. and would eliminate forested lands now used primarily for stream oriented recreation activities and for wildlife habitat. The flowing streams which would be inundated within this area are used by trout for spawning and rearing and for permanent residence by some fish.

The loss of wildlife habitat would affect a variety of wildlife species. The UW study team reported that deer populations in the Ross Basin would probably be affected most because of changes in the shrub successional communities which furnish significant browse material.

Applicant proposes to develop a browse area of about 20-25 acres above 1,725 elevation on the east side of Ross Lake, the work to be done during clearing of the proposed reservoir area. Plant succession would be set back and maintained in a seral stage by some combination of cutting, prescribed burning, and fertilizing.

High Ross Lake would inundate tributary spawning areas used by trout. While significant existing spawning areas would be lost by flooding, new areas for Ross Lake rainbow trout would become available by inundating log jams and other stream barriers. However, the net amount of spawning area available to trout upon completion of the project would be less than that which is currently available. During the construction period, when the reservoir would be maintained at a low elevation, access for trout to desirable stream spawning areas could be aided by providing fishways around waterfalls or other obstacles or by removal of log jams or other blockage to migration routes. Following completion of the project, if it is found from evaluation studies that a reduction in the trout populations has occurred, stocking of Ross Lake by hatchery reared trout could be accomplished as a measure of mitigation. However, it is the view of some fishermen that catching hatchery reared trout is not a fishing experience comparable to catching native stock trout. Stream improvement programs to improve natural spawning areas, and planting eyed eggs in tributary streams are two of the possible methods of mitigation which would help toward improving natural trout production. In order to maintain the fishery at the same level of abundance per surface acre with High Ross as with the smaller reservoir, it would be necessary to increase trout production.

No measures of mitigation are proposed by applicant in the event downstream water temperatures are damaging to stocks of resident and anadromous fish. To protect these resources, it may be necessary to provide for withdrawal of water from Ross reservoir at selected levels to maintain downstream water temperatures as closely as possible to those which now exist.

Pacific rhododendron, Rhododendron macrophyllum, was identified by Applicant as growing both above and below the proposed reservoir level in Canada. Applicant has indicated plans to transplant many of these plants to areas not affected by changes in reservoir level. The plants presently established in this area have well-developed root systems and are not easily accessible, therefore, attempts to transplant individual rhododendrons to higher elevations would probably be unsuccessful.

The existing recreation facilities at Ross Lake would be relocated at higher elevations. Applicant would construct these facilities to standards acceptable to the NPS at locations as shown in Exhibit R of the application. Specific final locations would require NPS approval. New reservoir access facilities are proposed at the dam consisting of a paved entrance road, boat launching ramp, parking access and other related features. This improved public access to Ross Lake may not be considered an enhancement measure by some, since it would result in an increase in visitors and impair more solitary-type experiences.

Operation of Ross reservoir, following completion of the project, would reduce the range of vertical drawdown from 127.5 feet to 56.2 feet. A reduced annual drawdown of this magnitude would enhance the scenic values of the project area and would expose less land to runoff, thereby improving the clarity of the lake during the drawdown period. Furthermore, during an average water year the reservoir would fill by the first week in July and remain so through September 15.

Boating safety would also be improved from existing conditions, with the proposed reservoir clearing plans which describe removal or cutting of stumps at or near ground level. Debris would be removed from the surface of the lake following construction, to provide for safe boating and recreational use of the shoreline. Protection for boaters with log booms and markers would continue.

Stream gauges and any other hydraulic monitoring stations affected by the project would be relocated as required.

Further archaeological surveys of the area to be inundated would be undertaken in conjunction with clearing operations to locate any possible sites that would require salvage excavations. Such a procedure would be undertaken in cooperation with the appropriate State and local agencies.

Gravel for construction purposes would be mined from the Crane Gravel Bar adjacent to the Skagit River about one to three miles south of Newhalem. Topsoil from the pit site would be stockpiled prior to gravel removal. Following gravel mining, the land around the pit would be regraded and topsoil would be spread to encourage regrowth of natural vegetation. The pond formed by gravel removal would be made available to the State Fisheries Department for salmon rearing purposes.

5. <u>UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS</u>

Approval of the proposed action of raising the height of Ross dam, and enlarging the size of the existing reservoir, would cause inundation of 3,600 acres land along the periphery of the present reservoir in the U.S. and about 4,700 acres of land in Canada along a 7 mile stretch of the Skagit River above the reservoir in Canada. The inundation of these areas would result in a number of adverse environmental effects.

5.1 WATER QUALITY

Construction of the project would require about 2 years when the reservoir would be lowered and maintained at an elevation of less than 1,600 feet. Scenic values and water quality of the reservoir would be adversely affected from exposed areas of the stream and lake shores and by runoff therefrom. Additional siltation might result during clearing of the reservoir and construction of recreation sites on the reservoir perimeter. A significant increase in the turbidity of Ross Lake at a sustained lower elevation would temporarily increase the turbidity of the Skagit River below Ross dam.

The proposal to modify the Ross outlet works provides for withdrawing water from its present elevation which would be at a lower depth after the reservoir is raised. The average temperature of the discharge down the Skagit River would be colder than existing temperatures and would affect the development and growth of the aquatic biota. Mitigative measures, such as a multi-level intake structure, for temperature control have not been proposed in the application.

5.2 LAND AND VEGETATION

Raising Ross Lake to elevation 1,725 feet would cause inundation of old growth Western redcedar (<u>Thuja plicata</u>) stands in a 5 mile portion of Big Beaver Valley. A significant value of these groves of redcedar is that they are part of an uncommon ecological mosaic referred to as the Cascade Valley bottom mosaic, which is an association of conifers and hardwoods in marsh, upland, and open areas in conjunction with the old growth cedars. Other creek bottoms would be inundated in varying degrees and attendant ecological communities also would be lost.

5.3 FISH AND WILDLIFE

The proposed action would result in a net loss of stream spawning area for the resident species of trout among which are rainbow, cutthroat, and eastern brook trout and dolly varden char. The habitat for cutthroat trout in beaver ponds below elevation 1,725 would also be lost.

Increased siltation in the streams during the construction period would adversely affect egg incubation and hatching. More stream area might be available for spawning during construction but trout migration would be prevented from passing from Ross Lake up Big Beaver and Lightning Creeks by waterfalls which would be exposed near the mouth of these streams.

Lowering the elevation of the reservoir during construction, especially during the first year when the reservoir level would be at its lowest point, would have an adverse effect on fishing access to the lake.

Studies by staff and the Applicant indicate that the average water temperature of the section of the Skagit River below Gorge Dam would be lowered following completion of High Ross Lake. A reduction of the present temperature regimen, although only a few degrees, would delay the date when spawning occurs and extend the incubation period of the eggs and development of fry of anadromous and other fish species.

The impounding of water up to elevation 1,725 feet would destroy a total of 8,300 acres of habitat for a diversity of wildlife species in the United States and Canada. By nature of the rugged terrain above elevation 1,725, habitat improvements done there could not substitute for the loss of lowland habitat and species. Beaver ponds and species dependent upon them, such as beaver, wood ducks, and cutthroat trout, would decrease in number. Passerine birds, such as orange-crowned warblers, warbling vireoes, and song sparrows, which nest in lowland brush and hardwood associations, would lose almost all their nesting habitat in the Ross development area.

5.4 RECREATION

Raising the elevation of Ross reservoir would inundate 8,300 acres of land which would be lost to recreational use. Thirteen campsites with connecting bridges and access trails would be inundated. These recreation facilities would be replaced at a higher elevation but the present sites would be lost to further recreational use. An access road from Canada would be inundated as well as sections of a foot trail through the scenic Big Beaver Valley which provides access to the Pickett Mountain Range.

5.5 MONITORING STATIONS

Raising Ross dam would inundate the international gaging station on the Skagit River about four miles north of the U.S. - Canada border. Relocation of this facility at an upstream location would be required. Also the U.S.G.S. stage recorder immediately above Ross dam would need to be relocated a a higher elevation.

5.6 SOCIO-ECONOMIC

Housing and services are in short supply in the immediate area of the development, therefore an influx of construction personnel, even of minor proportions, would place a strain on the local economy. Some lodgings ordinarily utilized by tourists would be occupied by construction workers. Local services would not always be able to satisfy the demands of regular customers in addition to construction personnel.

Construction equipment and vehicles on Highway 20 carrying construction workers to and from the development area would create congested traffic conditions during short periods of time. Because the highway is winding, large construction equipment on the highway would present a temporary hazard to motorists. Construction traffic on the access road, which would link the dam with Highway 20, would be a source of air pollution from dust and emissions. However, all these effects would be short-term, last approximately two to four years.

6. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The short-term use of the local environment, as represented by a period of up to 50 years, would provide benefits in power generation, flood control and recreational use, all of which have been described herein as relating to the existing project and to approval of the proposal to increase the size of the dam and its reservoir. These benefits contrast with effects of ecological alterations caused by construction of the dam and enlargement of the reservoir. Approximately 4,700 acres of land along 7 miles of the free-flowing Skagit River in Canada would be inundated and replaced by a reservoir which would fluctuate seasonally. The affected area in the U.S. includes free flowing sections of streams tributary to Ross Lake and land adjoining the existing reservoir. The total additional area to be inundated is about 8,300 acres which would eliminate wildlife habitat and its wildlife production and affect existing recreation uses. The commitment of this land would preempt its use for the length of the period during which the reservoir exists. Secondary adverse effects have also been described herein and include effects of clearing, project operation, and an influx of people associated with project construction and subsequent recreational use. All of these can diminish the full range of beneficial uses during the short-term period.

Long-term use of the area to be inundated would be changed from terrestial to aquatic habitat. The aquatic zone would be subject to seasonal reservoir drawdown, affecting its productivity. With improved access to the project area, additional people would be expected to use the reservoir and its relocated and new recreational facilities. An influx of people would be expected because of the new access to the Ross basin by the recently completed Highway 20 and by new facilities to be provided as a part of the Ross Lake National Recreation Area. Increased public recreational use of the area would provide economic benefits to the surrounding communities by a demand for services to accommodate the public.

The U.S. section of the Ross development has been designated for recreational use by its inclusion in the Ross Lake National Recreation Area. The increase in size of the reservoir would not change the intended long-term use of the area but the proposed action would be significant by expanding the area of water while reducing the available land area.

Long-term productivity of the area would be affected by the additional acreage of cleared land and its inundation by a seasonally fluctuating reservoir. While it would be possible in the future to return the area to reasonably near natural conditions, such action would be technically difficult to accomplish and would cause adverse effects to the ecosystems established during the short-term period.

In sum, the future of the U.S. section of the Ross basin has been established by the creation of the Ross Lake National Recreation Area. This intended long-term use of the area was planned with a knowledge of the ultimate Ross development and its contribution to the recreation plans for the reservoir and surrounding land. The proposal to increase the size of the Ross reservoir is consistent with the trend toward long-term recreational development of the basin. The principal environmental considerations during short-term use would include changes in the terrestrial and aquatic ecosystems and management of all natural resources resulting from the expected changes.

7. IRREVERSIBLE AND IRRETRIFVABLE COMMITMENTS OF RESOURCES

The proposed action of raising the elevation of Ross Lake would inundate a total of about 8,300 acres of land in the U.S. and Canadian sections of the Skagit River basin. The lands to be inundated presently exist as forests, swampland, brush, bottomland and streambed.

The terrestrial ecosystem of the affected area would be replaced by an aquatic one. With the inundation of the lower reaches of many tributary streams now flowing into Ross reservoir, there would be a net reduction in natural fish spawning areas. Inundation of the Skagit River above the reservoir would also eliminate a significant amount of spawning and stream rearing area for trout. The beaver ponds and stream in Big Beaver Valley below elevation 1,725 feet would be lost with an attendant effect on the cutthroat trout population in that section of the basin.

Flooding of lowland areas such as beaver ponds, and hardwood and brush associations would destroy habitat for several mammal species and numerous bird species. The fish and wildlife which could have been produced in the river, pond, and land habitats below elevation 1,725 would be resources irreversibly and irretrievably committed. The habitats themselves could be considered irretrievable commitments because even if a High Ross Lake ceased to exist, the area between 1,602 and 1,725 would probably come to support different flora and fauna than it does at present. Wildlife habitat on the land to be inundated would be lost although no rare or endangered species would lose habitat.

Construction of the project as proposed in the application would reduce the average water temperature of the Skagit River downstream from Ross dam less than 5°F. The biota in the area of reduced temperature would be affected as described in other sections of the FEIS and could result in unmeasured losses of natural resources.

Construction of the proposed project would also commit the surrounding area to a new pattern of recreational use and land use allocation. As a result of the proposed action, recreational use would be influenced by additional reservoir surface area, reduction in the drawdown of the reservoir, increased cleared areas below the reservoir surface and the establishment of an access waterway into Big Beaver Valley.

Construction materials and fuels needed to operate the construction equipment would be irretrievably committed although most of the electric and mechanical equipment would have salvage value. Construction of the project would require excavation of about 31,500 cubic yards of material and would use about 457,000 cubic yards of concrete.

There are no known mineral resources or active mineral claims held within the proposed reservoir. Moreover, the United States portion of the project area lies wholly within the Ross Lake National Recreation Area, which would ensure protection of natural resources within this designated area.

Should adverse environmental effects from operation of the project prove too serious, project structures could be removed. However, certain disadvantages, including losses to recreation, fish and water habitat, and power generation, would accrue from removal of the project facilities.

To re-establish reasonably natural conditions, the two other dams and reservoirs located on the Skagit River, Diablo and Gorge, would also have to be removed since all three dams are interdependent for both power generation and flood control purposes. Such a proposal is technically possible but is not considered feasible due to extreme economic and environmental impacts which would be expected.

8. ALTERNATIVES TO THE PROPOSED ACTION

All alternative types of electric power generation, including the so-called "exotic" types, were considered. The "exotic" alternatives, such as fusion power, solar power, and MHD, are not realistic because the first has not been proved scientifically possible and the latter two as commerical possibilities are still ten years or more in the future. The Geological Survey (45) shows only one known geothermal resource area in Washington State. It is a small area around Mount St. Helens near the Washington-Oregon border. The Washington State Department of Natural Resources is presently mapping potential geothermal resource areas; however, at this time there has not been any drilling for potential geothermal power generating resources in the State of Washington.

The alternatives studied in detail were combustion turbine, combined-cycle, baseload oil-fired, and baseload nuclear steam-electric plants, conventional hydroelectric plants, and purchased power. Annual values of High Ross output, based on annual costs of the thermal alternatives, were estimated and compared with the annual cost of the proposed High Ross development. Annual cost of purchased power would depend upon future Bonneville Power Administration (BPA) or Canadian rates which may be substantially increased soon. Beneficial and detrimental environmental effects were considered for each alternative.

The Pacific Northwest region is shifting from almost total reliance on hydroelectric generation to a combination hydroelectric and thermal-electric generating system. Economic, potential conventional hydroelectric projects are in limited supply; however, additional hydro capacity is being installed at existing projects which benefit from storage reservoirs in Canada.

Development of non-hydro power sources requires supplies of fossil or nuclear fuel. Washington, as of January 1, 1972, is estimated to have an identified resource of 6,179 million short tons of coal remaining in the ground with overburden thickness less than 3,000 feet (3). Half of this amount is considered to be recoverable, although most of it cannot be considered economically recoverable in the foreseeable future. An additional 30,000 million tons of coal are predicted to occur in unmapped and unexplored portions of the State. Most of Washington State coal is sub-bituminous with a high ash content and, although not well suited for domestic fuel use, can be and is used for steam electric generation.

At present, the Centralia steam-electric generating plant, which has an installed capacity of 1,400 mw, burns coal from the Centralia-Chehalis field located about 80 miles south of Seattle, Washington.

While many of the rock strata of Washington meet the geological criteria required for the occurrence of commercial volumes of petroleum and natural gas, it has not been established adequately that all of the requirements exist in combination to sustain commercial production. The presence of some oil seeps and gas in surficial sediments along the west and north coasts of the Olympic Peninsula suggests the possible existence of commercial deposits. To date, however, only minor production has been achieved and neither oil nor natural gas production is economically important in the state.

Completion of the Alaska oil pipeline from the North slope of Alaska would provide a new source of oil for the Puget Sound region. New refineries, however, are not currently being planned in the region since the Alaska oil will probably replace oil currently being imported from Canada and other sources. The estimated two million barrels per day of crude oil from Alaska available primarily for the West Coast exceeds the 800,000 barrels per day currently being imported to the West Coast. Additional fuel oil thus could be available to the Pacific Northwest from California where new refineries are being planned.

In 1964, major petroleum producing companies leased off-shore land in Washington and Oregon. Twelve wells were drilled, then plugged and abandoned when they failed to produce.

Low capacity factor (peaking) generation by oil-fired, thermal-electric plants may find an economic position in the future power supply of the region. The bulk of the future baseload electric supply, however, will most likely be generated by nuclear plants.

The sources of power considered to be possible alternatives to the proposed Ross development are combustion turbines, combined cycle (combustion and steam turbines), baseload oil-fired and nuclear steam-electric plants. Cost of the most economic alternative electric power generating plants are shown in Table 8-1. Estimated costs of the various fuels used in the studies were obtained from users of the fuels and are as of January 1, 1972. The estimated annual costs of the alternatives and the estimated annual cost of the proposed High Ross Development are shown in Table 8-1.

Table 8-1
Annual Cost of Power at Market Based on Public-Nonfederal Financing

(5-3/8% Annual Interest Rate)

High Ross	Alternative Combustion Turbine	Alternative Combined Cycle Plant	Alternative Baseload Oil-fired Steamplant	Alternative Baseload Nuclear Plant
- - - - - (in $1,000's) - - - - -				
3,590	7,464	7,527	8,095	9,856

The annual cost of power which would be obtained from the High Ross increment was estimated by Staff, beginning first with an estimate of the total capital costs. The capital cost estimate included all capital expenditures necessary to achieve the project in place as proposed by Applicant. Staff's estimate of total capital cost at an annual interest rate of 5-3/8 percent was $58,432,000.

The existing Ross development contains certain features which are designed to withstand the higher pressures of Ross reservoir if it were raised to elevation 1,725. These features include the power intake gates and hoists, the power tunnel lining, the penstocks, the butterfly valves ahead of the turbines, and the hydraulic turbine casings. Because these project works can be utilized essentially without modification, the High Ross development would enjoy an economic advantage over a similar project, all other factors being equal. Staff has not determined the amount of particular investment which this "over design" in existing Ross development represents; however, Applicant has estimated it to be about $6,000,000.

Staff's estimate of capital costs includes (1) the direct construction costs, increased by allowances for sales taxes and overheads and interest during construction; (2) the capital cost of replacement power which Applicant would purchase during construction and during the filling of the enlarged reservoir; (3) the capital cost of recreation facilities to be constructed and the capital cost of recreation, fish and wildlife studies; and (4) the capital cost of mitigating adverse impacts on fish and wildlife during the construction period. The estimate does not include costs for lands and resources to be inundated, since no lands would have to be purchased by Applicant. Also, cost of mitigating adverse environmental impacts are not included.

The High Ross annual cost ($3,590,000) is based on public nonfederal financing and a 50-year project life. It includes interest and amortization, interim replacements, insurance, taxes, payment to British Columbia for the additional lands flooded, operation and maintenance, and administrative and general expenses.

8.1 COMBUSTION TURBINES

The beneficial aspects of a combustion turbine alternative are: (1) relatively small physical size per kilowatt of capacity permitting installation at existing plants, (2) no cooling water required, and (3) a short lead time for construction. The negative aspects of a combustion turbine are its comparatively low efficiency and high operating and maintenance costs, particularly when operating at less than full rating or for long periods of time. Negative environmental impacts would include (1) consumption of fossil derivative fuels currently in short supply, i.e., natural gas and/or distillate oil, (2) release of combustion by-products into the atmosphere, (3) siting problems associated with state and local zoning ordinances, (4) procurement of sufficient competitively priced fuel, and (5) probable construction of new transmission lines.

It is estimated that generating 326,400,000 kwh of energy (equivalent to the incremental average annual output of High Ross) by oil-fired combustion turbines would consume approximately 816,000 barrels of distillate oil annually.

The total annual cost of producing an amount of power by combustion turbines equivalent to the additional power from the High Ross development is estimated to be $7,464,000, which is $3,874,000 more than the estimated annual cost of High Ross power. The annual cost for combustion turbines is based on burning low sulfur No. 2 distillate oil fuel (jet type) at an estimated cost of $0.94 per million BTU. Capital cost of gas combustion turbines is estimated to be about $100 per kw. Total installed capacity of the plant was assumed to be 660 mw, consisting of four 165 mw units.

8.2 COMBINED CYCLE (COMBUSTION AND STEAM TURBINES)

The beneficial aspects of a combined cycle plant alternative are: (1) it would add a source of power to the system capable of operating at high and intermediate load factors, (2) it could firm dump* and secondary** hydro energy in the Pacific Northwest and (3) its construction requires a relatively short lead time.

Adverse considerations of a combined cycle plant include: (1) siting problems associated with state and local zoning ordinances, (2) locating an adequate cooling water supply and (3) locating a sufficient competitively priced supply of fuel. Other considerations are: (1) the cost of providing condenser cooling, (2) the cost of constructing new transmission lines, and (3) irretrievable use of a natural resource.

It is estimated that a combined cycle plant generating 329,900,000 kwh of energy, the net estimated incremental average annual generation of the High Ross development, would consume about 516,000 barrels of low sulfur No. 2 type distillate oil annually.

The total annual cost of producing power from a combined cycle plant equivalent to the additional power from High Ross, assuming fuel at $0.94 per million BTU, is estimated by Staff to be $7,527,000, which is $3,937,000 more than Staff's estimated annual cost of High Ross power. The estimated capital cost of the combined cycle alternative is about $140 per kw and does not include costs for other than normal pollution control. Total installed capacity of the plant was assumed to be 710 mw, consisting of two 355 mw units (four combustion turbines and one steam turbine per unit).

A consideration of the adverse effects of a combined cycle unit plant would include the impact of air pollution from stack emmissions, the depletion of fossil fuel resources, and consumptive use of water

- -

* Dump Energy - is energy generated in hydroelectric plants by water that cannot be stored or conserved, in which energy is in excess of the needs of the electric system producing the energy

** Secondary Energy - is all hydro energy other than primary energy.

towers, heated water discharges. The construction and operation of a combined cycle unit would also have an impact on aesthetic values. These adverse impacts on scenic values would be caused by (1) construction of cooling towers (if required), (2) construction of silencers, (3) construction of new transmission lines, (4) stack discharges and (5) oil storage facilities.

8.3 BASELOAD OIL-FIRED STEAMPLANT

The advantages of a baseload oil-fired steam electric plant alternative are that it would add a high load factor power source to the system and could be used to firm dump and secondary hydro energy in the Pacific Northwest.

A new baseload oil-fired steamplant would have siting problems associated with state and local zoning ordinances, would require an adequate cooling water supply, and would need an adequate and competitively-priced supply of fuel. Other considerations of the steamplant alternative are: (1) the cost of providing condenser cooling, (2) the cost and availability of low sulfur content oil (no 0.5% sulfur content oil is avialable in the contiguous 48 states), (3) the cost of constructing new transmission lines and (4) irretrievable use of a natural resource.

It is estimated that for an oil-fired, baseload plant generating 327,300,000 kwh of energy, equivalent to the net estimated incremental average annual generation of the High Ross development, would consume about 490,000 barrels of low sulfur, type F06 oil annually.

The total annual cost of producing power from an oil-fired steamplant equivalent to the additional power from High Ross is estimated to be $8,095,000, which is $4,505,000 more than the estimated annual cost of High Ross development power. The estimated total annual cost of the oil-fired steamplant includes an estimated fuel cost of $0.809 per million BTU. The estimated capital cost of the plant is about $200 per kw which includes approximately $14 per kw for cooling towers and related facilities. Total installed capacity of the plant was assumed to be 2,000 mw, consisting of two 1,000 mw units.

Other adverse effects of a fossil-fuel baseload plant would include (1) air pollution from stack emissions, (2) the depletion of fossil fuel resources and (3) consumptive use of water by cooling towers or, in the absence of cooling towers, heated water discharges. The construction and operation of a thermal unit would also have an adverse aesthetic impact. Adverse impacts on scenic values would be caused by the construction of cooling towers, smoke-stacks, new transmission lines, stack discharges, and the large tanks necessary for storage of oil.

8.4 BASELOAD NUCLEAR STEAMPLANT

The beneficial aspects of a nuclear steamplant alternative are: (1) it would supply high load factor power to the system, (2) could be used to firm dump and secondary hydro energy in the Pacific Northwest, (3) would not release combustion by-products to the atmosphere, and would not consume fossil fuels.

Negative aspects are siting difficulties similar to those of fossil fuel plants and the need for a large volume of cooling water in the event cooling towers are not utilized. Other adverse considerations of nuclear plant alternatives are: (1) the cost of providing condenser cooling, (2) the cost of disposing of spent nuclear fuel, (3) the cost and availability of fuel, (4) radiation, (5) irretrievable use of a natural resource, (6) the cost of constructing new transmission lines, and (7) the long lead time necessary for construction.

The total annual cost of producing power by a nuclear steamplant equivalent to the additional power which could be produced by the High Ross development is estimated to be $9,856,000, which is about $6,266,000 greater than the estimated annual cost of High Ross power. The estimated capital cost of nuclear power is about $330 per kw which includes estimated capital costs for fuel inventory ($33.00 per kw) and cooling towers and related facilities ($20.70 per kw). Total installed capacity of the plant was assumed to be 2,000 mw, consisting of two 1,000 mw units. The incremental cost of producing nuclear energy was estimated to be 1.48 mills per kwh.

8.5 NO ACTION ALTERNATIVE

If an order approving the construction of the High Ross development is not issued by the Federal Power Commission, the Applicant and the Pacific Northwest would need to provide power from other sources to meet requirements as previously described. The Pacific Northwest Utilities Conference Committee's West Group Forecast shows an annual firm load growth for the area during the

10-year period (July 1973 - June 1983) of approximately 5.8 percent for peak load and 5.4 percent for energy. High Ross project output amounts to 3.6 percent of the 10-year period incremental peak demand and 1.5 percent of the incremental energy.

8.6 PURCHASE OF POWER

Power supply systems, in expanding generating capacity, are generally following a trend of constructing large high-efficiency units for improved economy; however, load growth on smaller utility systems may not be sufficient to absorb the full capacity of a large unit and surplus power is sold to neighboring utility systems. Generating systems in the Pacific Northwest Region of the United States subscribe to this policy as attested to by the Pacific Northwest Hydro-Thermal Power Program. This program is a long-range cooperative plan developed jointly by 104 public utilities, four private utilities, and the Bonneville Power Administration (BPA); it was organized by the Joint Power Planning Council in 1966. The program is being implemented by long-term agreements among the utilities and BPA. Under this program, the output of each thermal generating installation constructed will generally be shared by a number of utilities, both public and private. BPA will supply the transmission requirements, hydro-peaking capacity, and forced-outage reserves for these plants.

The City of Seattle is a preference customer of BPA and can purchase power from BPA in larger quantities than the High Ross development output. Any power purchased from BPA by Seattle as a preference customer would be taken from some non-preference utility apportionment, and thus, the latter would have to construct an alternative power source, i.e., gas turbine, combined cycle, fossil or nuclear fueled steamplant or obtain power from another source to supply its customers. Non-preference utilities could not obtain power from BPA and, in addition, the cost of money for private companies is much higher than for public bodies. Environmental consequences of alternative power sources would be similar regardless of who would construct them. At present rates, purchases from BPA would cost Applicant less than the cost of power from High Ross. However, BPA is expected to increase its rates 20 to 30 percent to all classes of customers in 1974, and the probability is that additional increases will be necessary in following years. In view of these circumstances, High Ross would provide power at a lower cost than any of the possible alternatives, including purchase from BPA.

8.7 CONVENTIONAL HYDROELECTRIC PROJECTS

The Pacific Northwest region of the United States is endowed with natural resources necessary for hydroelectric power development. As a consequence, the region has been extensively developed for hydroelectric power production and has been throughly studied by federal, state, municipal, and private interests. The natural development of the resource was to construct the most desirable projects initially. The remaining potential hydroelectric projects are: (1) under study, (2) in some phase of development, or (3) economically and/or environmentally not desirable. The status of potential projects in the Northwest Region for which some interest has been expressed is shown in Table 8-2. This table is from a report prepared by the Power Planning Committee, Pacific Northwest River Basins Commission, entitled, "Review of Power Planning in the Pacific Northwest, Calendar Year 1972." It should be noted that High Ross is not in Table 8-2 because each project listed under "Additions to Existing Projects" involves an addition of units, whereas the High Ross proposal involves an increase in power output by virtue of increasing the head. Also from this report is a map showing the location of electric powerplants existing, under construction, authorized, licensed, or under consideration in the Pacific Northwest and adjacent areas. The map , prepared by BPA and dated December 31, 1972, is attached as Appendix G.

In considering conventional hydroelectric power projects alternative to the Ross increment, several reports covering the comprehensive development of the Pacific Northwest region were reviewed by Staff (references 11, 17, 19, 20, 21, and 52). This review showed that there are no potential hydroelectric projects in the area available to Applicant which could be economically developed.

In the initial construction of its Boundary Project No. 2144, Applicant made provisions for future installation of two additional units. Studies show that installation of these units would provide additional peaking capacity but no additional primary energy and that the estimated annual cost of such capacity would be greater than the estimated annual cost of High Ross development. Since the two additional units do not provide any additional primary energy, they would

Table 8-2

POTENTIAL HYDROELECTRIC PROJECTS
PACIFIC NORTHWEST AREA

December 31, 1972

NEW PROJECTS	AGENCY or UTILITY	STATUS 1/	STREAM	USABLE STORAGE ACRE-FT.	ULTIMATE INSTALLED NAMEPLATE RATING KILOWATTS
Antilon Lake (Pumped-Storage)	Chelan County PUD	Appl. Permit	Chelan	Pondage	1,000,000
Beaver Creek	Chelan County PUD	Appl. Lic.	Wenatchee	Pondage	12,170
Ben Franklin	Corps of Engineers	Under Study	Columbia	Pondage	848,000
Brown's Canyon (Pumped-Storage)	Douglas County PUD	Appl. Permit	Columbia	Pondage	1,000,000
Buffalo #2 2/ *	Confed. Salish & Kootenai	Appl. Lic.	Flathead	Pondage	120,000
Buffalo #4 2/ *	Tribes & Montana Power Co.			Pondage	120,000
Clark Ranch 3/	Bureau of Reclamation	Under Study	Snake	Pondage	0
Dirty Face Mountain	Chelan County PUD	Appl. Lic.	Chiwawa	400,000	126,000 6/
Dryden	Chelan County PUD	Appl. Lic.	Wenatchee	Pondage	17,400
Eden Ridge	Pacific Power & Light Co.	Appl. Lic.	S.Fk. Coquille	110,000	77,000
Garden Valley	Bureau of Reclamation	Recommended	S.Fk. Payette	1,940,000	175,000
Garden Valley (Re-regulating)	Bureau of Reclamation	Recommended	S.Fk. Payette	Pondage	36,000
Guffey (High) 2/ *	Bureau of Reclamation	Recommended	Snake	Pondage	85,000
Guffey (Low) 2/	Idaho Water Res. Board	Under Study	Snake	Pondage	29,000
High Buffalo Rapids 2/	Bureau of Reclamation	Under Study	Flathead	668,000	516,000
Leavenworth	Chelan County PUD	Appl. Lic.	Wenatchee	Pondage	104,050
Lower Scriver Creek	Bureau of Reclamation	Recommended	Scriver Creek	Pondage	120,000
Lynn Crandell	Bureau of Reclamation	Under Study	Snake	1,420,000	240,000
Meadows Lower Drop	Pacific Power & Light Co	Appl. Lic.	Lewis	85,000	55,000
Meadows Upper Drop	Pacific Power & Light Co.	Appl. Lic.	Lewis		30,000
Middle Snake River Development 4/	PNPCO/WPPSS 4/	Appl. Lic.	Snake	342,000	2,700,000
Moiese 5/	Bureau of Reclamation	Under Study	Flathead	Pondage	0
Muddy	Pacific Power & Light Co.	Appl. Lic.	Lewis	277,000	110,000
Strube (Cougar Re-regulating) 10/	Corps of Engineers	Authorized	S.Fk.McKenzie	Pondage	4,500
Sullivan Creek	Pend Oreille County PUD	Appl. Lic.	Sullivan Creek	61,600	13,600
Sultan #1	Snohomish County PUD #1	Licensed	Sultan	97,700	84,000
Sultan #2	Jointly with the City	Licensed	Sultan	Pondage	32,000
Sultan #3	of Everett	Licensed	Sultan	Pondage	24,000
Swan Falls (New) 2/	Idaho Water Res. Board	Under Study	Snake	Pondage	157,500
Trout Creek	Klickitat County PUD	Appl. Lic.	White Salmon	Pondage	40,000
Twin Springs	Corps of Engineers	Under Study	N.Fk.Boise	490,000	103,500 11/
Upper Scriver Creek	Bureau of Reclamation	Recommended	Scriver Creek	Pondage	37,500
Subtotal				6,391,300	8,017,220
ADDITIONS TO EXISTING PROJECTS				NO. UNITS	
American Falls	Bureau of Reclamation	Authorized	Snake	3	60,000
Anderson Ranch	Bureau of Reclamation	Under Study	S.Fk.Boise	1	13,500
Bliss	Idaho Power Co.	Licensed 8/	Snake	1	25,000
Boundary	Seattle City Light	Licensed 8/	Pend Oreille	2	275,500
Brownlee	Idaho Power Co.	Licensed 8/	Snake	2	180,200
Chief Joseph	Corps of Engineers	Under Study	Columbia	13 9/	1,573,000 9/
Cougar	Corps of Engineers	Authorized	S.Fk.McKenzie	1	35,000
Grand Coulee 3rd Power Plant	Bureau of Reclamation	Under Study	Columbia	6 7/	3,600,000
Hells Canyon	Idaho Power Co.	Licensed 8/	Snake	1	130,500
Keno	Pacific Power & Light Co.	Licensed 8/	Klamath	2	100,000
Lower Salmon	Idaho Power Co.	Licensed 8/	Snake	1	15,000
Lucky Peak	Corps of Engineers	Under Study	Boise	3	106,300 11/
Mayfield	Tacoma City Light	Licensed 8/	Cowlitz	1	45,000
Merwin	Pacific Power & Light Co.	Licensed 8/	Lewis	1	45,000
Mossyrock	Tacoma City Light	Licensed 8/	Cowlitz	1	150,000
Noxon Rapids	Washington Water Power Co.	Licensed 8/	Clark Fork	1	70,720
Oxbow	Idaho Power Co.	Licensed 8/	Snake	1	47,500
Palisades	Bureau of Reclamation	Under Study	Snake	2	135,000
Priest Rapids	Grant County PUD	Licensed 8/	Columbia	6	473,100
Rock Island	Chelan County PUD	Under Study	Columbia	8	364,000
Wanapum	Grant County PUD	Licensed 8/	Columbia	6	498,750
Yale	Pacific Power & Light Co	Licensed 8/	Lewis	2	108,000
Subtotal				63	8,051,070
TOTAL KILOWATTS					16,068,290

1/ Authorized - Authorized for Federal Construction; Recommended - Recommended for Authorization for Construction by the Federal Agency; Licensed - License has been granted by FPC; Appl. License - Application for License Filed with FPC; Appl. Permit - Application for Preliminary Permit Filed with FPC; Permit Gtd. - Preliminary Permit Granted by FPC.

2/ Alternative project, conflicts with another project shown.

3/ Re-regulator for Lynn Crandell.

4/ Three alternative plans have been proposed: High Mountain Sheep, Appaloosa-Low Mountain Sheep, and Pleasant Valley-Low Mountain Sheep. The data shown is for the Pleasant Valley-Low Mountain Sheep alternative. FPC has conditionally issued a license for Pleasant Valley-Low Mountain Sheep.

5/ Re-regulator for High Buffalo Rapids.

6/ Includes 17.6 and 39 mw reversible units and a 69.4 conventional unit.

7/ In addition to the six units under construction listed on Table 5.

8/ Although structural provisions have been included, an amendment to the license will be required before construction.

9/ Approximate.

10/ Would be constructed in conjunction with the 35 mw 3rd unit at Cougar.

11/ Overload rating.

* Totals do not include the alternative projects indicated by asterisks.

not provide a comparable or valid alternative to the High Ross increment. However, as additional steam-electric generation is added to the Pacific Northwest generating mix, Boundary expansion could become feasible (33). In addition, it is believed that such installation would require construction of an afterbay dam in Canada to reregulate increased water releases from the enlarged powerplant.

Reconnaissance-type studies indicate there is possibility of providing future increases in generating capacity at the existing Ross, Diablo, and Gorge powerplants on the Skagit River. The extension of one or more of these existing plants, however, would require the construction of a new reregulating dam at the Copper Creek site, about 10 miles downstream from the Gorge powerplant. Copper Creek reservoir would eliminate 10 miles of free-flowing stream below Gorge, but would reregulate the flow of the Skagit River more uniformly than the existing Gorge reservoir (7).

The potential powerplant additions at Ross, Diablo and Gorge, and the addition of the Copper Creek reregulating project, are considered possible future hydro resources of the Skagit system following the construction of the High Ross dam increment rather than valid alternatives to the proposed scheme. Indications are that additions to these existing plants and the addition of Copper Creek would be more costly than the proposed High Ross dam project.

The proposed plant additions at Ross, Diablo, and Gorge would add only peaking capacity to the Skagit system. Hence, by itself this additional hydro capacity is not comparable to that which would be provided by High Ross. Copper Creek, on the other hand, would add about 50 mw of average energy in addition to 100 mw of peaking capacity. Its primary purpose, however, would be to reregulate the peak power releases from the potential plant additions. Construction of the Copper Creek project to provide reregulation only, without at-site power facilities, so as to reduce the environmental impact, would not be justified because the economic feasibility of the proposed development would be seriously impaired due to the substantial reduction in power benefits. The Copper Creek powerplant would be designed to operate at a high load factor, similar to the Gorge plant, so as to minimize any adverse environmental impact. The Ross, Diablo, and Gorge plant additions would add a total peaking capacity to the Skagit system of approximately 600 mw. Modification of the present turbines at the existing Ross dam would not increase the output of the Ross plant since there would be no change in head or water supply.

The installation of additional units at existing federal dams on the Columbia or Snake Rivers would not be valid or comparable alternatives to the proposed Ross increment, since these additional units would not produce any additional primary energy. Moreover, the City of Seattle could not enter into a contract with the Federal government to install these units, since that is the responsibility of the Corps of Engineers, which built these dams. Installation of these future units has been scheduled by BPA to meet the growth in Pacific Northwest capacity requirements. However, their actual installation depends on whether Congress appropriates funds required for the cost of installation. Power from these future units would then be marketed or sold by BPA.

8.8 PUMPED STORAGE HYDROELECTRIC PROJECTS

A pumped storage project would not at this time be a realistic alternative to High Ross dam. It takes about three kwh off-peak energy to produce two kwh on-peak energy and there is no assurance that Applicant could obtain off-peak energy during a critical streamflow period needed to operate a pumped storage project. Secondary energy from the Columbia River Plants cannot be used to provide pumping energy on a firm basis, since there is no secondary energy available during critical streamflow periods.

Construction of a pumped storage project would entail (1) land clearing and excavation operations, (2) loss of stream type habitat, (3) loss of wildlife habitat, and (4) loss of recreational use of lands required for the upper and lower reservoirs. In addition, pumped storage projects could require extensive transmission line construction.

Fish and wildlife impacts caused by development and operation of pumped storage projects are similar to those of conventional hydro insofar as wildlife habitat is lost or altered by construction of the projects. Reservoir fluctuations and operation would affect the production of certain species of fish. The species of fish involved would depend on the location of the project and the aquatic ecosystem in that area.

The recreational value of pumped storage alternatives would be considerably less than that of the proposed High Ross dam project, since the pumped storage operation would result in more frequent and greater reservoir fluctuations than would occur in the operation of the proposed project.

8.9 CONSERVATION OF ENERGY

During the next two decades a program for conservation of electric energy must focus principally on modifying traditional patterns of energy use toward reduced energy requirements. Although of long range importance, further improvements in generating and using equipment efficiencies will come slowly, and many years will elapse before such improved equipment could constitute a sufficiently large proportion of the total to significantly raise the average efficiencies of generation and utilization.

The Federal Power Commission in its 1970 National Power Survey projected the growth in power requirements and installed generating capacity through the next two decades as follows:

	1970	1980	1990
Installed Capacity (millions of kw)	340	665	1260
Energy Demand (trillions of kwh)	1.6	3.1	5.6
Population	203,235,298	227,765,000	251,431,000
Energy per Capita (kwh)	7,950	13,780	22,450

The 20-year projection (through 1990) indicates an annual growth rate in electrical energy demand amounting to about 6.5 percent, but it does not specifically consider the effect of a national commitment to energy conservation. The Staff knows of no comprehensive validated analysis of potential electrical energy savings from conservation measures, but notes that most speculative estimates appear to be in the range of a 5 to 7 percent reduction, which might be achieved in 5 to 10 years. These estimates are for voluntary conservation measures, not for a forced program of energy-use reduction with restrictions on kinds of energy use, embargoes on sale of electric equipment, or similar measures which might be employed in a power emergency.

Recent voluntary conservation efforts in the Pacific Northwest effected an approximate savings of five percent in energy requirements.

A recent forecast (FPC Form 12-E, Sept. 1973) by Seattle City Light gives an estimated peak demand of 1,624 mw for FY 1977. This contrasts with the peak demand of 1,747 mw given in the West Group Forecast of February 1, 1973. Long term effects of such a program are difficult to assess, but the percent of savings already achieved may be the maximum possible under a voluntary program. Studies evaluating the feasibility of raising the price of electricity to the consumer as a conservation measure are not available. Five percent of the 1973-74 Pacific Northwest area firm load (West Group Forecast July 1, 1973) would be 5,500 million kwh. The raising of Ross dam would add about 333 million kwh to the area's annual energy supply.

The Staff believes that utility promotional efforts aimed at conservation are desirable. Conservation-conscious operation of ranges, dishwashers, and laundry facilities; better use of heating and air conditioning equipment through stabilized settings of thermostats; effective insulation and use of storm windows; improved lighting practices--these are some of the ways the consumer can be encouraged to save in the home. Similar potential savings exist in office buildings, stores, and industrial plants.

There are economic and environmental-protection benefits from energy conservation that can be directly rewarding to individuals, commerical establishments and industries. As consumers waste less power and more efficiently use what is available, they reduce generation, atmospheric emissions and waste heat discharges.

Staff therefore concludes that electrical energy conservation practices are desirable, and expects that they will be promoted with increasing effect, as proposed in the President's various Energy Messages. Though conservation will not eliminate growth in energy demand and the need to expand electric generating capacity, Staff believes that conservation practices have the potential of reducing the annual growth rate. Such savings could effect some reduction in the need for new generating capacity.

9. DISCUSSION OF COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT

Notice of availability of the Draft Environmental Impact Statement (DEIS) was published and copies were mailed to appropriate federal, regional, state and local agencies and other entities for comment on October 24, 1973. Timely comments received from the distribution list on pages ii, iii and iv of the Summary Sheet are marked with an asterisk. All letters of comment, including those received late, are attached in Appendix H. *

The agencies and other organizations referred to in this section of timely comments are as follows: Washington Department of Fisheries (Fisheries), Washington Department of Game (Game), Washington Department of Ecology (Ecology), Interagency Committee for Outdoor Recreation (Recreation), U.S. Department of Commerce (Commerce), U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USCE), The North Cascades Conservation Council (NCCC), ROSS Committee (ROSS) and City of Seattle Department of Lighting (Applicant).

All comments received on the DEIS were reviewed carefully and considered in finalizing the EIS. Corrections and new information on the impacts which approval of the application would have on the environment have been incorporated in this Final Environmental Impact Statement (FEIS). In addition, timely comments and responses thereto are summarized generically by impact subject as follows:

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*The Canadian Government on November 15, 1973, delivered to the U.S. Embassy in Ottawa the text of a resolution relating to the flooding of the Canadian Skagit River Valley. The text of the resolution and the U.S. Department of State letter dated November 27, 1973, transmitting this expression of opinion are included in the Appendices with letters of comment.

The Government of the Province of British Columbia on December 6, 1973, established the lands in the general area of the Canadian Skagit Valley as a recreation area to be known as the Skagit Valley Recreation Area. A copy of the instrument and map describing the area are also included in Appendix H with the letters of comment.

FISHERIES

Comment a: In their letters of comment, Commerce, Fisheries, Game, Ecology, NCCC and the Applicant are concerned with the effect of the proposed action on downstream flows, colder water temperatures and fisheries resources in the Skagit River.

Response a: Sections 2, 3, 4, 5, and 10 are expanded in the FEIS to describe the expected impact of the proposed project on these topics. The possibility of controlling water temperatures from releases at Ross dam has been recognized in Sections 4 and 10.

The application for amendment does not propose any permanent change in the existing flow regime from the Skagit River Project. This point is expanded for clarity in Section 1 of the FEIS.

Applicant commented on its recent study of downstream water temperature and effects of salmon and trout but did not provide copies of the study reports in time for a thorough review.

Comment b: Fisheries, Ecology, and NCCC are concerned that there are no proposals to mitigate any adverse effects resulting from colder downstream water temperatures.

Response b: The possible need for withdrawing water from selected reservoir levels for temperature control is discussed in Sections 4 and 10.

Comment c: Game and NCCC request further consideration in the FEIS of the Big Beaver Valley cutthroat trout population and the effect of the proposed action on this resource.

Response c: The presence of cutthroat trout populations in beaver ponds of Big Beaver Valley is noted in Section 2 and impacts on this trout population resulting from the project are discussed in Section 3.

Comment d: Game commented that additional information on the Ross Lake rainbow trout population and creel census data should be provided in the FEIS.

Response d: Additional information on these subjects has been included in Section 2.

Comment e: Game and NCCC requested further comments on proposed mitigation of the loss of trout spawning areas and a discussion of the availability of new spawning areas.

Response e: The loss of existing trout spawning areas by inundation and the accessibility of new areas by eliminating stream obstacles is discussed in Section 3 of the FEIS. Some possible measures of mitigation for any losses which might occur are described in Section 4.

Comment f: Game and Ecology comment that further discussion is needed on the response of trout in finding new spawning areas and the effect of these trout moving into areas where there are existing trout populations. The Applicant also commented on this matter.

Response f: This subject has been expanded in Section 3.

Comment g: The NCCC comments that the Applicants' reports of fishery studies in the Ross basin are not reasonably accessible to reviewers.

Response g: As noted in the Introduction and in Section 2 of the FFIS, these reports are available for review in the offices of the Applicant and the FPC Staff.

Comment h: NCCC, Ecology and the Applicant comment that the IJC report does not fully cover the impacts in Canada and is not consistent with the DEIS.

Response h: The IJC report describes the natural resources in the Canadian section of Ross basin and the impacts expected from the proposed action. The inquiry was conducted in response to a request from the U.S. and Canadian governments to "investigate the environmental and ecological consequences in Canada of the raising of the Ross Lake to an elevation of 1,725 feet above mean sea level, ...", and it is believed the report is responsive to that assignment and is appropriate for use with the FEIS.

WILDLIFE

Comment a: In its letter of comment, NCCC expressed concern that the DEIS would lead readers to believe that wildlife are homogeneous around the lake.

Response a: Expanded discussions of habitat and species diversity appear in Sections 2, 3, 4, and 5.

Comment b: NCCC expressed concern that too much emphasis in the DEIS was placed on either the largest or most valuable resources in the Ross Basin.

Response b: The FEIS focuses more attention on species diversity; however, some emphasis is given to deer for the following reasons: (1) deer have been studied more than other animals, both historically and recently, in Ross Basin; (2) deer provide much enjoyment for sight-seers and hunters; (3) deer are the foremost competitors for food of herbivores such as hares and elk; (4) deer alter the habitat, sometimes drastically, by browsing; (5) deer serve as the major food for carnivores such as cougars, bobcats, and coyotes; and (6) deer respond to habitat management which benefits many other wildlife species.

Comment c: Applicant commented that UW researchers estimate 25-50 mountain goats and 10 elk in the vicinity of Ross Basin.

Response c: Section 2 of the FEIS was updated to present this information.

Comment d: Game wrote that certain deer winter ranges are of more importance than indicated in Figure 2-7 of the DEIS.

Response d: Game's information is presented in Section 2.

Comment e: NCCC stated that no numbers were provided in Section 3 of the DEIS to provide a means of analyzing the potential decrease in wildlife resources.

Response e: Numbers concerning loss of wildlife are presented in the FEIS as far as analysis of habitats and populations permit. The estimated population levels of deer, bear, mountain goats, and beaver were presented along with the estimated percents of their respective habitats that would be inundated. Other species were described as to whether their use of the proposed inundation zone is year-round or seasonal and the extent to which they could relocate successfully.

Comment f: NCCC expressed concern about the lack of comparison with the figures for wildlife losses that are presented in the IJC report.

Response f: The IJC report was included with the DEIS and is included with the FEIS to make known possible environmental wildlife effects in Canada. The body of the FEIS deals with effects in both Canada and the United States.

Comment g: Game commented that the deer populations in the Ross Basin were affected by more than the three phenomena of flooding, plant succession, and snow accumulations.

Response g: The effects of the proposed action on deer are further discussed in Sections 3, 4, and 5.

Comment h: Game wrote that imposing one population on another can result in habitat destruction and lowered carrying capacity and that this kind of damage cannot be rectified in one season or perhaps ever.

Response h: These problems are discussed in Section 3.

Comment i: Game commented that the DEIS discussion of impacts was limited to those resulting directly from inundation. Concern was expressed for impacts on wildlife caused by relocation and replacement of recreation facilities, general construction activities, and an increased number of visitors because of improved access.

Response i: Impacts on wildlife from events in addition to inundation are reported in Section 3.

Comment j: Game commented that the expected impacts on wildlife other than deer were not adequately covered in the DEIS.

Response j: The FEIS contains expanded discussions in Sections 2, 3, 5, and 7, on species other than deer.

Comment k: Game expressed concern that the discussion of unavoidable adverse impacts on wildlife was limited to loss of deer winter range and beaver habitat.

Response k: Section 5 contains an expanded discussion of adverse impacts.

Comment l: Game commented that Section 6 on Relationship Between Local Short-term Uses and Long-term Productivity included only loss of habitat and not productivity of the habitat.

Response l: Productivity of habitat is discussed in Section 6 of the FFIS.

Comment m: NCCC pointed out that effectiveness of measures to mitigate for loss of deer habitat and populations were not discussed. Game expressed concern that proposed mitigation measures would not be sufficient especially if done above elevation 1,727 because accumulations of snow could cover the browse. Applicant commented that their research indicated that the higher reservoir will push back the snow-melt zone to a higher elevation thereby establishing new winter habitat. Applicant stated that the greater shoreline length and resultant snow-melt zone would somewhat offset the habitat lost by inundation.

Response m: These comments concern the need for mitigation measures. Effects of mitigation measures cannot be predicted until a more detailed plan is developed. Applicant's proposal to manage plant succession on 20-25 acres is not deemed adequate mitigation by itself and this is indicated in Section 10 of the FFIS. The warming effects of High Ross reservoir are not expected to be great enough to provide much new deer winter range and this is discussed in Sections 3 and 10.

WATER QUALITY

Comment a: Applicant's comments point out that the DEIS on page 3-14 uses the term "natural" river temperature whereas the DFIS should have used the word "present" river temperature. Applicant's comments also noted that the "less than five degrees" indicated on page 9-3 and "as much as 3°F" on page 3-13 are not average yearly reductions in temperatures but are average reductions for certain summer and fall months. The State of Washington's Department of Ecology, and Department of Game and the U.S. Department of Commerce commented on the withdrawal of water from the hypolimnion of the Ross reservoir.

Response a: The comments of Applicant and the agencies on water quality have been considered in the revision of Sections 3, 4, and 10 (formerly 9).

Comment b: Comments received from the NCCC suggested that hydrologic data from other northwest rivers should be presented as a comparison to discharges from Ross Lake.

Response b: Data contained within Sections 1 and 2 of the FFIS show that although the maximum level of Ross reservoir would be increased, the flow regime from the project would not be altered. Also a reference to other riverflow data is mentioned in Section 2.

BIOTIC COMMUNITIES

<u>Comment a</u>: Comments filed by the NCCC, Applicant, EPA, Ecology, and Recreation are concerned with the inundation of Big Beaver Valley and the resultant loss of biotic communities.

<u>Response a</u>: Sections 2, 3, and 4 in the FEIS have been expanded to further describe the existing ecological values of Big Beaver Valley. In addition, a recent study of the Valley's potential value for research and education is discussed.

The fact that raising the reservoir would result in the complete loss of a five mile section of Big Beaver Valley, is discussed in Section 3.

<u>Comment b</u>: The NCCC and Fcology indicate that a detailed description of biotic communities and individual species is required for the Skagit Valley.

<u>Response b</u>: Section 2 has been expanded to include an explanation of the diversity of plant communities found in the Skagit Valley along with names of predominant species associated with each type. Moreover, Appendix E presents a list of plant species that are known to occur within the region. No rare species have been identified in the area to be inundated.

Section 3 discusses the loss of the plant types below elevation 1,725 feet.

<u>Comment c</u>: The comments submitted by the Applicant, Ecology, and NCCC question the completeness of the IJC report in describing the impacts on biotic communities in Canada.

<u>Response c</u>: Impacts discussed in the IJC report generally are similar to those in the U.S. Again, the IJC report was included to highlight the environmental impacts to be expected in Canada.

<u>Comment d</u>: The NCCC commented that the impact of burning activities associated with reservoir clearing operations was not fully clarified.

Response d: Information available in the Application is inadequate to assess the effects and extent of air pollution resulting from disposal of vegetative material.

Comment e: Comments submitted by Recreation stated that an incomplete treatment had been afforded the access and transportation section of the Statement.

Response e: Additional information on this topic has been added in Section 2 of the FEIS.

Comment f: Remarks supplied by EPA, ROSS, Applicant, Ecology, and NCCC requested further consideration of the impacts on Canadian biotic resources.

Response f: Sections 2, 3, 4, and 5 have been revised to reflect resources in the British Columbia section of the Ross basin that will be affected by the larger reservoir.

SOCIO-ECONOMICS

Comment a: The NCCC requested that a complete analysis be made of the economic impacts of the proposed action or that because of inadequate data, economic impacts should not be discussed.

Response a: Because the eastern segment of the North Cascades Highway (State Highway 20) has been opened only since late 1972, there has not been sufficient time for assessment of user pressure on Ross Lake or the nearby communities. Vehicular access to Ross Lake is available only by crossing the Canadian border and re-entering at Hozomeen. Until the National Park Service initiates a construction program for the Ross Development, economic impacts are difficult to predict. A lack of convenient access points would result in a very gradual increase in recreational pressure.

Economic impacts of alternative recreation plans again are dependent on development of plans of the National Park Service, currently being formulated. Economic development of the region would depend on user pressure on Ross Lake which is largely dependent on accessibility. The problem of access to the general area has been partially remedied by the completion of State Highway 20, thus expanding the availability of previously limited recreational opportunities. Moreover, limited gasoline supplies and a nationwide energy crisis may significantly alter the demand for recreational facilities at the development.

Section 3 discusses the potential economic impacts of the proposed action from presently available information.

RECREATION

Comment a: The ROSS Committee and NCCC express concern over the lack of assessment of the impacts High Ross would have on recreation values inherent in the Skagit Valley in Canada.

Response a: The impacts on recreation that would result from flooding the Skagit Valley in British Columbia are discussed in Appendix F, Environmental and Ecological Consequences in Canada of Raising Ross Lake in the Skagit Valley to Elevation 1,725, 1971, International Joint Commission.

Comment b: The Department of Game is concerned that a description of certain proposed project facilities may be misplaced in Section 3. Also, Game is concerned about the lack of consideration of impacts the proposed project would have on the "low-density" character of the existing reservoir.

Response b: Some descriptive information has been deleted from Section 3. Staff recognizes that some of the "semi-wilderness" attributes of the existing Ross Lake reservoir result from a relatively low level of public use. However, this use profile is not in keeping with public use concepts envisioned for a National Recreation Area. The increased visitation that can be expected at the Ross Lake National Recreation Area, whether the reservoir is raised or not, will have an adverse effect on riparian habitat and the wildlife it supports.

Comment c: NCCC is concerned that the DEIS does not stress the fact that the National Park Service will have to approve of all recreation developments proposed by the Applicant.

Response c: The need to obtain National Park Service approval for any recreational facility development at Ross Lake has been clarified in Sections 1 and 4. Also, by letter dated December 20, 1972, the NPS indicated approval of Applicant's recreation plan if it were modified to include reservoir access facilities at the dam.

<u>Comment d</u>: NCCC expresses concern that the DEIS does not contain a comparison of the recreation development potential available at the existing reservoir with that of proposed High Ross.

<u>Response d</u>: Staff has not made a specific study to determine the maximum acreage available for recreation facility development at either water level. There is sufficient lands above elevation 1,725 to allow for the relocation of all existing facilities.

<u>Comment e</u>: NCCC is concerned that maintenance of water levels has not been considered as a means of enhancing recreational use of the reservoir.

<u>Response e</u>: Section 4 has been revised to indicate that the operation of High Ross would provide a nearly stable full pool throughout the recreation season.

<u>Comment f</u>: Fisheries is concerned with the omission of downstream recreation consideration.

<u>Response f</u>: The construction phase of High Ross would create some short-term adverse impacts on recreational use of the Skagit River below Gorge powerhouse. However, subsequent operation of the power development with High Ross would be no different from existing operation and therefore would have no impact on existing recreational use of the Skagit below the project.

HYDROLOGY, HYDRAULICS, POWER ALTERNATIVES AND COSTS

<u>Comment a</u>: NCCC suggested clarification of the terms "critical period" and dependable capacity.

<u>Response a</u>: Section 1 of the FEIS includes additional language to define critical period and explains how dependable capacity relates to it. It is noted that dependable capacity is established during adverse flow periods.

<u>Comment b</u>: Ecology, EPA, NCCC and the Applicant have expressed concern over the discussion of Energy Conservation in the DEIS.

<u>Response b</u>: Section 8 has been expanded to include the effects of recent energy conservation measures in the Northwest.

Comment c: EPA and NCCC request that the FEIS indicate how capacity and energy lost during construction of High Ross would be replaced.

Response c: Power lost during construction of proposed High Ross would be replaced by purchases from BPA.

Comment d: The Applicant and EPA expressed concern with the DEIS coverage of modifications to the turbines.

Response d: Section 1 of the FEIS has been changed to show that the runners of the turbines would be replaced. The turbine runners were designed for efficient operation at the existing pressure head and flow. Replacement of the turbine runners without raising the pool would not produce additional power.

Comment e: EPA has raised questions with regard to timing of generation additions to the Northwest power supply and the degree to which Ross power addition has been considered in the Regional Plan.

Response e: Section 1 has been expanded to include additional information on the planned expansion program, with scheduled dates of initial operation, and to explain Regional Planning.

Comment f: EPA and NCCC have requested that dependable capacity of existing Ross and proposed High Ross be clarified.

Response f: The at-site dependable capacity of existing Ross dam is 252 mw and proposed High Ross would be 525 mw. Proposed High Ross would increase annual firm energy by 315,000,000 kwh. Section 1 has been revised to show these values.

Comment g: EPA, Ecology and NCCC have indicated concern that sufficient detailed cost information on the proposed High Ross expansion and alternative power sources is not included in the DEIS.

Response g: Although a detailed cost estimate for High Ross and alternatives has not been included in the impact statement, Section 8 has been revised to indicate the general procedure and items included in arriving at the annual costs.

Comment h: The USCE and NCCC have expressed concern on the amount of flood control storage to be included in the proposed High Ross reservoir.

Response h: Section 1 of the FEIS has been expanded to indicate that the USCE might be interested in having an increase in flood control storage capacity provided by High Ross Reservoir.

Comment i: Fisheries and Game noted the effect of present regulation provided by Diablo and Gorge developments and suggested that the DEIS implied total re-regulation by Diablo and Gorge.

Response i: The basin yield above Ross dam and the amount of usable storage in Ross reservoir would not change with the High Ross addition, also the hydraulic capacity of High Ross turbines would not be significantly changed from the hydraulic capacity of existing turbines; therefore, the reregulation of discharges from the Ross development by Diablo and Gorge developments would be essentially the same for High Ross as for existing Ross. Section 1 has been modified to clarify this point.

Comment j: Game and EPA have requested that information be included in the FEIS to indicate the degree to which High Ross development would supply the 10-year load growth.

Response j: This information has been included in Section 8.

Comment k: NCCC suggested that the FEIS should indicate what provisions were included in the original design, and at what cost, in planning for a future High Ross development.

Response k: Sections 1 and 8 of the FEIS have been modified to indicate the design features which were incorporated in the design of Ross development for future raising of the dam and reservoir. These items were the waffle design of dam and hydraulic structures. Applicant's estimate of the cost of such provisions was about $6,000,000.

Comment l: Ecology has requested additional information with regard to fuel costs of alternatives.

Response l: Section 8 of the FEIS has been revised to include additional data on fuel costs.

<u>Comment m</u>: Ecology has requested that the alternative of adding generators at Boundary, Diablo and/or Gorge should be presented in more detail.

<u>Response m</u>: Section 8 has been revised to include additional discussion concerning these alternatives.

<u>Comment n</u>: NCCC suggests that the IJC has authorized Applicant to flood in Canada only to elevation 1,725 feet and suggests that the final plans by Applicant must include spillway capacity to prevent flooding of additional lands in Canada above 1,725 feet.

<u>Response n</u>: High Ross development as proposed would be capable of passing the 150 year flood with the reservoir maintained at elevation 1,725 feet. Utilization of the flood control storage capacity of the reservoir would extend the frequency of occurrence. Although the frequency of occurrence of a probable maximum precipitation flood has not been agreed to by all hydrologists, there is some indication that it could be expected to occur once in 10,000 years. Applicant has not provided plans which would prevent flooding of additional lands in Canada above elevation 1,725.0 feet, for floods having a frequency of occurrence greater than once in 150 years.

10. DISCUSSION OF SIGNIFICANT ENVIRONMENTAL MATTERS

A Staff position on whether the application should be approved has not been reached at this point in the proceeding. Several matters of environmental concern were raised during processing of the application and reviewing comments on the DEIS, the most significant of which are summarized as follows:

10.1 FISH AND WILDLIFE RESOURCES

Agencies commenting on the application, and the DEIS, expressed concern about the lack of appropriate data deemed necessary to develop recommendations for adequate protection and enhancement of fish and wildlife resources. Since filing its application, the Applicant has continued to conduct detailed environmental studies and is completing reports which will provide a better basis for assessment of fish and wildlife impacts due to the proposed action. At this time, it appears there would be a net loss of fish spawning area in the Skagit River above the reservoir and in streams tributary to Ross reservoir upon completion of the proposed action. Also, wildlife habitat including winter range of deer, would be significantly reduced and altered by clearing land to be flooded by the larger reservoir.

The Washington State Department of Game is cooperating with the Applicant and the University of Washington in several studies to determine the extent of project impacts on fish and wildlife resources. These investigations include Ross Lake fishery resources, stream utilization, fish and wildlife life history studies and consideration of the need for post-flooding effects studies. Objectives of the Ross Lake basin wildlife investigations include an assessment of the existing environment with regard to wildlife populations and development of predictions concerning the probable effects of raising the elevation of the reservoir, development of recommendations for mitigation of anticipated wildlife losses and design of post-impoundment studies. A plant community-wildlife relationship study and a recreational use study is also being conducted.

There would be significant environmental impacts of the proposed action on the fish and wildlife resources of the affected area. Progress reports from ongoing studies have been used along with other information in assessing impacts on the affected fish and wildlife populations and in consideration of possible mitigating measures.

Applicant proposes to establish and maintain 20 to 25 acres of browse area for deer in order to mitigate for loss of wildlife habitat. This single measure is considered by Staff to be inadequate for deer and also would not mitigate for the loss of lowland habitat inhabited by other wildlife.

A mitigation plan should include establishing numerous small browse areas at suitable locations rather than an equal acreage in large plots. By this means plots could be distribute widely, thereby providing benefits for more animals. As far as possible, plots could be located on sites which the UW team identifies as having a favorable micro-climate, especially sites with low accumulations of snow. By developing numerous relatively small sites, the probability would be greater that some sites would be of high value to deer.

Habitat improvements should be undertaken before reservoir clearing is started, or during its earliest phases, so that mitigation measures could be in effect as soon as habitat destruction begins. Thus new browse would be available above the snow within the fewest winters possible.

The effect of High Ross on the flow of the Skagit River downstream from Project No. 553 is a matter of significant concern. At present, during the spring months, salmon fry become stranded on gravel bars by changes in the rate of flow from the project. The proposal for High Ross does not provide for changes in the rate of flow from Gorge dam (the lowermost of the three dams in Project No. 553) and should not be a long-term factor in aggravating or alleviating this problem. During filling of the enlarged reservoir, applicant may propose to maintain downstream flows at a lower level than normal. Sustained low flows could have an adverse effect on the emergence and rearing of salmonid fry. However, a schedule for reduced flows has not been proposed.

Forecasts of predicted water temperatures of the Skagit River downstream from Gorge dam at a point six miles below Newhalem have been prepared by the Applicant and also by Staff. These studies show the average reduction in temperature at Alma Creek, if the 1971 meterological and hydrological conditions were repeated,to be approximately 2.54°F, 3.26°F and 3.55°F for August, September and October, respectively. Even though this may appear to be a small change, it would result in salmon and steelhead spawning at a somewhat later time than at present and would result in a longer period for egg incubation, with a later hatching date. The combination of delayed spawning and longer incubation and rearing could be critical in the successful reproduction of some species and races of fish.

The proposed outlet works from Ross Lake would withdraw water from the same elevation as at present which would place them at a lower depth with the reservoir raised. A review of the completed heat budget studies should be made by Applicant in cooperation with the Washington Department of Ecology and EPA to determine the type of outlet works which would permit the withdrawal of water from various levels of the reservoir to maintain downstream water temperatures as closely as possible to the existing temperature regime if this is found to be desirable.

Adverse effects on fish caused by increased supersaturation of nitrogen gas in spillway discharge waters are also of concern. Studies reported by the Applicant in 1972 indicated that during heavy spilling at Diablo and Gorge dams dissolved gas readings exceeded 110 percent in some instances. Upon completion of High Ross, the conditions at the dam affecting the level of dissolved gas saturation in the tailrace area should not change significantly. The Department of Fisheries does not consider any change in spill from High Ross to be a problem with the downstream fisheries resource.

10.2 RECREATION

Management of the recreation resources in the Ross National Recreational Area (RNRA) is the responsibility of the NPS. Its plans for future development of the RNRA would continue to be implemented, whether or not Ross reservoir is raised in elevation. Interior estimates that ultimate annual recreational use in this area will be 2,000,000 visitor days. Additional recreational facilities are to be provided by the NPS beyond those to be relocated by the Applicant. Interior recommends development of an access road, boat launching and related facilities at Ross Lake. Utilization of the access road, to be used for construction during the raising of Ross dam, as a permanent reservoir access point would be a viable alternative to the proposed Roland Point Road which was originally planned by the NPS but is now deemed infeasible.

A permanent access road from State Highway 20 to Ross Lake would open boating opportunities far beyond those which now exist. The number of visitors to the Lake would also increase significantly and could impair the wilderness-like qualities of the Ross Lake area.

NPS will continue to manage and develop the RNRA and Staff defers to expertise of the NPS for future development planning and administration of this area. However, there is concern that the existing wilderness-like quality of the area could change with additional access to the Lake. Future recreation planning and development should be designed to protect the type of outdoor experience which is now enjoyed by visitors to Ross Lake.

10.3 BIOTIC COMMUNITIES

The proposed action would create a five-mile stretch of waterway extending up the broad, flat Big Beaver Valley. This is the only flat, alluvial valley in the development area that will be inundated up to elevation 1,725 feet. Because it is Federal land, undeveloped, with recognized ecological values, there is widespread concern over the impact which would result from conversion of this lower five miles into an aquatic habitat. Old-growth western redcedar groves, associated with bog, marsh, and flowing stream habitats with stands of hardwoods and other conifers, form an ecosystem noted for its potential as a Federal Research Natural Area representing the Cascade Valley bottom mosaic.

Prior to any clearing of this area, an inter-disciplinary team of scientists shoud make an intensive study of the Valley to preserve information of interest to ecologists and to document the importance of this example of a Cascade Valley mosaic. Comparison with other valley bottom communities would determine the ecological values of each similar valley bottom in the Cascade region for purposes of establishing a baseline or undisturbed community for observing changes in other plant communities. These baseline communities also function as check plots for analyzing the results of management techniques on similar areas.

Intensive biotic surveys and detailed sampling has not been conducted in the Ross Basin to date. These studies should be completed before the proposed action is effected.

10.4 FLOOD CONTROL AND NAVIGATION

The U.S. Army Corps of Engineers (Corps) indicated that an increase in current total flood control storage capacity would be desirable. Additional flood control studies have been proposed by the Corps but have not been completed. Flood control storage capacity of 120,000 acre-feet would continue to be provided pending further recommendations by the Corps. Navigation safety would not be jeopardized by the proposed action.

10.5 SCENIC AND HISTORIC VALUES

The lower Skagit River is currently under study for possible incorporation into the Wild and Scenic Rivers System. The proposed revisions at Ross dam and reservoir would not change the flow regime in the lower Skagit River. Therefore, increasing the height of Ross dam should not affect the status of the lower Skagit River as it relates to its qualifications for a scenic river.

The proposed action has been reviewed pursuant to NEPA and Commission Order No. 414 in regard to scenic and historic values. A survey of archeological resources of the project area has been conducted. More detailed surveys of lands to be inundated may be necessary following clearing.

10.6 EXISTING ENVIRONMENTAL LICENSE CONDITIONS

The existing license for Project 553, which expires on October 28, 1977, contains provisions for public recreational use of the reservoir, gaging of streams tributary to Ross reservoir, flood control, and cooperative studies of downstream flows to protect the fisheries resources.

Any approval of the application for amendment of the existing license, if given, should require the inclusion of a number of additional conditions in the license for protection of the environment. These conditions should provide for protection and enhancement of fish, wildlife, water quality, recreation, and other natural values at the project. However, a decision has not been reached on what additional conditions would be required. The ongoing study results and the hearing record in this proceeding will provide additional environmental information needed to reach appropriate decisions.

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APPENDIX A

Mammals Reported in the Skagit Valley

INSECTIVORES

Common Name	Scientific Name
Cinereous Shrew	Sorex cinereus
Wandering Shrew	Sorex vagrans
Trowbridge Shrew	Sorex trowbridgei
Northern Water Shrew	Sorex palustris
Shrew-Mole	Neurotrichus gibbsii
BATS	
Little Brown Myotis	Myotis lucifugus
CARNIVORES	
Black Bear	Ursus americanus
Raccoon	Procyon lotor
Long-Tailed Weasel	Mustela frenata
Mink	Mustela vison
Marten	Martes americana
River Otter	Lutra canadensis
Red Fox	Vulpes fulva
Coyote	Canis latrans
Cougar	Felix concolor
Bobcat	Lynx rufus
Striped Skunk	Mephitis mephitis
Spotted Skunk	Spirogale putorius
River Otter	Lutra canadensis

Mink	*Mustela vison*
Longtailed Weasel	*Mustela frenata*
Shortailed Weasel	*Mustela erminea*
Marten	*Martes americana*
Fisher	*Martes pennanti*

RODENTS

Mountain Beaver	*Aplodontia rufa*
Yellowbelly Marmot	*Marmota flaviventris*
Hoary Marmot	*Marmota frenata*
Northern Flying Squirrel	*Glaucomys sabrinis*
Red Squirrel	*Tamiasciurus hudsonicus*
Chickaree	*Tamiasciurus douglasi*
Cascade Ground Squirrel	*Spermophilus saturatus*
Yellow Pine Chipmunk	*Eutamias amoenus*
Townsend Chipmunk	*Eutamias townsendi*
Bushy-Tailed Woodrat	*Neotoma cinerea*
Beaver	*Castor canadensis*
White-Footed Deer Mouse	*Peromyscus maniculatus*
Boreal Red-Backed Vole	*Clethrionomys gapperi*
Pacific Jumping Mouse	*Zapus trinotatus*
Townsend Vole	*Microtus townsendi*
Oregon Vole	*M. oregoni*
Long-Tailed Vole	*M. longicauda*
Heather Vole	*Phenacomys intermedius*
Porcupine	*Erethizon dorsatum*
Muskrat	*Ondontra zebethicus*

LAGOMORPHS

Pika	Ochotona princeps
Snowshoe Hare	Lepus americanus

ARTIODACTYLS

Black-Tailed Deer	Odocoileus hemionus columbianus
Mule Deer	Odocoileus hemionus hemionus
Elk	Cervus canadensis
Moose	Alces alces
Mountain Goat	Oreamnos americanus

APPENDIX B

BIRDS OF THE SKAGIT VALLEY

WATER BIRDS

Common Name	Scientific Name
Common Loon	*Gavia immer*
Red-Necked Grebe	*Podiceps grisegena*
Horned Grebe	*Podiceps auritus*
Eared Grebe	*Podiceps caspicus*
Pied-Billed Grebe	*Podilymbus podiceps*
Western Grebe	*Aechmophorus occidentalis*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*

WATERFOWL

Common Name	Scientific Name
Whisteling Swan	*Olor columbianus*
Canada Goose	*Branta canadensis*
White-Fronted Goose	*Anser albifrons*
Mallard	*Anas platyrhynchos*
Pintail	*Anas acuta*
Shovaler	*Spatula clypeata*
Blue-Winged Teal	*Anas discors*
American Widgeon	*Mareca americana*
Cinnamon Teal	*Anas cyanoptera*
Green-Winged Teal	*Anas carolinensis*
Wood Duck	*Aix sponsa*
Redhead	*Aythya americana*
Canvasback	*Aythya valisineria*
Ring-Necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*

Common Name	Scientific Name
Common Goldeneye	Bucephala clangula
Barrow's Goldeneye	Bucephala islandica
Bufflehead	Bucephala albeola
Oldsquaw	Clangula hyemalis
Harlequin Duck	Histrionicus histrionicus
White-Winged Scoter	Melanitta deglandi
Ruddy Duck	Oxyura jamaicensis
Hooded Merganser	Lophodytes cucullatus
Common Merganser	Mergus merganser
Red-Brested Merganser	Mergus serrator
RAPTORS	
Goshawk	Accipiter gentillis
Sharp-Shinned Hawk	Accipiter striatus
Cooper's Hawk	Accipiter cooperii
Red-Tailed Hawk	Buteo jamaicensis
Swainson's Hawk	Buteo swainsoni
Golden Eagle	Aquila chrysaetos
Bald Eagle	Haliaeetus leucocephalus
Marsh Hawk	Circus cyaneus
Osprey	Pandion haliaetus
Peregrine Falcon	Falco peregrinus
Pigeon Hawk	Falco columbarius
Sparrow Hawk	Falco sparverius

GALLINACEOUS BIRDS

Common Name	Scientific Name
Blue Grouse	*Dendragapus obscurus*
Spruce Crouse	*Canachites canadensis*
Ruffed Grouse	*Bonosa umbellus*
White-tailed Ptarmigan	*Lagopus leucurus*

SHORE BIRDS

Sandhill Crane	*Grus canadensis*
Virginia Rail	*Rallue limicola*
American Coot	*Fulica americana*
Black-Bellied Plover	*Squatarola squatarola*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Common Snipe	*Capella gallinago*
Spotted Sandpiper	*Actitis macularia*
Long-Billed Curlew	*Numenius americanus*
Greater Yellowlegs	*Totanus melanoleucus*
Lesser Yellowlegs	*Totanus flavipes*
Long-Billed Dowitcher	*Limnodromus scolopaceus*
Pectoral Sandpiper	*Erolia melanotos*
Semipalmated Sandpiper	*Ereunetes pusillus*

JAEGERS AND GULLS

Pomarine Jaeger	*Stercorarius pomarinus*
Glaucous-winged Gull	*Larus glaucescens*
California Gull	*Larus californicus*

Common Name	Scientific Name
Ring-billed Gull	Larus delawarensis
New Gull	Larus canue
Bonaparte's Gull	Larus philadelphia
DOVES	
Band-tailed Pigeon	Columba fasciata
Rock Dove	Columba livia
Mourning Dove	Zenaidura macroura
OWLS	
Screech Owl	Otus asio
Great Horned Owl	Bubo virginianus
Short-Eared Owl	Asio flammeus
Pygmy Owl	Glaucidium gnoma
Spotted Owl	Strix occidentalis
Saw-Whet Owl	Aegolius acadicus
GOATSUCKERS	
Poor-Will	Phaladenoptilus nottallii
Common Nighthawk	Chordeiles minor
SWIFTS	
Black Swift	Cypseloides niger
Vaux's Swift	Chaetura vauxi
HUMMINGBIRDS	
Rufous Hummingbird	Selasphorus rufus
Calliope Hummingbird	Stellula calliope

KINGFISHERS

Common Name	Scientific Name
Belted Kingfisher	*Megaceryle alcyon*

WOODPECKERS

Red-shafted Flicker	*Colaptes cafer*
Pileated Woodpecker	*Dryocopus pileatus*
Lewis' Woodpecker	*Asyndesmus lewis*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Hairy Woodpecker	*Dendrocopos villosus*
Downy Woodpecker	*Dendrocopos pubescens*
Black-Backed Three-Toed Woodpecker	*Picoides arcticus*
Northern Three-Toed Woodpecker	*Picoides tridactylus*

PASSERINES

Eastern Kingbird	*Tyrannus tyrannus*
Western Kingbird	*Tyrannus verticalis*
Say's Phoebe	*Sayornis saya*
Traill's Flycatcher	*Empidonax traillii*
Hammomd's Flycatcher	*Empidonax hammondi*
Dusky Flycatcher	*Empidonax oberholseri*
Western Flycatcher	*Empidonax difficilis*
Western Wood Pewee	*Contopus sordidulus*
Olive-sided Flycatcher	*Nuttallornis borealis*
Horned Lark	*Eremophila alpestris*
Violet-green Swallow	*Tachycineta thalassina*
Tree Swallow	*Iridoprocne bicolor*

Common Name	Scientific Name
Bank Swallow	Riparia riparia
Rough-winged Swallow	Stelgidopteryx ruficollis
Barn Swallow	Hirundo rustica
Cliff Swallow	Petrochelidon pyrrhonota
Gray Jay	Perisoreus canadensis
Stellar's Jay	Cyanocitta stelleri
Black-billed Magpie	Pica pica
Common Raven	Corvus corax
Common Crow	Corvus brachyrhynchos
Northwestern Crow	Corvus caurinus
Clark's Nutcracker	Nucifraga columbina
Black-capped Chickadee	Parus atricapillus
Mountain Chickadee	Parus gambeli
Boreal Chickadee	Parus hudsonicus
Chestnut-backed Chickadee	Parus rufescens
Red-breasted Nuthatch	Sitta canadensis
Brown Creeper	Certhia familiaris
Dipper	Cinclus mexicanus
House Wren	Troglodytes aedon
Winter Wren	Troglodytes troglodytes
Robin	Turdus migratorius
Varied Thrush	Ixoreus naevius
Hermit Thrush	Hylocichla guttata
Swainson's Thrush	Hylocichla ustulata

Common Name	Scientific Name
Veery	*Hylocichla fuscescens*
Western Bluebird	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Townsend's Solitaire	*Myadestes townsendi*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Water Pipit	*Anthus spinoletta*
Bohemian Waxwing	*Bombycilla garrulus*
Ceder Waxwing	*Bombycilla cedrorum*
Loggerhead Shrike	*Lanius ludovicianus*
Starling	*Sturnus vulgaris*
Solitary Vireo	*Vireo solitarius*
Red-eyed Vireo	*Vireo olivaceus*
Warbling Vireo	*Vireo gilvus*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficapilla*
Yellow Warbler	*Dendroica petechia*
Myrtle Warbler	*Dendroica coronata*
Audubon's Warbler	*Dendroica auduboni*
Black-throated Gary Warbler	*Dendroica nigrescens*
Townsend's Warbler	*Dendroica townsendi*
MacGillivray's Warbler	*Oporornis tolmiei*
Wilson's Warbler	*Wilsonia pusilla*
Northern Waterthrush	*Seiurus noveboracensis*
Yellowthroat	*Geothylpis trichas*

Common Name	Scientific Name
American Redstart	*Setophaga ruticilla*
Bobolink	*Dolichonyx oryziuorus*
Western Meadowlark	*Sturnella neglecta*
Yellow-headed Blackbird	*Xanthocephalus*
Red-winged Blackbird	*Agelaius phoeniceus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Brown-headed Cowbird	*Molothrus ater*
Western Tanager	*Piranga ludoviciana*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Evening Grosbeak	*Hesperiphona vespertina*
Lazuli Bonting	*Passerina amoena*
Purple Finch	*Carpodacus purpureus*
Cassin's Finch	*Carpodacus cassinii*
Pine Grosbeak	*Pinicola enucleator*
Pine Siskin	*Spinus pinus*
American Goldfinch	*Spinus tristis*
Red Crossbill	*Loxia curvirostra*
White-winged Crossbill	*Loxia leucoptera*
Rufous-sided Towhee	*Pipilo erythrophthalmus*
Savannah Sparrow	*Passerculus sandwichensis*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Slate-colored Junco	*Junco hyemalis*
Oregon Junco	*Junco oreganus*

Common Name	Scientific Name
Tree Sparrow	*Spizella arborea*
Chipping Sparrow	*Spizella passerina*
Harris' Sparrow	*Zonotrichia querula*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Song Sparrow	*Melospiza melodia*
Fox Sparrow	*Passerella iliaca*
Lincoln's Sparrow	*Melospiza lincolnii*

APPENDIX C

Amphibians and Reptiles whose Range includes the Skagit Basin

SALAMANDERS

Common Name	Scientific Name
Northern Long-Toed Salamander	*Ambystoma macrodactylum*
Tiger Salamander	*Ambystoma tigrinum*
Pacific Giant Salamander	*Dicamptodon ensatus*
Rough-Skinned Newt	*Taricha granulosa*

FROGS AND TOADS

Common Name	Scientific Name
Tailed Frog	*Ascaphus truei*
Boreal Toad	*Bufo boreas*
Pacific Treefrog	*Hyla regilla*
Red-Legged Frog	*Rana aurora*
Cascades Frog	*R. cascadae*
Spotted Frog	*R. pretioga*
Bullfrog	*R. catesbeiana*

LIZARDS

Common Name	Scientific Name
Western Fence Lizard	*Sceloporus occidentalis*
Northern Alligator Lizard	*Gerrhonotus coeruleus*

SNAKES

Common Name	Scientific Name
Rubber Boa	*Charina bottae*
Western Yellow-Bellied Racer	*Coluber constrictor*
Great Basin Gopher Snake	*Pituophis melanoleucus*
Valley Garter Snake	*Thamnophis sirtalis*
Wandering Garter Snake	*Thamnophis elegans*
Northwestern Garter Snake	*Thamnophis ordinoides*

APPENDIX D

FISH OF ROSS LAKE *

Common Name	Scientific Name
Brook Trout	*Salvelinus fontinalis*
Dolly Varden Char	*Salvelinus malma*
Cutthroat Trout	*Salmo clarki clarki*
Rainbow Trout	*Salmo gairdneri*

* Staff does not have information available from which to list all species of fish which may be found in the Ross Basin.

APPENDIX E

Plants Reported in the Skagit Valley

LICHENS

Common Name	Scientific Name
	Peltigera aphthosa
	P. canine
	Stereocaulon tomentosum

MOSSES

	Aulacomnium androgynum
	Calliergon cordifolium
	Dicranum sp.
	Drepanocladus exannulatus
	Hylocomium splendens
	Hypnum circinale
	Mnium insigne
	M. glabrescens
	M. spinulosum
	Plagiothecium sp.
	Pleurozium schreberi
	Polytrichum juniperinum
	Rhacomitrium canescens
	Rhytidiadelphus triguetris
	Rhytidiopsis robusta

FERNS & FERN ALLIES

Common Horsetail	*Equisetum arvense*
Scouring Rush	*E. hyemale*

Common Name	Scientific Name
	E. telematela
Stiff Club Moss	Lycopodium annotinury
Ground Pine	L. clavatum
Ground Cedar	L. complanatum
Maidenhair Fern	Adiantum pedatum
Lady Fern	Athyrium felix-femina
Parsley Fern	Crypto-gramma crispa
	C. densa
Oak Fern	Gymmocarpium dryopteris
Sword Fern	Polystichum munitum
Bracken	Pteridium aquiliuium
Rocky Mountain Woodsia	Woodsia scupulina

GRASSES, SEDGES, AND RUSHES

Quack-Grass Couch-Grass	Agropyron repens
Red-Top	Agrostis alba var. palustris
Silver Hair-Grass	Aira caryophyllea
Water Foxtail	Alopecurus geniculatus
Sweet Vernal-Grass	Anthroxanthum odoratum
Nodding Brome	Bromus anomalus
California	B. carinatus var. carinatus
Brome	B. carinatus var. linearis
Soft Chess	B. mollis
Blue-Joint	Calamagrostis canadensis

Common Name	Scientific Name
Pinegrass	C. rubescens
Hoary Sedge	Carex canescens
Cusick's Sedge	C. cusickii
Sedge	C. deweyana
Hood's Sedge	C. hoodii
Sedge	C. lenticularis
Sedge	C. limnophila
Mertens' Sedge	C. mertensii
Thick-Headed Sedge	C. pachystachya
Ross' Sédge	C. rossii
Beaked Sedge	C. rostrata
Slender Hairgrass	Deschampsia elongata
Blue Wild-Rye	Elymus glaucus var. glaucus
Reed Fescue	Festuca arundinacea
Western Fescue	F. occidentalis
Red Fescue	F. rubra
American Manna-Grass	Glyceria grandis
Velvet Grass	Holocus lanatus
Sharp-Fruited Rush	Juncus acuminatus
Common Rush	J. effusus
Dagger-Leaved Rush	J. eusifolius
Thread Rush	J. filiformis
Slender Rush	J. terruis

Common Name	Scientific Name
Perennial Ryegrass	*Lolium perenne*
Reed Canary Grass	*Phalaris arundinacea*
Domestic Timothy	*Phleum pratense*
Annual Bluegrass	*Poa annua*
Inland Bluegrass	*P. interior*
Boy Bluegrass	*P. leptocoma*
Fowl Bluegrass	*P. palustris*
Kentucky Bluegrass	*P. pratensis*
Sandberg Bluegrass	*P. sandbergii*
Rough Bluegrass	*P. trivialis*
Bullrush	*Scripus macrocarpus*
Bullrush	*Scripus sp.*
Western Needle Grass	*Stipa occidentialis* var. *minor*
Tall Trisetum	*Trisetum canescens*
Broad-Leaved Cat-Tail	*Typha latifolia*

FORBS

Common Name	Scientific Name
Yarrow	*Achillea millefolium*
Vanilla Leaf	*Achlys triphylla*
Bane Berry	*Actea rubra*
Hooker's Onion	*Allium acuminatum*
Silver-Green	*Adenocaulon bicolor*
Slender Agroseris	*Agoseris aurantiaca*
Pearly Everlasting	*Anaphalis margaritacea*
Anemone	*Anemone lyallio*
Pussytoes	*Antennaria racemosa*

Common Name	Scientific Name
Rosy Pussytoes	A. rosea
White Pussytoes	A. neglecta
Spreading Dogbane	Apocynum androsaemifolium
Columbine	Aquilegia formosa
Mouse - Ear Cress	Arabidopsis thaliana
Tower Mustard	Arabis glabra
	A. lyrata
Burdock	Arctieum sp.
Sand Wort	Arenaria lateriflora
Sand Wort	A. marcrophylla
Broadleaf Arnica	Arnica cordifolia
Goat's Beard	Aruncus sylvester
Wild Ginger	Asarum caudatum
Winter Cress	Barbarea orthoceras
Star Wort	Calitriche verna
Fairy Slipper	Calypso bulbosa
Harebells	Campanula routundifolia
Bitter Cress	Cardemine oligosperma Cardomine pennsylvanica
Crimson Indian Paintbrush	Castilleja miniata
Orange Indian Paintbrush	C. Chenopodium angustifolia sp.
Oxeye Daisy	Chrysanthemum leucanthemum
Field Chickweed	Cerastium arvense
Chickweed	Cerastium viscosum C. vulgatum

Common Name	Scientific Name
Enchanter's Nightshade	*Circaea alpina*
Thistle	*Cirsium hookerianum*
Queen's Cup	*Clintonia uniflora*
Blue-Eyed Mary	*Collinsia parviflora*
Coralroot	*Corallorhiza maculata* var. *mertensianus*
Bunchberry	Cornus canadensis
Bleeding Heart	Dicentra formosa
Rough Fairy Bells	Disporum trachycarpum
Waterwort	Elatine triandra
Fireweed	Epilobium angustifolium
Glandular Willow Herb	E. glandulosum
Tall Annual Willow Herb	*Epilobium paniculatum* *E. watsonii*
Fleabane	*Erigeron philadelphicus*
Wooly Sunflower	*Eriphyllum lanatum*
Avalanche Lily	*Erythronium montanum*
Strawberry	*Fragaria vesca* var. *crinita*
Chocolate Lily Rice Root	*Fritillaria lanceolata*
Bedstraw	*Galium triflorium*
Bedstraw	*G. trifidium*
Large Leafed Aven	*Geum macrophyllum*
Cow Parsnip	*Heradeum lanatum*
Small-Flower Alumroot	*Heuchera micrantha*
White Hawkweed	*Hieracium albiflorum*
Canada Hawkweed	*H. canadense*
Low Alpine Hawkweed	*H. gracile*

Common Name	Scientific Name
Marestail	Hippuris vulgaris
Hairy Cat's-Ears	Hypochaeris radicata
Wild Pea	Lathyrus nevadensis
Tiger Lily	Lilium columbianum
Swale Desert Parsley	Lomatium ambiguum
Lupine	Lupinus polyphyllus
Lupine	L. sericeus
Skunk Cabbage	Lysichitum americanum
Pineapple Weed	Matricaria matricariodes
Pink Annual Phlox	Microsteris gracilis
Baby Monkey Flower	Mimulus alsinoides
Monkey Flower	M. guttatus
Lewis' Monkey Flower	M. lewisii
Musk Monkey Flower	M. moschatus
Miterwort	Mitella trifida
Indian Pipe	Monotropa uniflora
Miner's Lettuce	Montia parviflora var. parviflora
Miner's Lettuce	M. Perfoliata
Siberian Miner's Lettuce	Montia sibirica
Forget-Me-Not	Myosotis laxa
Parrots Beak	Pedicularis racemosa
Spreading Penstamon	Penstamon serrulatus
Phacelia	Phacelia heterophylla

Common Name	Scientific Name
Narrow Leaf Plantain	Plantago lanceolata
Broadleaf Plantain	Plantago major
Cinquefoil	Potentilla arguta
Shrubby Cinquefoil	P. fruticosa
Fanleaf Cinquefoil	P. flabellifolia
Sticky Cinquefoil	P. glandulosa
Slender Cinquefoil	Potentilla gracilis
Diffuse Cinquefoil	P. milligrana
Rough Cinquefoil	P. norvegica
Nuttal's Cinquefoil	P. nutall
Sago Pond Weed	Potamogeton pectinatus
Pond Weed	P. gramineus
Self-Heal-All	Prunella vulgaris
Pine Drops	Pterospora andromedea
	Ranunculus abortivus
Plantain Leaved Buttercup	R. alismaefolius
Water Buttercup	R. aquatilis
Yellow Water Buttercup	R. flabellaris
Macoun's Buttercup	R. macounii
Creeping Buttercup	R. flammula
Western Yellow Cress	Rorippa curvisiliqua
Yellow Water Cress	R. islandica
Red Sorrel	Rumex acetosella

Common Name	Scientific Name
Curled Dockweed	*R. crispa*
Rusty Saxifrage	*Saxifraga occidentalis*
Stonecrop	*Sedum sp.*
Meadow Senecio	*Senecio pauperculus*
False Gold Ragwort	*S. pseudoaureus*
Menziesii Campion	*Silene menziesii*
False Solomon's Seal	*Smilacina racemosa*
Starflowered Solomon's Seal	*S. stellata*
Sow Thistle	*Sonchus sp.*
Sand Spurry	*Spergularia rubra*
Twisted Stalk	*Streptopus amplexifolius*
Tansy	*Tanacetum vulgare*
Dandelion	*Taraxacum ceratophorum*
Large Fringe-Cup	*T. officinale*
Western Meadow-Rue	*Thalictrum occidentale*
Foam Flower	*Tiarella unifoliata*
Youth-On-Age	*Tolmiea menziesii*
Oyster Plant	*Tragopogon dubius*
Starflower	*Trientalis latifolia*
Clover	*Trifolium agarium*
Hop Clover	*T. Dubium*
White Dutch	*T. repens*
Trillium	*Trillium ovatum*

Common Name	Scientific Name
Stinging Nettle	Urtica lyallii
Indian Hellebore	Veratrum escholtzii
Great Mullein	Verbascum thapsus
American Speedwell	Veronica americana
Purslane Speedwell	V. peregrina
Thyme-Leaved Speedwell	V. serpyllifolia var. humifusa
American Vetch	Vicia americana
Western Long-Spurred Violet	Viola adunca
Smooth Woodland Violet	V. glabella
Death Camas	Zygadenus venenosus

SHRUBS

Saskatoon	Amelanchier alnifolia var. cusickii
Saskatoon	A. a. var. semiintegrifolia
Kinnikinnick	Arctostaphylos uva-ursi
Tall Mahonia	Berberis aquifolium
Oregon Grape	B. nervosa
Creeping Mahonia	B. repens
Redstem Ceanothus	Ceanothus sanguineus
Snowbrush	Ceanothus velutinue
Red-Osier Dogwood	Cornus stolonifera
Hazelnut	Corylus spp.
Teaberry	Gaultheria ovalifolia
Salal	G. shallon
Ocean Spray	Holodiscus discolor
Labrador Tea	Ledum groenlandicum

Common Name	Scientific Name
Twin-Flower	*Linnaea borealis*
Orange Honeysuckle	*Lonicera ciliosa*
Red Honeysuckle	*L. dioica* var. *glaucescens*
Black Twinberry	*Lonicera involucrata*
False Azalea	*Menziesia ferruginea*
Devil's Club	*Oplopanax horridus*
False Box	*Pachistima myrsinites*
Mock Orange	*Philadelphus lewisii*
Ninebark	*Physocarpus capitatus*
Shrubby Cinquefoil	*Potentilla fruticosa*
White Rhododendron	*Rhododendron albiflorum*
Red Rhododendron	*R. macrophyllum*
Stink Currant	*Ribes bracteosum*
Wild Gooseberry	*R. divaricatum*
Swamp Gooseberry	*R. lacustre*
Red Flower Currant	*R. sanguinium*
Sticky Currant	*R. triste*
Western Wild Rose	*R. woodsii* var. *ultra-montana*
Red Raspberry	*Rubus idaeus* var. *sachalinensis*
Black Raspberry	*R. leucodermis*
Thimbleberry	*R. parviflorus*
Salmonberry	*R. spectabilis*
Trailing Blackberry	*Rubus ursinus*
Willows	*Salix spp.*
Blue-Berry Elder	*Sambucus cerulea*

Common Name	Scientific Name
Red-Berry Elder	S. racemosa var. arborescens
Soopolallie, Soapberry	Shepherdia canadensis
Hardhack	Spirea douglasii
Flat-Top Spirea	S. lucida
Pyramidal Spirea	Spirea pyramidata
Snowberry or Wax Berry	Symphoricarpos albus
Cascade Blueberry	Vaccinium deliciosum
Thin-Leaved Huckleberry	V. membranaceum
Oval-Leaved Huckleberry	V. ovalifolium
Red Huckleberry	V. parvifolium
Grouseberry	V. scoparium
Menzies' Pipsissewa	Chimaphila menziesii
Princes' Pine Pipsissewa	C. umbellata
Rattlesnake Plantain	Goodyera oblongofolia
Large Pyrola	Pyrola asarifolia
Lesser Pyrola	P. minor
White-Veined Pyrola	P. picta
One-Sided Pyrola	P. secunda
Greenish-Flowered Pyrola	P. virens
Squashberry	Viburnum edule

TREES

Common Name	Scientific Name
Amabalis Fir Pacific Silver Fir	Abies amabalis
Grand Fir	A. grandis

Common Name	Scientific Name
Alpine Fir	A. lasiocarpa
Vine Maple	Acer circinatum
Douglas Maple	A. glabrus var douglasii
Broadleaf Maple	A. macrophyllum
Red Alder	Alnue rubra
Sitka Alder	Alnus sinuata
Mountain Alder	A. tenufolia
Water Birch	Betula occidentalis
White Birch	B. papyrifera
Yellow Cedar	Chamaecyparis nootkatensis
Black Hawthorn	Crataegus douglasii
Engelmann Spruce	Picea englemannii
White Bark Pine	Pinus albicaulis
Lodge-Pole Pine	P. contorta latifolia
Western White Pine	P. monticola
Ponderosa Pine	P. ponderosa
Trembling Aspen	Populus tremuloides
Black Cottonwood	P. trichocarpa
Bitter Cherry	Prunus emarginata
Douglas Fir	Pseudotsuga menziesii
Crabapple	Pyrus fusca
Cascara	Rhamnus purshiana
Pacific Willow Black Willow	Salix lasiandra
Scouler Willow	Salix scouleriana

Common Name	Scientific Name
Sitka Mountain Ash	*Sorbus sitchensis*
Western Mountain Ash	*S. scopulina*
Western Yew	*Taxus brevifolia*
Western Red Cedar	*Thuja plicata*
Western Hemlock	*Tsuga heterophylla*
Mountain Hemlock	*T. mertensiana*
Dwarf Juniper	*Juniperus communis*
Rocky Mountain Juniper	*J. scopulorum*

APPENDIX H

LETTERS OF COMMENT

ON

DRAFT ENVIRONMENTAL IMPACT STATEMENT

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

H-2

NOV 1 1973

Mr. Kenneth F. Plumb
Secretary
Federal Power Commission
Washington, D.C. 20426

Re: PWR-LP
Project No. 533-Washington
The City of Seattle, Washington

Dear Mr. Plumb:

We appreciate the opportunity to comment on the Draft Environmental Impact Statement prepared by the Federal Power Commission in connection with an application for an amendment of license filed by the City of Seattle for Skagit River Project No. 553.

Since the proposed project will not conflict with any project subject to AEC Regulatory jurisdiction or any activities subject to control by the General Manager, we have no comments to offer.

Sincerely,

for Daniel R. Muller, Assistant Director
for Environmental Projects
Directorate of Licensing

cc: Council on Environmental
Quality (10)

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NOV 19 1973
DIVISION OF LICENSED PROJECTS

FEDERAL POWER COMMISSION
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NOV 2 - 1973
DOCKET SECTION

December 10, 1973

Mr. Kenneth F. Plumb
Secretary
Federal Power Commission
Washington, D. C. 20426

P-553

Dear Mr. Plumb:

The draft environmental impact statement for the "Ross Development of Project No. 553, Skagit River, Washington," which accompanied your letter of October 24, 1973, has been received by the Department of Commerce for review and comment.

The statement has been reviewed and the following comments are offered for your consideration.

We question whether the report adequately describes the effects on downstream anadromous fish resources of releasing during peaking operations water that is colder than the water downstream of the dam due to withdrawal from the hypolimnion, as discussed on page 9-3. We suggest that greater stress be placed upon the results of the study mentioned there; perhaps a table showing present and predicted temperatures should be included.

Thank you for giving us an opportunity to provide these comments which we hope will be of assistance to you. We would appreciate receiving a copy of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:
DAEN-CWE-Y

10 December 1973

Honorable John N. Nassikas
Chairman, Federal Power Commission
Washington, D. C. 20426

RECEIVED
DEC 14 1973
SECRETARY'S OFFICE

P-553

Dear Mr. Chairman:

This is in reply to the Commission's letter dated 24 October 1973 concerning a draft Environmental Impact Statement (DEIS) prepared by the Commission's staff for the City of Seattle's Project No. 553 located on the Skagit River in Washington.

The DEIS on the applicant's proposal for the modification of Project No. 553 in order to increase its dependable capacity from 252 megawatts to 525 megawatts is satisfactory insofar as the interests of navigation on the Skagit River are concerned.

The existing Ross reservoir is operated to provide for 120,000 acre-feet of seasonal storage space for flood control, as indicated on pages 1-6 and 1-32 of the Commission's staff DEIS. As stated in our letter dated 7 July 1971 on the applicant's proposal, preliminary studies indicated that an increase in the total flood control storage space may be desirable. Accordingly, the potential for this increased storage space should be recognized in the EIS.

As requested, ten copies of this letter are being furnished the Council on Environmental Quality.

Sincerely yours,

Daniel D. Ludwig, LTC, CE
for
JOHN F. WALL
LTC, Corps of Engineers
Assistant Director of Civil Works,
Environmental Programs

FEDERAL POWER COMMISSION
DOCKETED
Dec 14, 1973
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1. DOC... 2. GENERAL FI...

H-5

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION X
ARCADE PLAZA BUILDING
1321 SECOND AVENUE
SEATTLE, WASHINGTON 98101

December 6, 1973

OFFICE OF THE REGIONAL DIRECTOR

Federal Power Commission
Attn: Kenneth F. Plumb, Sec'y
Washington, D.C. 20426

Dear Mr. Plumb:

Re: Your PWR-LP, Project #553-Washington, City of Seattle

This is in response to your request for comments on the draft Environmental Impact Statement on the above noted project.

It is apparent that several recreational facilities are proposed as part of this project. We recommend that such facilities conform to the appropriate health guidelines contained in the Public Health Service Publication No. 1195, Environmental Health Practice in Recreational Areas.

In addition, the recreational facilities should conform with applicable State and local requirements.

Thank you for providing this opportunity to review the statement.

Sincerely,

W. Phillips Rockefeller

W. Phillips Rockefeller
Acting Regional Environmental Officer

FEDERAL POWER COMMISSION
DOCKETED
DEC 10 1973
DOCKET SECTION

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS: (G-WS)
U.S. COAST GUARD
400 SEVENTH STREET SW
WASHINGTON, D.C. 20590
PHONE: 426-2262

7 DEC 1973

Mr. Kenneth F. Plumb
Secretary
Federal Power Commission
Washington, D. C. 20426

Dear Mr. Plumb:

This is in response to your letter of October 24, 1973 addressed to Mr. W. R. Riedel concerning the draft environmental impact statement in connection with the licensing of the Skagit River Project No. 553, Skagit County, Washington.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. The Federal Highway Administration commented as follows:

"We find that no Federal or Federal-aid highways are substantially affected by the proposal, and that the small increases indicated in the number of parking spaces and campground size would have insignificant effects upon the nearby North Cross State Highway.

"We note that the access road to Ross Dam is 20 feet wide. We believe that 22 or 24 feet would be desirable to permit safer passage of vehicles in two-way operation.

"The last paragraph on page 1-7 makes a reference to maximum pool evaluation of 1275.0 feet. It appears that this is a misprint that should read 1725.0 feet.

"The penultimate sentence on page 2-7 in the last paragraph discusses small airports in Sedro Wooley and Darrington. There are also small airports in Mount Vernon and Concrete."

The Coast Guard commented as follows:

"Ross Lake is listed as navigable water in 33 CFR 2.71-5.

"The proposed project will not involve any bridge for which permits have been issued.

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DEC 14 1973
DIVISION OF LICENSED PROJECTS

"In view of the expected increase in use of motor boats on the lake (page 313), it is recommended that any recreational development catering to boaters, such as fuel docks, launching ramps, etc., utilize designs which assist in pollution prevention.

"The min[illegible] aggregate mentioned on page 1-23 should be conducted in a manner which prevents oil and hazardous substances from reaching the river."

The Department of Transportation has no further comments to offer nor do we have any objection to this project. However, the concerns of the Federal Highway Administration and the Coast Guard should be addressed in the final environmental impact statement.

The opportunity to review this impact statement is appreciated.

Sincerely,

R. I. PRICE
Captain, U. S. Coast Guard
Deputy Chief, Office of Marine
Environment and Systems
By direction of the Commandant

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION X

H-8

1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

December 10, 1973

REPLY TO ATTN OF: 10MEI - M/S 325

Mr. Kenneth F. Plumb
Federal Power Commission
Washington, D.C. 20426

P-553

Dear Mr. Plumb:

We have reviewed the draft environmental impact statement for the proposed Ross Development Project 553, Skagit River, Washington.

We find that the statement adequately describes the proposed project. The statement does not discuss to a sufficient degree the environmental impacts associated with this proposal. Insufficient discussion concerning environmental impacts does not allow the reviewer to weigh the tradeoffs between the power to be gained and the environmental resources to be lost.

The following are our comments and questions regarding Project No. 553.

1. The possibilities of modification of present turbines in the existing dam for generation of additional peak power should be discussed. How much could be produced?

2. Will the power produced by High Ross come at a time when other systems and/or producers will be coming on the line, e.g., Chehalis #2 generator, Trojan, Grand Coulee generator #3, etc., and other sources under the direction of the "West Group"?

3. How does this project fit into the Hydro-Thermal Power Program? Is it deemed necessary within and by this program body?

4. Will construction start in 1974 or will construction be delayed by any litigation not discussed in the statement? If so, what is the status of this litigation and what are the issues to be resolved?

5. With new energy sources coming on line yearly, will the West Group be suffering a peaking power deficit when High Ross comes on line? When (what year?) will the peaking power deficit be alleviated assuming constant growth of power needs? How much of the projected 1980 peaking power will be produced by the Ross addition and how much by the Ross Dam (modified)? We feel that it is a very poor time to close down a

hydro power producing project during a critical power shortage period. How will the lost generating capacity be covered during this critical period of power shortage?

6. Is the flooding of unique ecosystems such as Big Beaver Creek and the 8,300 acres of B.C. Skagit River viewed favorably by the Hydro-Thermal Program participants? We feel that the environmental impacts resulting from the flooding of the 8,300 acres of the B.C. Skagit is inadequate. The statement gives no evidence that a thorough environmental investigation has been performed on this area.

7. What is the effect on stream flow of a peaking power project during full operation and drawdown for construction?

8. Can the Seattle City Light contract to purchase power from "Hydro-Thermal Power" facilities to be constructed or under construction? Will these purchases satisfy the Seattle City Light needs?

9. Develop table and information such as on page 8-18 showing regional rather than nationwide per capita power requirements to 1990.

10. Expand justification or discussion of price holding policy for hydro-electric power.

11. The statement should reference environmental studies developed by non-Seattle City Light consulting firms or organizations.

12. Expand section on derivation of annual cost section to include the actual formulation for the basic computation. Include such things as number of years used as basis for annual cost.

13. How much of the approximately 5.8% peak load and 5.4% energy annual firm load growth for the ten year period 1973-83 will the High Ross constitute (p. 8-10)?

14. Discuss further the energy (power) saved through consumer energy conservation efforts vs. the power produced by the raising of Ross Dam.

15. Have studies been conducted evaluating the feasibility of raising the price of electricity to the consumer?

As we stated at the outset, we find that the project is adequately discussed. Our main concern, however, is that the statement does not adequately speak to the environmental issues associated with its construction. We hope that our comments will assist you in the types of information we believe to be essential if one is to realize the environmental losses.

We have rated this project ER-2 (Environmental Reservations - Inadequate Information).

The National Environmental Policy Act specifically states that we must try to sustain a high quality of life in conjunction with contributing to the preservation and enhancement of the environment. The final impact statement should convey this spirit.

Sincerely,

Hurlon C. Ray

Hurlon C. Ray
Assistant Regional Administrator
for Management

WASHINGTON STATE

ADVISORY COUNCIL ON HISTORIC PRESERVATION

H-11

P. O. BOX 1128, OLYMPIA, WASHINGTON 98504

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NOV 26 1 25 PM '73
FEDERAL POWER COMMISSION

November 23, 1973

Mr. Kenneth Plumb, Secretary
Federal Power Commission
441 G Street, N.W.
Washington, D.C. 20246

Dear Mr. Plumb:

Ross Development Projects

We have reviewed the proposed Ross Development of Project No. 553 Skagit River, Washington, and find that there are no sites in either the State or National Registers of Historic Places in or near the project area.

Thank you for the opportunity to comment on your project.

Sincerely,

David M. Hansen, Chief
Office of Archaeology and
Historic Preservation

DMH:cq

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NOV 30 1973
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FEDERAL POWER COMMISSION
DOCKETED
NOV 26 1973
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December 28, 1973

State of Washington
Department of Ecology

Federal Power Commission
Washington D.C.
20426

Attention: Kenneth Plumb
Secretary

Subject: PWR-LP
Project No. 553-Washington
the City of Seattle, Washington
Draft Environmental Impact Statement

Gentlemen:

In accordance with your request of October 24, 1973, the Washington State Department of Ecology has reviewed and evaluated your Draft Environmental Impact Statement for the proposed raising of Ross Dam.

We find that the subject impact statement is seriously deficient in the identification and evaluation of the adverse effects to be expected if High Ross Dam is approved. The environmental changes that High Ross Dam will create are not clearly disclosed in the FPC document.

MITIGATION OF IMPACT

Many of the environmental consequences of the High Ross project are wholly dependent upon the measures to be taken by Seattle City Light for minimizing and mitigating the projected adverse impacts that have concerned and alarmed the public, City Lights own consultants, other Federal agencies, State agencies, and environmental-conservation groups. The Federal Power Commission has not revealed in their impact statement the minimizing measures that must be taken to procure reasonable protection in those cases where environmental mitigation and minimization are possible. Without disclosure of procedures and measures to be taken to protect the environment (either commitments from Seattle City Light or requirements by the FPC) the final environmental impact cannot be recognized. Measures to be taken to minimize adverse environmental impact are an integral part of the proposed project. Without full disclosure of the applicants' proposal, including environmental measures to be taken, only the worst possible environmental impact can reasonably be predicted. Anything less would be wishful thinking.

IRRETRIEVABLE LOSSES

A substantial part of the environmental impact to be expected by the raising of Ross Dam is not subject to environmental mitigation, minimization, or compensation. Such areas as Big Beaver Valley, the Upper Skagit and others will be irretrievably lost if the High Ross proposal is implemented. The FPC statement does not contain an adequate inventory and

Daniel J Evans Governor John A. Biggs, Director Olympia, Washington 98504 Telephone (206) 753-2800

assessment of the resources, wildlife habitats, plant communities, etc., that will be irretrievably lost if these areas are inundated as planned. Without such inventory and assessment, the public is not being provided full disclosure of the implications of the High Ross Project.

ENVIRONMENTAL IMPACT IN CANADA

The subject impact statement completely ignores the environmental effects to be expected in Canada. Instead of identifying and evaluating the anticipated environmental impact in Canada, the FPC has attached to its impact statement the report issued in 1971 by the International Joint Commission: "Environmental and Ecological Consequences in Canada of Raising Ross Lake in the Skagit Valley to Elevation 1725".

The IJC report cannot be considered a complete, up-to-date environmental impact statement. The IJC report merely identifies major environmental concerns and, subsequently, recommends further studies and generalized mitigative actions.

Nowhere in the FPC impact statement is there a discussion of the further Canadian studies recommended by the IJC in their 1971 report. Were these studies undertaken? What were the findings, determinations, and conclusions of these recommended studies?

Nowhere in the FPC impact statement is there a commitment or stipulation that the mitigative and minimizing measures, recommended by the IJC in their 1971 report, will be implemented. Has Seattle City Light made a commitment to carry out these environmental measures in Canada as recommneded by the IJC? Will the FPC stipulate that they will require Seattle City Light to implement these recommended measures in Canada?

While these questions remain unanswered, the consequences to the Canadian environment from the High Ross project continue to be unresolved. Neither the FPC impact statement nor the IJC report satisfy the obligation to assess the environmental damage that will occur in Canada should the High Ross project be implemented.

ALTERNATIVES

Perhaps the most serious indictment that can be leveled against the environmental impact statement prepared by the Federal Power Commission is the conspicuous absence of the logical sequence of events that would occur if the High Ross proposal is denied. The public has not been given a clear picture of the decisions and actions that would be taken in lieu of High Ross. Without knowing the events that would occur in place of High Ross and the environmental damage these events would cause, the public and involved governmental officials cannot possibly compare the relative merits of High Ross versus the logical alternative.

Under 18 CFR 2.80 (Code of Federal Regulations), the FPC is required to study not only the alternatives to a given action but also the environmental consequences of such alternative courses of actions. Furthermore, the regulations require the FPC to specifically discuss plans for future development related to the application under consideration. The FPC impact statement does not meet these requirements. The FPC impact statement does

not contain an assessment of the environmental consequences of Thunder Creek H-14
and additions to Diablo and Gorge Dams, all of which are either alternatives or part of the 'future development'.

The Federal Power Commission and the City of Seattle have the obligation to reveal the future development that will follow High Ross Dam, including the attendant environmental consequences. Both parties also have the obligation to disclose the next logical sequence of events, including environmental impact, that would take place if the High Ross project is denied. These obligations have not been fulfilled.

SPECIFIC AREAS OF CONCERN

WILDLIFE

The IJC report predicts drastic losses of wildlife. In contrast, the FPC reference 50 seeks to refute this contention. These conflicting determinations only lead to confusion and they should be thoroughly addressed in the FPC Environmental Impact Statement.

The expected impact upon wildlife species other than deer is not adequately covered in the Draft Statement. To what extent will stocks of cougar, bear, beaver, grouse, etc., be affected and what, if any, mitigative measures will be taken?

Forced concentration of predators and prey by the higher reservoir level may cause short term numerical over-adjustments from which the population will need many years to recover. Studies are needed to assess the extent of this problem and possible mitigative measures which the applicant may be required to finance.

PLANT COMMUNITIES

The plant ecosystem in Big Beaver Valley is not clearly assessed in the FPC statement. The statement does not put the analysis of Big Beaver Valley and its plant resources in proper perspective.

Over one-third (1,250 out of 3,600 acres) of the land inundated in the USA occurs in Big Beaver Valley. This valley comprises a pristine ecosystem and its great value as a unique, irreplaceable part of our state and national heritage must be fully weighed. It must be clearly shown in what way this valley is specifically reduced in value by raising the dam. The value, character and extent of Big Beaver Valley that may be left undisturbed by the higher reservoir should be clearly delineated. The FPC statement leaves many critical questions unanswered and the relative value and benefit of Big Beaver Valley has not been resolved.

AQUATIC ENVIRONMENT

Aquatic plants have been given inadequate attention both in the impact statement and in the source documents. The lower levels of the food chain (Primary productivity) are vitally important to the balance of aquatic life. According to the FPC impact statement, studies of existing chlorophyll a levels were used as a means for estimating standing stock of aquatic plants.

It should be noted, however, that levels of standing stock, as measured by chlorophyll a, are not a reliable indicator of productivity. Direct productivity measurements, which are more reliable, have been omitted. Additionally, the study of existing chlorophyll levels were limited to one sampling. With this type of incomplete investigation, the peak population (bloom), if there is one, was probably missed. Without adequate data on the levels of productivity, it is impossible to project the effect of the higher lake on any of the species of aquatic life including fish. H-15

Turbidity in lake waters produced during and after construction operations will adversely affect light penetration and, therefore, primary production. These effects and their repercussions to the aquatic environment have not been addressed in the FPC statement.

The total biological effects of the higher lake level are not adequately identified in the FPC document. Existing spawning grounds will be inundated and new ones will become accessable. The relative productivity of these two groups of areas should be investigated. Assurances and commitments should have been submitted that would require the applicant to:

1. assume full financial responsibility for maintaining stocks at present levels by whatever means are deemed necessary by Canadian and American fishery agencies. A monitoring program should be established to detect whether steps such as stream improvement work done prior to reservoir filling were effective; if not, further steps should be taken as determined necessary by responsible governmental authorities.

2. adjust fill schedules to maximize spawning success. (Data presented do not support the conclusion of adequate spawning success during filling.) The effect upon fish populations of the predicted increase in recreational fishing should be determined and presented.

Only when assurances are given that the environmental safeguards and controls will be adequate and effective can the total impact to the aquatic environment be accurately measured. The FPC impact statement has not succeeded in this respect.

WATER QUALITY

It is predicted in the FPC statement that discharge temperature from the High Ross reservoir will be lower than at present. The subject impact statement should contain a judgement as to the relative effect of the lower temperature. Furthermore, suggested mitigated measures should be included. One such measure could be the construction of a power intake tower so that withdrawal would not be from the hypolimnion. Gated ports at various elevations would permit control of the discharge temperature (within limits).

Section 9.1 states that upon completion of High Ross the frequency and durations of spill would be expected to decrease, therefore the problems of dissolved gas supersaturation should be lessened by raising Ross Dam. The evaluation in the statement should also consider the possibility that the higher spillway crest would increase the spillway velocity and therefore the plunge depth, which has been found to be one of the principal factors causing nitrogen Supersaturations.

ENERGY OPTIONS

Consideration of alternative energy options along with environmental impact, are key elements in deciding whether Ross Dam should be raised or not. We believe the analysis of energy options, as presented in the FPC statement, are inconclusive:

A. A full and realistic evaluation of environmental consequences should be included for each alternative energy source. Analysis would be facilitated by a clearly comparable presentation of environmental impacts. As an example of inadequate presentation of environmental impact, of the five negative impacts listed for Gas Turbines, (p. 8-5), only two can considered valid: (1) Resource consumption and (2) air pollution. The other three either have nothing to do with the environment (i.e. finding low cost fuel) or could easily be solved by siting the gas turbine facility adjacent to existing transmission lines.

B. Costs of High Ross Dam, used to compare and analyze alternatives, are included in the FPC statement without supporting data. For example, it is unclear whether the following factors are included in the asserted low annual cost ($4,542,000) of power from High Ross: (a) loss of power at Ross Dam during the construction period, (b) the value of the lands and resources to be inundated, and (c) funds necessary to finance measures for mitigating adverse environmental impacts of High Ross.

C. Fuel Costs - Information is lacking as to the basis for fuel costs used in arriving at a calculation of total costs for the various power alternatives. The fuel cost derivation should be made clear. Basing fuel costs solely on current prices could create a completely erronious picture of the relative future costs of the competing power systems.

D. Generators and Copper Creek - The alternative of adding generators at Boundary, Diablo, and/or Gorge Dams should be presented in greater detail. The possibility of applicant financing additional generators in existing federal dams on the Columbia or Snake rivers should similarly be examined. The environmental impact of the Copper Creek project might be reduced by utilizing the new dam for re-regulation only, omitting power production there and placing additional generators in Diablo and Gorge Dams.

E. No Change Alternative - Will failure to obtain increase in electric power capacity equivalent to High Ross (272 megawatts) really be catastrophic? If we limit the situation solely to Seattle City Light, it would seem the answer is yes. Current City Light capacity is 1391 megawatts and planned fiscal year 1977 capacity with High Ross is 2027 megawatts. High Ross would increase current capacity by 20% and would be 13% of 1977 capacity.

However, Seattle City Light is a member of the West Group of the Pacific Northwest Power pool. Planned power capacity of the West Group in 1977 is 29,609 megawatts including High Ross. The contribution of High Ross would only be 0.9% of the total. Failure to raise the dam would hardly be catastrophic when seen in this broader light.

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For the reasons presented in this review, the Washington State Department H-17
of Ecology finds that the Draft Environmental Impact Statement submitted by the Federal Power Commission does not adequately disclose or evaluate the environmental implications and consequences to be expected if the High Ross project is implemented. Alternatives and attendant environmental impact are not completely covered. Environmental damage to be expected in Canada is not directly considered by the FPC. Irretrievable losses are de-emphasized and given superficial treatment. Minimizing and mitigating measures that must be taken to protect the environment are not delineated in the statement. The public has not been informed of the events and environmental consequences that will occur should High Ross be denied. Thus, it is the conclusion of this Department that the subject impact statement is deficient and, in our judgement, the statement does not comply with the intent and spirit of the National Environmental Policy Act of 1969.

The Department of Ecology, State of Washington, as an intervener in the proceedings regarding the application of the City of Seattle, Project No. 553, preserves its right to be heard on all matters in the above review in which the Department takes issue with the Commission's draft impact statement.

Thank you for the opportunity to review and evaluate this draft impact statement. It is hoped that the Department of Ecology has been of assistance to you in the environmental consideration of the High Ross Dam proposal.

Sincerely,

Steve Mitchell

Steve Mitchell, Coordinator
Environmental Review and Evaluation

SM:jmv

Attachment

OGC

H-18

[illegible] J. EVANS
GOVERNOR

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OLYMPIA, WASHINGTON 98504

THOR C. TOLLEFSON
DIRECTOR

December 5, 1973

Mr. Kenneth F. Plumb, Secretary
Federal Power Commission
Washington, D.C. 20426

Dear Mr. Plumb:

The State of Washington Department of Fisheries has reviewed the draft Environmental Impact Statement filed on October 24, 1973 on the contemplated modification of the Skagit River Project No. 553. Our interest in this matter has been previously expressed in our Petition to Intervene, dated June 6, 1971. Since our authority includes only the food fish resources of the state - in this instance, the salmon production in the Skagit River below Gorge Dam - our comments will be restricted to that area.

The Commission's staff, in preparing this draft statement, has addressed only the impact of proposed project alterations. This agency is vitally concerned with both the existing environmental impact and that of the proposed action of raising the structural height of Ross Dam by 121 feet. We feel that both aspects must be addressed in order to ensure adequate consideration for the downstream fisheries resources. Our comments are detailed below:

Page 1-7, paragraph 2

Downstream recreational navigation is presently affected by project flows. This is particularly true during low power production periods on weekends. This affects boating and sport angling for salmon and steelhead and may extend to the entire river during certain periods. This paragraph further implies that releases from Ross Power Plant are re-regulated by Diablo and Gorge Reservoirs. These projects do not totally re-regulate fluctuating discharge from Ross Dam. Daily discharge below Gorge Dam frequently changes as much as 4,000 cfs or more during a 24-hour period.

Page 2-26, Section 2.8 (Fisheries)

Little mention is made of the fisheries resource in the Skagit River downstream from the project site. Extensive documentation is found on fish and wildlife populations in Ross Lake and surrounding areas upstream from Ross Dam. Since considerable impact will be imparted on the downstream populations of fishes, this report should contain reference to these communities.

Page 3-2, Section 3.2 (Recreation)

Recreational aspects of the Skagit River below the project site are not included in the draft statement. Existing discharge patterns affect boat access and "fishability" of the river. While these discharge patterns will not be affected by the proposed project, their continued effect on recreation should be mentioned.

Page 3-8, Section 3.5

The discussion of the effects of raising the height of Ross Dam on the fisheries resource is generally limited to the Skagit River basin upstream from Ross Dam. Potential impact on the downstream resource is omitted with the exception of the limited reference to colder water temperatures.

1. Construction period: The impact of increasing the height of Ross Dam on the fisheries resource downstream from Gorge Dam during the construction period is difficult to assess from the information available in the Environmental Impact Statement and in the Interim Report on Ross Lake Environment by the International Skagit-Ross Fisheries Committee. During the first summer, Ross Reservoir will not be filled beyond the 565-foot elevation compared to a maximum elevation of 1,602 feet under present operation. This may result in an altered temperature regime downstream. Siltation is expected to increase, as pointed out in the impact statement, due to increased runoff from additional exposed shore area during the construction. Will there be additional turbidity due to construction activity itself? Increased silt load during construction could have serious effects on the salmon resource if the silt load is transported downstream below Gorge Dam.

2. Fill period: The filling of Ross Lake is expected to take at least two years. During this period, discharge from the project would be possibl maintained at a very low level (as low as 1,000 cfs). This will reduce the amount of spawning and rearing area for salmon in the lower river and may alter temperature patterns. During the reservoir fill period, there may be a desire expressed by the Licensee to maintain a minimum discharge of 1,000 cfs during the critical spring month period as permitted by the existing license. If these minimum discharges are preceded by high generation flows from the project, serious stranding problems will result in the lower river. Our studies have indicated that large numbers of juvenile salmon are stranded and killed on grave bars downstream from Gorge Dam due to the flow fluctuation patterns.

3. Completed project: While the fact that the lower water temperatures can affect the time of spawning and the rate of egg incubation is mentioned, the potential impact of such action is not discussed. The Department of Fisheries is conducting studies this year on the

temperature requirements for salmon egg incubation and intra-gravel fry development in the Skagit River. Our results will be included as a part of our testimony. Preliminary indications are that the temperature changes projected for the new Ross discharge will result in considerable delay in the development of salmon during the egg incubation and intra-gravel growth period. This delay in emergence and subsequent delay in downstream migration of pink and chum salmon fry will result in a more pronounced overlap between these two species and the coho smolt migration. This will result in a considerably higher predation by coho on these smaller fishes. Furthermore, prolonging the time spent in the gravel may reduce fry production due to increased exposure to such factors as stream bed shift, siltation, desiccation and intra-gravel predation. Delayed fry will encounter a warmer estuary with habitat characteristics that differ substantially from those found earlier in the season. Estuarial and marine fry survival may be related to seasonal food production and availability. Timing could, therefore, be a critical factor if food production varies seasonally as would be anticipated. Studies of Puget Sound have indicated a decline in littoral plankton, a major food source for pink and chum salmon during late May. It is this period, or later, when delayed migrants would enter the estuary. The varieties of temperatures within the Skagit River system would result in a broader timing curve for downstream migration with fewer fry present in the estuary at any given time. This will permit density-dependent predation to occur over a long period of time and therefore increase the total predation and reduce overall survival.

Cooling of the habitat will also have a bearing on the rearing of juvenile salmon in the upper Skagit River. Coho and spring chinook production may be altered by changes in food availability during all periods of the year.

Fall chinook would also be affected during their shorter freshwater rearing period, although the extent of the impact cannot be precisely determined. However, since existing temperatures are cool in the winter and moderate in the summer, a further reduction would likely be accompanied by lowered food production and slow attainment of migratory size. The total biomass that the stream is capable of sustaining would be lowered.

Page 4-1, Section 4

This section deals with measures to enhance the environment or to avoid or mitigate adverse environmental effects. No major mitigating measures for downstream impact are included. The obvious would include alteration of peaking patterns (with further regulation in Gorge and Diablo Reservoirs) and installation of multi-level intakes for temperature control.

Page 4-4, paragraph 1

The pond formed by gravel removal may be usable in the Department of Fisheries' salmon rearing program. Our experience has been, however, that off-station rearing of salmon on a production basis without feeding is not very successful. We would anticipate a minimum production of juvenile fish with a natural-rearing program in such a pond. To obtain significant production from this area, it would be necessary to install feeding stations in the ponds and feed daily during the rearing period.

Page 5-1, Section 5.1 (Water Quality)

Water temperature is an important aspect of water quality. Construction of the project, without facilities which will provide a temperature regime similar to that existing in the Skagit River below Gorge Dam at the present time, is not an avoidable adverse environmental effect. However, we see no indication that this effect will be mitigated. Reference to changes in temperature regime should be included in this section on water quality. The amount of turbidity which may be present in the river below Gorge Dam due to reservoir clearing and construction is not mentioned.

Page 6-1, Section 6

Ecological alterations caused by increasing the height of Ross Dam and enlargement of the reservoir should certainly include the effect on the downstream resources. Such effects are not mentioned in this section. These effects include changes in temperature regime and continuation of the existing flow fluctuation pattern.

Page 7-2, paragraph 2

This paragraph states that should adverse environmental effects from operation of the project prove to be serious, project structures could be removed. It further states that it would be necessary to remove all physical facilities, since all three dams are interdependent, to re-establish natural conditions. The tone of the Environmental Impact Statement to this point has been to consider existing conditions as "natural". The obvious intermediate step would be to remove only the additional structure at Ross Dam and avoid the extreme impact, both economical and environmental, that results from total removal of all structures.

Page 9-3, paragraph 1

The Department of Fisheries feels that the loss of salmon fry which are stranded on gravel bars by changes in the rate of flow from the project is so severe that the proposal for High Ross should be altered to include provisions for additional minimum flow protection during the critical spring months.

Page 9-3, paragraph 2

The Department of Fisheries will provide additional comment on this paragraph following completion of the temperature-effect studies presently underway from the Skagit River.

Page 9-3, paragraph 3

The statements in this paragraph are highly speculative and cannot be documented. Consequently, this paragraph should probably be removed from the report.

Page 9-4, paragraph 1

The Department of Fisheries is not overly concerned with supersaturation of nitrogen gas in the spill at the project dam. We have not had the opportunity to review the study reported by the Applicant in 1972, which indicates that dissolved gas readings exceed 110% in some instances. The characteristics of the river course downstream from Gorge Dam are such that supersaturated gases should dissipate rapidly. The reduction in spill frequency and subsequent reduction in dissolved gas supersaturation will have little impact on the downstream resource.

Page 9-4, Section 9.2 (Recreation)

The intense recreational use of the Skagit River downstream from Gorge Dam is not mentioned in this report. This recreation is primarily keyed to present and future production of fish in the river.

In general, this draft Environmental Impact Statement is very lacking in information relating to the effect of raising Ross Dam on the anadromous fish resource of Skagit River. The few comments which are incorporated are brief and lacking in detail. The Skagit River is an extremely important natural production area for salmon. In 1963, for example, the Skagit River salmon catch was valued at approximately $5 million to commercial and sport fishermen. Its capitalized value to the industry is more than $270 million. We trust that the final Statement will contain more information regarding the impact of the proposed actions on the Skagit River resources below Gorge Dam.

Sincerely,

Thor C. Tollefson

Thor C. Tollefson
Director

cc: Federal Power Commission - San Francisco
Council on Environmental Quality - Washington,D.C. (10)

Director / Carl N. Crouse

Assistant Directors / Ralph W. Larson
Ronald N. Andrews

Game Commission

Arthur S. Coffin, Yakima, Chairman
James R. Agee, LaCrosse
Elmer G. Gerkin, Quincy
Claude Bekins, Seattle
Glenn Galbraith, Wellpinit
Frank L. Cassidy, Jr., Vancouver

DEPARTMENT OF GAME

600 North Capitol Way / Olympia, Washington 98504

December 26, 1973

Federal Power Commission
441 G Street N. W.
Washington, D. C. 20426

Gentlemen:

Your draft Environmental Impact Statement - High Ross Development, Project # 553 - was reviewed by our staff; comments follow.

In our review of the above environmental impact statement, we note that Federal Power Commission staff (hereinafter referred to as "Staff") has relied heavily on reports of the International Skagit-Ross Fishery Committee (ISRFC) for information concerning Ross Lake Basin fisheries resources. We agree with Staff that these reports are the most comprehensive treatments of this subject available. ("It is assumed that the factual material in the committee report is the most current available data on the Ross Lake fishery", page 2-27 Staff draft Environmental Impact Statement.) We must point out, however, that we feel these reports fall short of presenting or considering all data or circumstances necessary to confidently predict the effects of Seattle City Light's (hereinafter referred to as "Applicant") proposed action.

As Staff is aware, Washington Department of Game did participate in ISRFC studies and had contractual commitment with Applicant relative to that participation. However, Washington Department of Game's cooperation and assistance in the activities of ISRFC should not be interpreted as complete endorsement of data, recommendations or conclusions contained in committee reports. We have reviewed these reports and commented on them to ISRFC. Among other points, we take particular exception to the speculative nature of conclusions stated as to effects Applicant's proposed action will have on Ross Lake fisheries resources. Many conclusions in ISRFC reports, often qualified with such terms as "if" or "probably", are overly optimistic in our opinion because they do not adequately consider potential negative influences of a proposed project (including stages leading to completion of said project) which could have substantial impact on the aquatic environment. Overall, we feel insufficient attention is given in both ISRFC reports and Staff's draft environmental impact statement to the multiplicity of possible impacts to Skagit basin fisheries below Ross Dam (specifically excluded by ISRFC) and Ross Lake basin fisheries of raising Ross Dam.

Comments relating to Federal Power Commission Staff's Environmental Impact Statement follow. In general, comments on fisheries aspects precede those on terrestrial and avian wildlife under headings used in your format.

Description of Proposed Action

Generally, we find this segment of Staff's Environmental Impact Statement is adequate except that on Page 1-7 it is stated that, "...releases from Ross power plant would be re-regulated by Diablo and Gorge reservoirs of Project No. 553". With the increased head of High Ross and, it appears, increased hydraulic capacity (there appears to be a typographical error in a maximum pool elevation figure, page 1-7), we question the ability of Diablo and Gorge projects to achieve reasonable levels of performance in terms of re-regulating Skagit River downstream flows with High Ross.

As Staff is aware, there currently are serious impacts to food fish resources as evidenced by extensive stranding of salmon fry. Preliminary studies indicate that substantial losses of Skagit River steelhead production from stranding of incubating eggs and, later in the year, steelhead alevins has also occurred due to inadequate re-regulation of project waters. Recreational navigation, including commercial guide activities on Skagit River below Project No. 553, will be more affected by project related flow irregularities in the future as public interest increases in utilizing upstream reaches of Skagit River, particularly reaches upstream from Marblemount.

Consequently, the ability of Diablo and Gorge reservoirs to re-regulate project waters, both with and without High Ross, is of considerable concern to us and needs substantially more emphasis and detail in this and succeeding segments of Staff's Environmental Impact Statement. Flow regime in Skagit River below Project No. 553 is of critical importance to preservation of Skagit River game fish resources and recreational value.

The last paragraph listed under 1.1 on page 1-8 and also in section 1.3.2 on pages 1-18 deals with replacement and expansion of existing facilities which would be provided. All these developments would create additional negative impacts on remaining wildlife habitat. Additionally, increased use provided by improved access will have negative impacts in terms of harassment of birds and mammals especially during reproductive seasons and other vulnerable periods of their life cycles.

Expansion of the Crane Bar Gravel Pit and related activity will result in harassment of deer, commonly found in the vicinity, during spring and winter. There also would be additional loss of habitat as a result of this activity.

The two years required to clear and fill the reservoir would impact and harass terrestrial wildlife species located in and adjacent to the inundated zone. It is not clear whether clearing operations would extend beyond the two year period stated, but habitat loss harassment would result during whatever period this phase of the operation takes.

Description of the Existing Environment

Beginning on page 2-26, discussion of existing fishery resources to be affected by the proposed action are inadequate to provide a sufficient overall description. In particular, it is not brought out with sufficient emphasis that the Ross Lake fishery is one self-sustained by natural reproduction. The resource, as it exists today, supports a substantial harvest without artificial supplementation. This feature, rare among Washington lakes, is especially significant in view of Ross Lake's size and adds considerably to recreational and esthetic importance of the area. Much of the value of Ross Lake as a fishery lies in the fact that naturally sustained trout and char populations are found there.

Several spawning areas of Ross Lake fish, identified in ISRFC studies, are not listed in Staff's discussion. Of greatest importance is the Canadian Skagit River. Loss of productive abilities of this river could mean the end of the unique Ross Lake fishery. The Ross Lake fishery resource exists as a natural system, irrespective of political boundaries, and must be viewed in this context. Among other spawning areas not mentioned are Canyon Creek, Dry Creek and Roland Creek. Known shoreline spawning areas also include the vicinities of International and Silver creeks. Other stream and shoreline spawning areas may exist. Spawning habitats of Ross Lake fish species other than rainbow need consideration.

Reference to the lacustrine environment and biota is made very indirectly. Detailed description is needed. Details concerning the relationship between the present environment of Ross Lake and its fish population are also needed. Current limiting factors to trout and char production in the Ross Lake - stream environment need to be identified.

It is not mentioned that trout in the several ponds of Big Beaver Valley are predominantly cutthroat. These too are self-supporting stocks and, except for an apparent movement of some of these fish to Ross Lake and possibly vice versa, they are essentially a separate entity from Ross Lake fish. All of the Big Beaver Valley ponds, possessing productive qualities of significance, lie below the 1,725 contour. Those above are quite small and very shallow. This entire subject needs much more attention in your statement.

Much more detail is needed concerning results of creel census studies conducted in the course of the ISRFC study. Total annual catch and angler usage is the least that is needed. The table given (page 2-36) does not give any indication of magnitude or importance of this fishery.

In your statement of 1971 closed waters, "and its tributaries", should be deleted from the Ruby Creek portion of regulation cited.

On page 2-37, under your discussion of "Unique Biotic Resources", the cutthroat trout residing in the ponds of Big Beaver Valley are a component part of that ecosystem. We are pleased to note you have given attention to other unique aspects of this particular ecological complex but we feel you have defined the scope of your "Unique Biotic Resources" discussion too narrowly.

More generally, we feel your description of the existing environment has devoted too much emphasis to "Socio-Economic" and "Economic Development" aspects of the surrounding area at the expense of adequately describing the full spectrum of fish and wildlife resources that could be affected by the proposed project. This should include, but not necessarily be limited to, the fisheries and terrestrial wildlife resources associated with Diablo and Gorge reservoirs and the main stem Skagit below Gorge project.

In summary (2.7 Wildlife) of the three phenomena influencing the deer population in the Ross Basin, the phenomena listed were:

(a) Flooding covering some winter habitat
(b) Plant succession following burning which reduces productivity of winter range shrubs.
(c) Severity of the winter-snow covering food supplies.

There are further effects which were not discussed, such as effects of habitat lost because of flooding placing additional burdens on remaining habitats, particularly during severe winters. This would result in further depletion of the winter supply of forage. This, in turn, would affect deer numbers over a period of years through lowered deer reproductive capability as well as lowered productivity of winter forage plants.

Even if the capacity of these winter ranges were expanded through fertilization, burning, and manipulation of the vegetation, it is quite possible that heavy accumulations of snows could result in their being unavailable to deer.

The map of deer winter ranges (Fig. 2-7) does not include some areas felt to be important wintering areas. Sightings during past winters indicate Rainbow Point also serves as an important winter area. Roland Point, Cougar Island, and the shoreline hillside behind Cougar Island are areas that should be considered "major" rather than the minor catagory under which they are now listed. Also, nearly all of the shoreline area of Ross Lake below the 1725 elevation receives some utilization by deer during winter. Possible exceptions are the very steep, rocky segments.

Environmental Impact of Proposed Action

Comments contained in section "3.2 Recreation" consist mainly of descriptions of proposed facility rearrangements and additions pursuant to the proposed project which, it would seem, would be more appropriate under "Description of Proposed Action". The closest this segment comes to reviewing actual environmental impacts is the last sentence stating, "Noise, air, and water pollution would increase from added boating and vehicular traffic". Needing recognition is the fact that recreational motivations and qualities of the project area, as it exists today, are inherent in the low people densities and high quality fish, wildlife, and scenic values of the semi-wilderness of Ross Lake basin as it exists today. Primary and secondary environmental impacts of these features of existing environment of the new access corridor and related facilities proposed by Applicant need particular attention. Also needing consideration are primary and secondary impacts to fish and wildlife of the relocated and expanded campgrounds, trail routes, direct people access from a higher lakeshore to previously isolated ecosystems, et al, as well as any developments related to or dependent on Applicant's proposed action.

Discussion in "3.5 Fisheries" inadequately considers the effect on trout spawning location and particularly success with lake levels to be expected during construction and fill periods. Anticipated lake level criteria during these phases of project installation need to be spelled out in detail. There is considerable reason to believe that significant damage to Ross Lake fish populations could occur during this period.

For example: According to information available in the fishery committee report, Ross Lake, during the first summer of construction, could continue to rise in level through the month of October. Also, according to the report, rainbow trout spawning commences in May and emergence of rainbow fry continues well into September. Further, egg incubation tests in inundation zones off the mouths of major spawning tributaries in Washington show very poor survival, due mainly to siltation from runoff. Consequently, if Ross Lake stream spawning rainbow and cutthroat do not, or cannot, migrate far enough upstream during the first spring of construction, survival of an entire year class could be seriously jeopardized. The fate of Ross Lake fish spawning on shoreline areas and success of that spawning needs detailed consideration also.

Other related questions needing attention are:

(a) Effects of construction and fill periods on success of char (Dolly Varden and brook trout) spawning and availability of new spawning habitat above 1725 feet elevation.

(b) Response of Ross Lake fish spawning location to lake level at the beginning and/or during spawning period.

(c) Relative importance of shoreline versus stream spawning areas, since shoreline areas, of suitable quality, would be slow to develop from newly inundated land.

(d) Amount and quality of new shoreline areas at 1725 feet elevation and length of time necessary for these to become suitable.

(e) Amount and quality of stream spawning areas available to Ross Lake fish above 1725 contour.

(f) Specificity of Ross Lake fish to particular spawning areas and their ability to adapt quickly (or at all) to new spawning areas located elsewhere as former spawning areas become inundated.

(g) Impact to stream resident stocks above present barriers to upstream migration of Ross Lake fish when these reaches become accessible.

(h) Importance to Ross Lake fish of stream rearing habitat (as opposed to lake rearing habitat).

The several ponds in Big Beaver Valley supporting important populations of cutthroat and lesser numbers of rainbow trout need a great deal more attention than given. Although several ponds are present above 1725 feet elevation, the highest fishery values are represented by those located in the inundation zone, below the 1725 contour. Environmental consequences of losing this potential fishery and associated recreation are not discussed.

As is pointed out, forecasts by Applicant and Staff indicate that Skagit River water temperatures below Gorge Powerhouse will be reduced as a result of High Ross. Considerably more detail is needed concerning specific impacts this will have on game fish spawning time, spawning success, juvenile growth and survival in Skagit River below Gorge project. Effects to fisheries resources of Diablo and Gorge reservoirs need treatment as well. Details of present water release criteria from Gorge Powerhouse need to be provided and contrasted to those expected with High Ross.

Primary and secondary impacts to fish and wildlife of gravel removal from Crane Gravel Bar for construction aggregate of High Ross need review. The full impact and meaning of the quote from, "The application for permit...('the land will be retained in its natural state to be used as a portion of a proposed future reservoir')," needs explanation. It is stated that ponds created by gravel removal, "will be made available to the state for salmon rearing". Assuming it would be desirable to retain these "ponds" which is not at all certain at this time, their possible use for game fish rearing should be considered. We understand there also will be gravel removal from other sites to provide road fill for Applicant's proposed access road from North Cascades Highway to Ross Dam. Environmental impacts of this action should be discussed.

The proposed relocated and expanded campground facilities (3.2 Recreation), as well as improved access from Highway 20, would increase impact of "people use" on wildlife populations. Habitat loss associated with construction of these facilities, will lead to reduction of or changes in wildlife species and numbers.

As indicated in the Environmental Impact Statement, noise, air, and water pollution will increase. This too, will contribute to harassment of wildlife during critical nesting, rearing periods.

Impact of habitat loss (3.4 Wildlife) related to clearing and flooding of terrestrial habitat to elevation 1727 feet was deemed significant as wildlife populations "...would be forced to move to adjacent areas and compete with established populations...". However, this point was followed by a statement that this would occur only "if" the surrounding area was at carrying capacity. The statement further indicated that if "...the habitat is at carrying capacity, there would be little survival of the least fit individuals."

We suggest that it would be more correct to state that nearly all habitats are at carrying capacity, and that this is particularly true in Ross Basin where cropping by hunting is minimal and winter mortality is the chief population control.

Further, we point out that imposing one population upon another, by its nature, results in detrimental impacts on habitat; consequently, lowering carrying capacity of the range. This damage is not the type that can be rectified in one season. Sometimes, damage of this type can never be repaired. Then, animals normally capable of surviving even severe conditions would be lost; in addition, populations would be further affected by a lowering reproduction including abortion, and absorption of embryos associated with poor condition of pregnant does.

The Environmental Impact Statement refers to the University of Washington report at stating that 25-35 percent of the winter range, which in turn provides 25-35 percent of the winter food, would be lost to the wintering deer herd. However, it would be helpful to document percentages of major and minor winter ranges that would be lost. The lower elevations of the winter range (below 1725 feet) would seem to be the most important segment of habitat which quite probably provides substantially more than 25-35 percent of the winter forage for Ross Basin deer.

Loss of beaver habitat is fairly straight forward; however, beaver pond habitat is utilized by other wildlife species. Loss of this habitat would be detrimental to the variety and quantity of all dependent species.

Measures to Enhance the Environment or to Avoid or Mitigate Environmental Effects

Whether or not "new" spawning areas, made available by inundation or removal of barriers to upstream migration of Ross Lake fish, will compensate for losses of existing areas remains to be more adequately substantiated. Spawning habitat may now, or sometime in the future, be a limiting factor to fish production in the present Ross Lake. Stream spawning areas, not now available, could be made available without the High Ross addition. It should be borne in mind that High Ross reservoir must support a substantially larger fish population to equal present abundance per surface area.

Stocking of Ross Lake with hatchery reared fish to mitigate project related losses would be a poor substitute for the existing quality fishery. Much of the value and attraction of Ross Lake lies in the fact that it is presently self-sustaining, requiring no artificial supplementation. In this regard it is a unique and rare resource, possessing unique value.

Stream improvement or egg planting in tributary streams to improve production are also techniques which could be applied today, without High Ross. Enhancement measures of one kind or another may have to be undertaken to accomodate inevitable increased public use of the present Ross Lake with existing access opportunity; increased access and public pressure brought about by Applicant's project related access proposals alone would almost certainly require some enhancement action. Inundation of additional stream area reduces opportunity for, and potential benefit of spawning enhancement measures, if spawning is now or, in the future, becomes a limiting factor to production in this system.

Insofar as fish and wildlife are concerned, relocation and enlargement of "existing recreational facilities" cannot incontrovertibly be considered "Measures to Enhance. . . Avoid or Mitigate Environmental Effects". Primary and secondary impacts to environments of fish and wildlife are involved in such developments and, as mentioned earlier in our comments, these need to be identified. On the bottom of page 4-2, Staff is quite correct in pointing out that increased public access may not be desirable.

Enhanced scenic value of Ross Lake, to be brought about by reduced annual drawdown of High Ross, is of questionable benefit. Present drawdown and extensive shoreline exposure, below levels proposed, occurs at a time of year and when weather conditions are such that few people are using the area and long before legal fishing and general recreation seasons. Boating safety and existing boat launch opportunity could be enhanced without the proposed project. This needs to be pointed out.

The discussion of the losses of habitat incurred by the project does not consider losses other than those lost through flooding. It does not consider effects of relocation and expansion of campground facilities, trails, roads, and access areas. Also not discussed as a part of the detrimental effects of the project, are the impacts of increased human use. In addition, the gravel removal operation will have a detrimental impact on riparian habitat; and, actual operation will limit use of the surrounding area by wildlife, because of harassment.

Some consideration is given (page 4-2) to the effect of direct public access to Ross Lake in altering the present wilderness setting. But it appears that this reference applies only to the human reaction to such change, and not the overall impact on the environment and the wildlife that it supports.

The draft suggests that a combination of cutting and controlled burning, along with fertilization will enhance remaining browse vegetation and allow production of browse on a sustained basis. However, this will not necessarily replace habitat lost through flooding, but would simply arrest natural succession. As pointed out in the University of Washington report, this succession in many areas has already proceeded to a point of lower productivity; such measures should be initiated regardless whether the Ross project becomes a reality. Impact of such measures would be greater with existing lake levels since winter range below 1727 feet elevation could also be enhanced and utilized.

Also, it must be considered that, should such enhancement be limited to those areas above the 1727 feet elevation, there would be a strong possibility that these sites might be unavailable during critical winter periods when deep snow accumulates.

Unavoidable Adverse Environmental Effects

In your section "5.3 Fish and Wildlife", Dolly Varden need to be added to your list of fish species affected. Also needing attention is the loss of the pond resident fish populations of Big Beaver Valley and potential recreational, scenic, esthetic, and research value of this ecological complex as a whole. Much more information is needed concerning project related temperature decreases of Skagit River below Gorge Powerhouse and its impact on game fish resources there. There may be numerous other "Unavoidable Adverse Environmental Effects"; see comments on other sections of your draft environmental impact statement.

The only unavoidable adverse effect (page 5-3) of the project mentioned was loss of some of the deer wintering range and beaver habitat. This is not a complete and accurate analysis of total adverse environmental impacts. The draft should include the fact that 3200 acres of terrestrial habitat will be lost. This habitat is utilized by many species of wildlife throughout the entire year. And deer utilize the area on a year-round basis, not just during the critical winter period. There is no mention of the fact that habitat below the 1725 feet elevation supports breeding populations of eleven species of birds which will be eliminated from the Ross Basin if the dam is raised. Loss of wildlife, and recreation associated with it, thus, would cause greater adverse effect than indicated.

Relationship Between Local Short-term Uses and Long-term Productivity

Among short-term benefit of the proposed action, Staff has identified recreation. Recreation, at least as it relates to fishing of Ross Lake, cannot be an assured project benefit since protection of fish resources from project construction through the short-term period defined is not at all certain.

The following statement appears on page 6-3, "This intended long-term use of the area (Ross Lake National Recreation Area) was planned with a knowledge of the ultimate Ross development and its contribution to the recreational plans for the reservoir and surrounding land." Identification is needed of "contributions" ascribed to High Ross that could not be realized without the project. Much more detailed discussion is needed of recreational possibilities of Ross Lake National Recreation Area possible without High Ross.

The statement included only loss of habitat. There should be some consideration given for the productivity of that habitat, in terms of numbers and species of wildlife that this habitat could have produced over the fifty-year short-term period. This was pointed out in the long-term discussion.

Irreversible and Irretrievable Commitment of Resources

On page 7-1 it is stated that, "With...inundation (from High Ross)... there would be a reduction in natural fish spawning areas, however some new spawning areas would become available by inundating present barriers to fish migration." This statement is basically true insofar as Ross Lake fish are concerned but so called "new" spawning areas would only be new to Ross Lake fish. There presently are populations of stream resident fish above barriers to Ross Lake fish using those "new" stream reaches now for spawning and rearing. Consequences of interspecific competition from a merger of these populations are far from completely understood. There could be impacts to one or both of these populations from such interaction. At the least, integrity of these now isolated stream resident populations in affected stream reaches would be jeopardized. This needs consideration in your statement here and possibly other sections of your Environmental Impact Statement.

Inundation of a large portion of Big Beaver Valley ecosystem needs considerably more treatment here than the statement "...establishment of an access waterway into Big Beaver Valley." There is an access waterway to this area now which, quite by chance, happens to approximately coincide with the downstream edge of this hanging valley. Significant, and for all practical purposes, "Irreversible and Irretrievable" commitment of resources would take place with flooding of this valley. We appreciate the fact you have considered the possible removal of project structures, "Should adverse environmental effects from operation of the project prove too serious..." However, as you have pointed out, this would be "technically difficult" to say the least and, you must admit, in all practicality this would be a highly unlikely course of action, with significant environmental effects in itself.

Needing consideration under this heading also, we feel, are effects to the Skagit system below Ross Dam of anticipated decreased water temperatures. Other commitments, not obvious at this time, may well be involved in Applicant's proposed action.

Again, the statement is made in this section that terrestrial ecosystem of the affected area would be replaced by an aquatic one. Wildlife habitat on the land to be inundated would be lost. No mention is made of the numbers and variety of wildlife species, presently using this habitat, that will also be lost.

Alternatives to the Proposed Action

We are pleased to see you have included in this discussion "Conservation of Energy" (page 8-17) and "No Action..." alternatives. In the "No Action Alternative", page 8-10, a ten-year firm load growth forecast of approximately 5.8 per cent for peak load and 5.4 per cent for energy is stated. It would be informative if the degree to which High Ross would satisfy this projected growth was given.

Your discussion of alternatives generally seems fairly comprehensive but of the ten alternate power sources discussed, only the pump storage option considered impacts on fish and wildlife. We realize that wildlife considerations for each of the proposed alternatives would be extremely difficult to determine, but we do think they should have been given greater weight and some comparison made of values other than economics.

Concerns we have expressed of environmental impacts related to Applicant's proposed action almost certainly do not encompass all areas of potential concern to us. Our comments on your draft environmental impact statement are, in many cases, based on knowledge we have gained from many of the same documents available and referred to by Staff. The substantial accumulation of data gathered to date and contained in reports by consultants to Applicant remains, in our view, inadequate in scope and detail to confidently anticipate, or formulate plans to alleviate, all possible impacts to the natural environment of raising Ross Dam. Considerably more needs to be known.

Thank you for the opportunity to review your draft and provide our comments. We respectively add that these comments do not constitute our formal position, nor do they affect our intervention into application for amendment of license filed by City of Seattle for Project No. 553.

Sincerely,

THE DEPARTMENT OF GAME

Carl N. Crouse
Director

CNC:jb
Enc. (10 copies)
cc: Agencies
Reade Brown

STATE OF WASHINGTON

INTERAGENCY COMMITTEE FOR OUTDOOR RECREATION

4800 Capitol Blvd.
Tumwater, Washington 98504

Phone (206) 753-7140

Daniel J. Evans, Governor
Omar Lofgren, Chairman

PARTICIPATING AGENCIES

Department of Commerce and Economic Development
Director

Department of Ecology
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Thor C. Tollefson, Director

Department of Game
Carl N. Crouse, Director

Department of Highways
George H. Andrews, Director

Department of Natural Resources
Bert L. Cole, Commissioner of Public Lands

State Parks and Recreation Commission
Charles H. Odegaard, Director

CITIZEN MEMBERS
Lewis A. Bell
Warren A. Bishop
Mrs. Frederick Lemere
Omar Lofgren
Jack Rottler

ADMINISTRATOR
Stanley E. Francis

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DOCKET SECTION

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NOV 21 1973
FEDERAL POWER COMMISSION

November 15, 1973

Office of the Chairman
Federal Power Commission
Washington, D.C. 20426

Dear Sir:

We have reviewed the Draft Environmental Impact Statement on the application for amendment of license for Skagit River Project No. 553 and offer the following comments for your consideration.

General Comments

Basically, we disagree with your conclusion on page 3-2 which states that "two impacts need to be considered in a discussion of the environmental impact of recreation at the Ross development." Not only are there more than two impacts worthy of discussion but as far as recreation is concerned the statement should describe how the project would effect recreation rather than vice-versa as stated. For example, both current and expected patterns and levels of recreation use are only touched on in the statement. Additionally, much more thorough treatment is needed of the subjects already addressed.

Specific Comments

The subject of present access and transportation to Ross Lake has not, in our opinion, been adequately covered. For example, in addition to "tour boat" transportation, the public may reach Ross Lake Daily by means of a City Light tugboat to Ross Powerhouse and by connecting service road in a truck operated by the Ross Lake Resort operator, both requiring payment of a small fee. Small boats in addition to freight may also be transported in this manner.

The recurrent mention of the "wilderness" character and values of the area could be misleading. The term wilderness carries different connotations to different people. For instance, the main feature being that of a reservoir with power boats, including a full sized tugboat, plying its waters would lead some to question such a description. It is true that the area in question in only lightly used, substantially undeveloped, and varies markedly in its degree of wilderness. However, the land involved is designated as for high intensity outdoor recreation and the fact that poor access precludes high intensity use should be emphasized. Much of the use that does occur is not characteristic of the type which occurs in wildernesses with which we are familiar. Though the area is largely wild and undeveloped, we suggest that use of "wilderness" in describing the area be used much less comprehensively, if at all.

We sincerely doubt the 10,000 visitors per day forecasted by the NPS as a projected level of general recreation use. The figure is much too high, in our opinion, at least without much further qualification. We wonder whether the estimate was made assuming completion of High Ross, Roland Point, and/or other access points. The use of such an estimate with no current use estimates make it even more questionable.

Federal Power Commission
Page 2
November 15, 1973

The discussion of "the possible increased use of rough-terrain vehicles and motorcycles" is curious. Inclusion of a singular statement about it is unfortunate in that one can easily get the impression that such use is more likely than it actually is. Our information is that no such use is allowed in the project area and management plans do not envision that it will ever be allowed. If the "possible use" needs discussion, it should be qualified as to how possible it is.

Very brief mention is made of the "establishment of an access waterway into Big Beaver Valley." However, more extensive, though inadequate, discussion of the natural area attributes of Big Beaver Valley is included in several places in the text. Not only should the beauty of such a potential waterway and its availability to large numbers of people be discussed but so should the other possible examples of such plant communities which have been located in the general area. The valley of Big Beaver Creek is where much of the controversy surrounding the project is centered, yet only a very limited discussion of this project's effects on it is included. We think more treatment is needed.

Thank you for the opportunity to comment.

Sincerely,

STANLEY E. FRANCIS
Administrator

SEF:RAC:me

cc: OPPFM, State Clearinghouse

RECEIVED
JAN 8 - 1974
FEDERAL POWER COMMISSION

215 - 14th Street
West Vancouver, B. C.

H-37

December 27, 1973

Federal Power Commission,
Washington D.C. 20246,
U. S. A.

OUT
JAN - 9 1974
DIVISION OF LICENSED PROJECTS

Attention: Mr. Kenneth Plumb

Dear Sirs:

Re: License Amendment,
Ross Development Project No. 553
Draft Environmental Impact
Statement by FPC Staff

We regret that we did not receive document FPC-PWR-553 until December 15th, it is therefore difficult to make much detailed comment before your deadline of December 31, 1973.

A quick perusal of the Draft Environmental Impact Statement leads to the following comments:

1 The statement does not deal with the environmental impact in Canada except for the inclusion of Appendix F which is an outdated document, and which is not even commented on in the main document.

2. Specifically the document makes no attempt to assess the impact in Canada on the low level land available for recreation to the people of the Lower Mainland of B.C. on a regional basis. No analysis is made of the alternative recreation land available and its quality relative to that of the Skagit.

3. No attempt is made to assess the true worth of the Canadian Skagit to Seattle City Light. The lack of adequate payment will make considerable impact in B.C. The disparity between the annual saving of $3,880,000 between the cost of High Ross and the next cheapest source (gas-steam turbine) is in marked contrast to the $37,000 (approx) which Seattle is to pay to British Columbia.

......../2

4. After reading the document we have little confidence that due consideration is being given to the impact of this project in Canada, yet in Canada we realise that we will suffer the brunt of the impact if the project goes ahead.

We therefore ask you to revise this document to make adequate assessment of the impact of the scheme in Canada.

Yours truly,

K. G. Farquharson

K. G. Farquharson,
Secretary,
ROSS Committee

KGF/ams

2300 Madison Avenue
Burnaby 2, B.C.

H-39

December 24, 1973

Mr. Kenneth F. Plumb,
Secretary,
FEderal Power Commission,
441 G. St. N. W.,
Washington, D.C.

Dear Sir:

Re: PROJECT #553 - CITY OF SEATTLE

The following is offered as comment to the F.P.C. Staff Draft Environmental Statement on the above project.

Due to the shortness of available time, it is difficult to make very much comment before the extended deadline of December 31, 1973.

However, from the point of view of the Canadian interested parties, the glaring omission from the Draft Statement is the complete lack of any real reference to environmental impact in Canada. In this regard, it has been generally accepted that the greatest such impact is in Canada rather than on the U.S. side of the border.

At the same time, when looking at costs of this project versus alternate sources of power, the statement makes no reference to the very nominal amount being paid by Seattle City Light for the flooding of this Canadian valley.

I was personally assured in June 1972, by Mr. Sander, Assistant General Counsel of the F.P.C., that Canadian environmental considerations and other effects in Canada would be given full and equal consideration to the U.S. The approach of the Draft Environmental Impact Statement makes it abundantly clear that this will not in fact be the case.

Yours very truly,

David M. Brousson.

D. M. Brousson
2300 Madison Avenue
Burnaby 2, B.C.

H-40

December 24, 1973

Mr. Kenneth F. Plumb,
Secretary,
FEderal Power Commission,
441 G. St. N. W.,
Washington, D.C.

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Yours very truly,

David M. Brousson.

BEFORE THE
FEDERAL POWER COMMISSION
UNITED STATES OF AMERICA

CITY OF SEATTLE)	PROJECT NO. 553
)	
)	COMMENTS ON ENVIRONMENTAL IMPACT STATEMENT FROM ENVIRONMENTAL INTERVENOR
)	
)	

COME NOW environmental intervenors North Cascades Conservation Council and the Wilderness Society et al, previously having been granted status as intervenors in this proceeding, and comment on the draft environmental impact statement for the above-captioned project prepared by the Federal Power Commission on October 24, 1973 pursuant to Commission's order number 415-C and 18 CFR Section 2.81.

SUMMARY OF COMMENTS

After thoroughly reviewing the draft environmental impact statement, the environmental intervenors conclude that the statement failed to provide intervenors, governmental agencies and the general public with a full and complete investigation of environmental effects upon which responsible criticism may be based. Intervenors' conclusion that the draft environmental impact statement failed to meet the requirements of the National Environmental Policy Act is based on the following factors:

1) The statement fails to analyze the particular outputs to be produced by High Ross Dam;

2) It fails to provide any sort of analysis on environmental or social effects to be felt in the Canadian Skagit Valley in British Columbia;

3) The statement fails to analyze alternatives in any detail, and in fact does not include particular significant alternatives available to the applicant;

4) The impact statement fails to resolve conflicts in the data and conclusions between the draft impact statement itself and the report of the International Joint Commission appended thereto.

Thus, the draft environmental impact statement completely fails to provide a basis upon which responsible criticism and comment may be made. Thus, the intervenors believe it is incumbent upon the Federal Power Commission to revise and improve the draft environmental impact statement after comments are received and thereafter recirculate an improved document as the draft environmental impact statement to receive appropriate comments. Hereinafter, the intervenors will comment, generally and specifically, on the draft environmental impact statement so that the Commission staff may prepare an adequate draft environmental impact statement through the use of these comments and others to be received.

COMMENTING PROCEDURES

Environmental intervenors will comment on the impact statement both generally and specifically. Comments will generally be divided by the nine subject headings of the draft environmental impact statement (DEIS). Each section will be commented on generally as well as by specific reference, by page number.

COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT

I. DESCRIPTION OF PROPOSED ACTION.

General Comments. This section is generally insufficient to provide the public and governmental agencies with a responsible basis on which to compare features of High Ross Dam as an economic unit with the environmental problems to be encountered by its construction. As the environmental impact statement is to provide analysis not only for those who are experts in matters of hydro-electric generation, but also with those who are laymen in the subject, the description must be given for both types of commentors. Unfortunately, this section fails to describe what High Ross Dam will mean to the City of Seattle and to other utilities in the northwest.

Specific Comments.

PAGE 1-1. On this page, and those that follow, certain figures are set forth as to the "dependable cpacity" of High Ross Dam. This figure, as stated on page 1.1, is 252mw during a 42.5 month critical period. Nowhere in this section is the term "critical period" defined for the non-expert commentor.

The concept of the "critical period" is continued on page 1-2. Therein it is indicated that High Ross will result in an additional 272 mw of dependable capacity and 297,840,000 kwh of annual energy during the critical streamflow period. It is to be noted that the critical period is a period of historic low streamflows, not in the Skagit River, but in the Columbia River system. Because the concept of a critical period involves an event unlikely to occur during any normal year or years, the use of the critical period and judging High

Ross power output from it does not give the public or commenting agencies an indication of the real output from High Ross Dam. The critical year concept has relevance to Bonneville Power Administration (BPA) rates and possible critical electric conditions in the Northwest. To provide adequate consideration of the economic feasibility of High Ross, the Commission should provide figures indicating the dependable peaking capacity of High Ross during a typical January in Seattle when the city experiences its peak demands. Further, in the event that high streamflows occur in any year, comparisons should be made between Low Ross and High Ross when both reservoirs are completely filled. Intervenors believe that the use of 272 mw, calculated during a critical streamflow period, gives an incomplete view of the value of High Ross Dam.

PAGE 1-4. On this page, it is indicated that the load forecast for the City of Seattle indicates an increased peak demand of about 77 mw through fiscal year 1977. The date of such a forecast should be given as well as the base documents at which this estimate was made. The Commission will note that the City of Seattle has recently adopted energy conservation measures which may have a distinct effect on any load forecast within the city. These efforts have resulted in a net decrease of some five to seven percent decrease in the City's load, which will in turn have an effect on the load forecasts.

Again, critical year projections of power capacity from High Ross are inappropriate when compared to any annual peak energy demand increases. It is inappropriate to apply the critical year increases when discussing any annual peak load forecast if critical year streamflow conditions are not repeated during that period of time.

PAGE 1-5. On this page, the environmental impact statement discusses peak demands and peak supply for the west group. It would be appropriate in the analysis of west group peak demands and supplies for comparisons to be made between the dependable capacity and annual generation of High Ross and other existing or proposed hydroelectric and thermal plants in the Northwest. Such comparisons should include new capacity being installed at such installations as Grand Coulee, Bonneville and thermal plants such as Centralia and Hanford. As to hydroelectric plants compared, figures should be given for streamflows at various other hydroelectric plants, including Grand Coulee, Bonneville and other federal Columbia River dams.

PAGE 1-13. On this page, it is indicated that Ross was "originally constructed with provisions for raising at a future date." No data or study is provided to support this conclusion. Detailed figures should be provided as to the particular design features included in Low Ross which would provide for raising to a future higher dam. In addition, figures should be given with regard to the amount of particular investment in High Ross in Low Ross which may be unused if High Ross is not constructed.

PAGE 1-18. Beginning here, and continuing throughout the environmental impact statement is a discussion of proposed recreational facilities to be added by the applicant around and at High Ross Dam and the reservoir. It is to be noted that, under the jurisdiction of the National Park Service (NPS) the addition, enlargement or construction of recreational facilities is entirely dependent upon approval by the National Park Service. While the applicant may plan and, assert to this Commission its intention to build recreational facilities, all of these matters are under the sole jurisdiction of the National Park Service and can be constructed only if they are complementary to NPS plans for the area. If the NPS has approved these plans, súch approval should be indicated.

PAGE 1-20. It is indicated on this page that the annual mean reservoir elevation of High Ross would be 1710 feet. Comparisons should be given between annual mean reservoir elevations in the High and Low Ross Reservoirs in relationship to power production capabilities, i.e. what is the dependable peaking capacity of High Ross at 1710 feet and what is the dependable peaking capacity of Loww Ross at 1575 feet. Also found on page 1-20 is a comparison of physical data as to the existing and enlarged Ross reservoirs. This information fails to provide sufficient data upon which to base a comparison. Additional data should be provided in Table 1-2 which will indicate the amount of exposed bottom land with High and Low Ross. In particular, emphasis should be placed on the location of these mudflats and how much would exist in Canada and the United States.

PAGE 1-22. Herein is indicated that land rights within the United States for operation of the Ross Reservoir to elevation 1725 were granted to the City of Seattle in 1937. The nature and extent of these rights should be specified in detail.

It is also indicated that rights to flood lands in British Columbia were granted in 1967. The nature and extent of such rights should be specified in detail in any further EIS. Also it must be indicated in the DEIS that the government of British Columbia has taken a position in opposition to the flooding of the Canadian Skagit Valley and that British Columbia government has indicated that it will not allow the Canadian Skagit Valley to be flooded.

Further, the next EIS should provide complete and thorough analysis of the recently established Skagit Valley Provincial Recreation Area in British Columbia. This recreation area, established in the fall of 1973, provides that lands to be flooded in British Columbia are now designated as provincial recreation lands. The Province has further indicated that it intends to improve this area and develop it through the use of provincial funds. Information as to this recreation area must be provided in the final environmental impact statement including the geographic extent of such recreation area, plans for its use and proposed expenditures.

PAGE 1-23. Herein it is indicated that the applicant plans to relocate some 8.5 miles of the Silver Skagit Road in Canada. With the current stand of the British Columbia government and its designation of the proposed flooded area as a recreation area, it is doubtful that any rights to relocate this road will be granted in Canada.

PAGE 1-25. Again, there is an indication that the applicant plans to relocate certain recreational facilties. Again, it must be noted that the NPS will entirely control the relocation or reconstruction of recreational facilities within the Ross Lake recreation area. It should be clearly indicated that the majority of the applicants' recreational development will be to replace recreational facilities destroyed by the flooding behind High Ross.

PAGE 1-26. It is indicated here that merchantable timber in the Canadian Skagit Valley would be harvested prior to flooding. The designation of the area for a British Columbia Provincial Recreation Area may prohibit the harvesting of any timber from the affected land in Canada.

PAGE 1-27. Herein it is indicated that the existing Ross Reservoir must be drawn down 127.5 feet to construct the High Ross facility. Complete figures should be given as to the amount of dependable peaking Capacity and annual energy which will be lost because of this artificial drawdown in the reservoir. In addition, comparisons must be made with projected available energy supplies during the period of construction and what provisions the city intends to make for the purchase of power during this period, including whether or not such power will be readily available from other sources, including BPA.

PAGE 1-29. As average year flows are indicated on Table 1-3, information must be given in the next environmental impact statement as to dependable peaking capacity available during such an average year. In addition, comparisons must be made between High Ross and Low Ross in a year of high waters, or wet year, as described in Table 1-3.

PAGE 1-32. The draft EIS indicates that "minor soil restabilization" may occur along the new shoreline. Indication should be given as to any studies or reports which would indicate that such readjustment would be "minor," as indicated in the draft EIS, and also to indicate in what areas soil restabilizations would be expected. In addition, 1-32 indicates that the spillway capacity at High Ross would be 85,000cfs at normal pool elevation and 140,000 cfs at maximum flood surcharge. Engineering studies indicate that a maximum flood would surcharge the High Ross Reservoir to an elevation of 1741.3 feet. It must be indicated that under the International Joint Commission order of 1941, the City of Seattle is authorized to flood in Canada only to elevation 1725 feet. As a result, it is necessary to include in any final plans of the applicant sufficient spillway capacity to prevent flooding of additional lands in British Columbia above 1725 feet

II. DESCRIPTION OF EXISTING ENVIRONMENT.

General Comments. This section is completely inadequate to meet the requirements of the National Environmental Policy Act. The primary reason for such inadequacy is the arbitrary division of the description of the environment at the Canadian border. There is almost no comment about the effect of the high dam on the Skagit Valley in Canada, despite the fact that most of the additional flooded lands will be in the Province of British Columbia. This is a glaring defect, especially in light of the requirement of the National Environmental Policy Act that international environmental effects be studied in any environmental impact statement. Though the Commission has provided a copy of the 1971 International Joint Commission report, this report is not, and was not intended to be, an environmental impact statement. The international boundary is an entirely arbitrary line drawn across a homogeneous valley, used by both Americans and Canadians. Though American and Canadian citizens may understand the significance of such a boundary, the boundary has no effect on the biotic environment, including fish and animal life. The arbitrary division by Commission staff of the description of the environment, to include the United States description in the environmental impact statement and the Canadian description in the IJC report prevents adequate analysis on a uniform basis. Thus, it is apparent that Commission staff must prepare an entirely new draft environmental impact statement which will consider, in the same place, and under the same criteria, the effects in the entire Skagit River Valley, without regard to the Canadian-U.S. border.

Specific Comments.

PAGE 2-1. The EIS indicates that no private lands are included within the development boundary since all land immediately surrounding the reservoir is federally owned and managed by the Department of the Interior. This is, of course not true, in that certain lands exist on the boundaries of the reservoir in Canada which are not owned and managed by the Department of the Interior. As noted previously, the area in Canada to be flooded, and adjacent to the existing reservoir, has been designated as a provincial recreation area under the laws of the Province of British Columbia. Indication should be given as to the type of management possibilities and limitations which are inherent in that designation.

PAGE 2-6. The Commission staff seems to see a trend in greater public use in the Ross Lake National Recreation Area because of construction of SR-20 (the North Cascades Highway). Again, it must be indicated that the NPS entirely controls any development within the Ross Lake Recreation Area and as such has the prerogative to entirely open or close development. This decision is not vested in the hands of the applicants and the applicant stands as only one of many organizations which is providing input to the National Park Service with regard to future plans for the Ross Lake Recreation Area.

PAGES 2-18 to 2-21. Herein the DEIS discusses biotic communities in the area surrounding the Ross Reservoir. The Commission apparently attempts to make up for its lack of detail in this section by reference to studies prepared by the University of Washington. While references to generally available research materials are appropriate in a draft environmental statement, it is entirely inappropriate to refer to such items as the applicants' investigations conducted by the University of Washington. These documents are not enclosed with the environmental impact statement and, to environmental intervenors' knowledge,are not available for inspection and copying at any location other than Commission staff offices in Washington, D.C. Nor can environmental intervenors, governmental agencies or public have ready access to these documents in the project area in the state of Washington. As such, no commentor can adequately comment on the draft environmental impact statement without the availability of these documents.

This section seems to indicate that the biotic communities surrounding the existing Ross Reservoir are homogeneous in type. This is, of course, not the case and there are particular areas which should be individually considered for their particular value. Of course one of these is the Big Beaver Valley, which is discussed in the impact statement and will be commented upon by intervenors in this document. Also, there is the particularized habitat around the lake which must be considered. An example of this particularized habitat is a unique small grove of aspen located on the east side of the reservoir in the vicinity of Cougar Island. Further, a small stand of Ponderosa pine exists in the Canadian Skagit Valley. The occurrence of this species in this location is absolutely unique in the coastal Douglas fir zone of the western United States and Canada. In fact, the entire Skagit Valley in the United States and Canada is unique in that it provides a diversity of plant and animal life [illegible] individual locations. The tendency of the environmental impact statement to lump all of these biotic communities [illegible] ehend the diversity of biotic communities in the Skagit.

Similar comments may be made for the discussion of wildlife of the Ross Reservoir area beginning at page 2-21 and continuing to 2-26. Once again the impact statement leads one to believe that the wildlife mentioned is homogeneous about the lake. Further, the impact statement directs one to unavailable resource material for further evaluation of these wildlife effects. The next EIS should include either specific analysis of the work done by the Institute of Forest Products (see 2-22) or provision for the inclusion of such studies within the environmental impact statement.

PAGES 2-26 to 2-37. The same deficiency as was apparent in wildlife and biotic sections of the draft EIS is apparent in the fisheries consideration. All commentors should be pleased to know that the 1971 and 1972 fisheries investigation of the International Skagit-Ross Fishery Committee have been made available to the Commission staff as indicated on 2-27. Of course, commentors cannot analyze the details of these fisheries investigations without a trip to Washington, D.C. and a perusal of the file in this case.

The fisheries investigations suffer from another defect which is common in the impact statement to biotic and animal communities' descriptions. That is, emphasis is placed almost entirely on either the largest or most valuable resources available. It is clear that the visitor to the Ross Lake area not only comes to observe the largest of trees, the largest of animals (deer and bear) and to catch the possibly plentiful rainbow trout, but also comes to observe a diversity of other wildlife and biotic communities. In particular, though spawning times and habitats for rainbow trout are described, little is indicated with regard to cutthroat trout and their spawning habits. It is a matter of fact that cutthroat trout spawn at different times, that is winter, than do the rainbow trout.

PAGE 2-47. Beginning at 2-37, the EIS describes the Big Beaver Valley. Comments on Big Beaver Valley fail to take into account several important facts about the existing environment there. First, the Big Beaver Valley is the only flat-floored valley at the present level of Ross Reservoir, if the Canadian Skagit Valley is excluded. Geologically, it is one of the most splendid examples of a low-level glacially carved valley in the entire North Cascades region and it is the only valley leading to the Ross Reservoir which has not been markedly altered by post-glacial gorge-cutting.

The uniqueness of the Big Beaver Valley is derived from the fact that it is an "ecotone", or transitional zone between the west side wet coastal and east side, dry interior species of vegetation. Certainly the variety of the habitat and plant communities in the valley represents in microcosm the entire Skagit Valley as it once existed, prior to destruction by original Ross Dam. The EIS comments on the existing stands of old growth western red cedar in the valley. Also of significance in the valley is the large sphagnum bog in the early stages of its development in Section 5, Range 13E, Township 38N. These bogs, which were once relatively common in western Washington, have become increasingly rare because of man's intervention.

It is also to be noted that the number of roadless valleys in western Washington once numbered about 130 and now the number is down to less than ten. One of these unroaded wilderness valleys which remain is that of the Big Beaver, which will be flooded for five and one-half miles of its length on the raising of Ross Dam.

PAGE 2-53. It is indicated on this page that flood control storage in Ross Reservoir has reduced the magnitude of floods on the Skagit River. This bare statement is unsupportable unless figues are given to indicate the extent to which floods have been reduced in the Skagit River because of flood storage at Ross Reservoir. The agreement between the applicant and the United States Army Corps of Engineers indicates holding of 150,000 acre feet between April and June. Figures should be given as to whether this flood storage is significant in terms of outflows from the Skagit River in the Lower Skagit Valley. Further, it should be indicated whether the flood storage would need to be increased to provide more significant effects. Further, it should be noted that flood control storage in acre feet remains indentical between Low Ross and High Ross.

Also found on 2-53 is a table (2-8) that indicates hydrologic data from metering stations near Ross Dam. For a reader to fully understand the amount of discharge from Ross Dam, and make adequate comparisons with other rivers, data should be given on typical water flows in other northwest rivers. These might include the Snake near its confluence with the Columbia and at various points on the Columbia River.

PAGE 2-55. Gauge measurements are made for water flows at several rather isolated spots near the Ross Reservoir, including one near Hope, British Columbia. To adequately assess the flows coming into the Ross Reservoir from Canada, staff should maintain a gauging station near the confluence of the Skagit River and Ross

Reservoir to give the reader of the EIS an indication of water flows out of the river and into the lake.

PAGE 2-57. The impact statement indicates that the effect of the larger Ross Reservoir on downstream water quality will be "studied by the applicant and a report will be made a part of the hearing proceedings." This statement is unacceptable in terms of an exposition of all environmental effects. Any study of downstream water quality should be made a part of the environmental impact statement and should be available to all commenting parties who wish to provide input to the process. The question of downstream water quality, and its effect on anadromous fish, is an important part of this proceeding and if the applicant is unwilling, or unable to prepare appropriate studies on this subject, the task must be taken on by Commission staff.

III. ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

General Comments:

Intervenors note that the entire length of the section on environmental impacts is only sixteen pages, while the section on a description of the project area is sixty-one pages in length. It is apparent from this section that considerable revision and reassessment of the consideration of environmental impacts is necessary. In general, this section is insufficient to meet the requirements of the National Environmental Policy Act primarily because though descriptions are made of existing resources in Section II, there is a failure to follow up and analyze the effects on the existing resources in Section III.

Specific Comments:

PAGE 3-1. This section on economic impacts is completely devoid of any substance. To assess the environmental impact, we are left with nothing more than the bare assertions of Commission staff as to the truth or falsity of the statements given. It is essential that analysis be given in this section as to the effects to be expected from the construction of Ross Dam. Among these, would be the following:

1) To separate the effect on the surrounding community of the construction of Ross Dam from that of increased recreational traffic passing over State Highway 20.
2) To analyze and provide the basis for assembling facts on the economic impacts, a base analysis should be provided to be able to identify the amount of economic gain to the region and the local area from the construction of Ross Dam. Further, analysis should be made as to economic impacts with alternate recreation plans, including that of leaving Ross Lake a wilderness area, increasing the use to provide minimum recreation facilities and establishment of an intensive recreational development.
3) The EIS indicates that employment in the project area will be increased. To support this statement, specific figures should be given as to the number of individuals who will be employed in the construction of Ross Dam, the period for which they will be employed, employment possibilities that are available to local residents as opposed to specialized construction work coming from outside the project area.

If this kind of detailed economic analysis is not available, no comments should be made on economic impact in the DEIS.

PAGE 3-2. Comments in the section on recreational effects leave the reader with an incorrect interpretation of the development of recreational facilities in the Ross Lake National Recreation Area. It is apparent that no matter what is proposed by Seattle City Light, or what promises are made for the construction of recreational facilities, the development of those facilities, as well as the final word as to the recreational development in the national recreation area, is dependent on the judgment of the National Park Service.

The EIS indicates that the surface area of the reservoir would be increased by 8,300 acres, of which only 3,600 are in the United States. Again, the environmental impact statement fails to consider environmental effects in Canada. The environmental impact statement fails to take note of the fact that the Province of British Columbia has recently established a provincial recreation area in the Canadian Skagit Valley which is to be flooded. It is incumbent upon the Commission staff to fully assess the recreational and economic impacts of this new park in Canada which would be flooded by the waters from a higher Ross Dam.

The EIS studies recreational land in terms of absolute numbers of acres. However, the diverse topography of the Ross Lake area indicates that all land near the lake and lands to be flooded by the raising of Ross Dam are not equal in recreational potential. Some lands are very steep while others are flat and relatively available for recreational use, including campsites. The environmental impact statement should analyze the areas to be flooded for their particular recreational potential on an areal basis. In this manner, the commentor and the Commission itself can better analyze what areas will be lost and what areas potentially may be gained by the raising of Ross Dam.

There should be included in the assessment of impact on recreational areas, area to be exposed by drawdown with the new reservoir and the high reservoir. In this regard, it is a matter of fact that a considerable amount of the drawdown area will be exposed in the Canadian Skagit Valley, as opposed to the United States. This shifting of exposed drawdown area is perhaps beneficial for recreationists using Ross Lake in the United States but will be a decided detriment in the Canadian Skagit Valley. Further, the flooding of the Big Beaver Valley will remove that area from use by recreationists who seek use of an unroaded flat-floored valley for wilderness and research purposes.

PAGE 3-4. This section discusses the plant communities in and around Ross Lake. The first sentence indicates that large volumes of timber and other plant material would be removed or burned. The burning of this plant material, in extensive volumes, would create a considerable amount of air pollution within the project area. Analysis should be made as to the amounts of air pollution to be created, over what period they will be expected and over what general area the air contaminants will be expected to spread. In addition, analysis should be made as to whether these burning activities will have an adverse impact on the amount of recreation use to be expected in the Ross Lake National Recreation Area.

The EIS correctly states that the unique ecological association in the Big Beaver Valley will be destroyed by the raising of the water levels and the inundation of the area. However, because there was an inadequate analysis of the components of the Big Beaver

Valley in Section II of the EIS, it is impossible for the reader to know exactly what will be lost from the description as found on page 3-6. Intervenors have previously mentioned the fact that the Big Beaver Valley is an ecotone and contains many plant communities which are mixed east and west side climatic types. Such areas are particularly valuable for research study in that they provide a better analysis of such plant communities than in their more native habitat.

PAGE 3-7. In this section, the EIS provides comment on the effect to wildlife of raising the Ross Reservoir. This section however fails to provide any analysis of the potential amounts of wildlife to be lost from the area. No figures are provided upon which to analyze the effect of the Ross Reservoir and the potential decrease in wildlife resources. In that the EIS provides absolutely no analysis of the potential loss of wildlife, it is apparent that the figures found in the IJC report (Appendix F) must be used. This report indicates that the fishery in Ross Lake would worsen or might even collapse because of the raising of the reservoir (See p.17). As to land-based wildlife, the EIS indicates that considerable winter range would be lost for deer. However, there is no indication in the EIS as to the effect of this loss of winter range on the deer population. Again there is a complete lack of any comparison between the IJC report and the figures as given in the EIS. The IJC report indicates that the deer herd will decline by at least fifty percent and possibly as much as eighty percent. No analysis is given in the EIS as to whether the figures represented in the IJC report are true and if they are true what particular deer populations they refer to, that is, whether it is a resident

Canadian deer population or an international deer population which will be affected.

The impact statement indicates that at least thirty-five beaver occupy the Big Beaver Valley. However the EIS stops short of saying that the beaver which would be flooded out from the Big Beaver Valley by the High Ross Reservoir would be exterminated because of a lack of suitable habitat.

PAGE 3-8. This section deals with the fisheries of the Ross Lake Area. Again, the EIS suffers from a lack of any evaluation as to the amount or extent of decrease in the resident population of Ross Lake. Though the impact statement identifies problems which "could" adversely affect spawning and feeding of these resident populations, certain effects are not considered. First, it is apparent from review of page 2-48 that Ross Lake does on occasion entirely freeze over. Comment should be made in the impact statement as to whether this complete freeze-over of the lake, at a time at which the lake level is drawn down to a level for construction activity, would adversely affect spawning and fish populations.

On page 3-10 the impact statement indicates that the effect of the increased reservoir elevation on trout production would require a post-flooding study. Such statements are unaccepatable in an environmental impact statement; it is the duty of the Commission staff to assess, under the best available techniques, the effect of increased reservoir levels on the resident trout population.

Further, effects should be considered on other species than rainbow trout. In this regard, we note that the cutthroat trout spawn at different times than the rainbow trout, that is in the winter. Because of the spawning of the cutthroat trout and the maximum drawdown level for construction occur at the same time, analysis should be made as to the effect on the cutthroat population during this drawdown period, especially as to how extreme cold weather during this period may cause the elimination of spawners or juvenile cutthroat trout.

IV. MEASURES TO ENHANCE THE ENVIRONMENT OR TO AVOID OR MITIGATE ENVIRONMENTAL EFFECTS.

General Comments. This section of the EIS suffers from similar deficiencies as does the remainder of the statement. It fails to identify measures to avoid or mitigate environmental effects in Canada, and for those measures identified, sufficient analysis is not provided upon which to base a reasoned judgment. Of particular significance in this section, is the complete lack of any quantified data as to the ability of mitigation measures to significantly change the environmental effects identified. Only through the use of quantified data can the commentor analyze the effectiveness of mitigation measures and in turn, compare these measures with the overall effect of High Ross.

Specific Comments.

PAGE 4-1. It is indicated on this page that wildlife effects may be mitigated through a variety of measures identified on this page. However, no specifics are given as to the effectiveness of these measures to successfully avoid the loss of the deer population. Specific analysis must be provided as to the percentage of the deer population which may be saved by such mitigation measures. Further, there appears to be conflict between the IJC report and the EIS with regard to the success of these measures. The IJC report indicates, on page 34, that mitigation, in terms of the provision of new vegetation areas, is "unlikely to compensate to any significant degree for the elimination of deer by High Ross Reservoir". This conflict should be resolved by the EIS with an indication as to whether or not the situation in the Canadian Skagit Valley would be expected to be any different from that in the United States.

PAGE 4-2. The successful mitigation of fisheries losses is not identified in detail sufficient to provide the ability to comment. It should be indicated whether or not studies have been prepared for comparable streams to test the sufficiency of mitigation measures in terms of stream improvement techniques. Additionally, many fishermen are concerned that the use of hatchery-reared trout in the lake would result in a decline in the quality of the fishery itself. Identification must be made as to whether the hatchery-reared trout provide a comparable fishing experience to that already existing in Ross Reservoir.

PAGE 4-3. Mitigation of the effect of High Ross is identified also in terms of possible changes in the operation of the Ross Reservoir. In that the Ross Reservoir has been identified for its value as a recreation area, mitigation measures should be provided which would enhance the recreational potential of the area. One of the measures not considered in the EIS is a requirement in the license that the reservoir be required to be filled during particular parts of the year for recreational use, independent of hydro-electric operations. Under such a mitigation measure, the Ross Reservoir would be required under its license to be filled to capacity from June 1 to September 15 of every year. In discussing this mitigation measure, identification should be made of the potential effects such a requirement would have on power production and economic feasibility of High Ross. It must also be noted that though the drawdown is also shifted in large measure from areas within the United States to areas in the Canadian Skagit Valley.

PAGE 4-2. The impact statement indicates that the rare rhododentron macrophyllum may be transplanted to areas above the proposed reservoir level. It must be pointed out that the age, large size and extensive rooting systems of these plants will probably prevent their successful transplantation, above the new Ross Reservoir.

PAGE 4-3. The EIS indicates that because of reservoir clearing operations, Ross Lake will be made more safe for boating activities. Such a statement fails to recognize that much of the boating safety problem comes from the failure of the applicant to completely clear timber from the original reservoir. It is the snags and trees from the original reservoir which continue to break off and come to the surface that provide boating hazards.

V. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Specific Comments.

PAGE 5-1. With regard to water quality, the EIS fails to identify potential sources of adverse environmental effects from the raising of Ross Dam. In the Big Beaver Valley, the alluvial soil found therein is not gravelly but contains a large amount of organic peaty material. The Department of the Interior has indicated that serious problems of water quality may exist in reservoirs as a result of the decay of these substances. In that the potential use of the flooded Big Beaver Valley may be great, studies should be completed to identify the extent of organic deomposition of these materials and the amount of organic material which may be expected to decay.

As to land areas which would be flooded, the EIS identifies, on page 5-1, only the Big Beaver Valley as being a significant unavoidable environmental loss. The EIS amazingly ignores some 5,000 acres in Canada which would be flooded. But even in the United States, the EIS does not identify areas which are particularly suitable for recreational development; these areas include the delta of Silver Creek, Rowland Point, Hozomeen Camp, Rainbow Point, Dry Creek Camp, Green Point, and the area at the foot of Pumpkin Mountain. In addition, the raising of Ross Dam would cover five islands in the reservoir itself and the waterfalls at Skymo and Arctic creeks would be flooded to approximately half their height. In addition, there is a significant plant community of old growth Douglas fir / western hemlock forest which lies along the 1.3 miles of the Ruby Creek drainage which would be flooded. This area should be identified and examined in detail especially because of its easy accessibility.

V. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS.

General Comments. As with previous sections of the DEIS, this section again fails to give any consideration to the effects in Canada. No consideration is given to the land or wildlife values in Canada which would be lost because of the destruction of 5200 acres of terrestrial habitat. The DEIS does state that about seven miles of the Skagit River above the reservoir in Canada would be flooded by the waters behind High Ross. Even this single comment is inaccurate. Though seven miles of Skagit River would be inundated as measuring on a line from the U.S. - Canada border to elevation 1725, in fact, the Skagit River in this area meanders such that ten miles of the river itself would be flooded.

This section also suffers from the consideration of only the largest and most valuable individual resources. In fact the value of land around Ross Reservoir, both in the United States and Canada, is its incredible diversity of experience to the recreationist or researcher. The Skagit Valley in Canada contains an abundance of diverse wildlife, which is found in a lush green valley with occasional open meadows toegether with an interesting streamside habitat. The consideration of resources to be lost on an individual basis does not do the valley justice in total aspect.

VI. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

General Comments. The treatment of the subject matter in this section indicates a basic failure to understand the nature of the considerations required by the short-term versus long-term uses. The consideration of the short versus long-term comparison must begin with the underlying fact that the flooding of terrestrial areas around Low Ross Dam will mean an end to their present habitat, which can never be restored. From this thesis, it is necessary to consider the decreasing amount of recreational area of the type found near the Ross Reservoir with the comparative needs of increasing electrical energy. This is fundamentally a question of tradeoffs which requires an in-depth analysis of both recreation need over the long term and the demand for electrical energy in both the short and long term. On all accounts, this section fails to meet the requirements of the National Environmental Policy Act. In fact, this section even begins with incorrect assumptions. The impact statement says that benefits from High Ross will be apparent in terms of power generation, flood control and ecreational use. The fact that the project will result in increased generation of electrical energy is apparent, though the fundamental question is how much and at what time. With regard to flood control, it is apparent that High Ross Dam will result in no additional benefits over Low Ross in that the applicant does not intend to increase the amount of flood-holding capcity over the present 120,000 acre feet. Whether or not recreational use will be benefited by the reservoir is certainly not obvious and the effect on recreational use in Canada is probably a decided detrimental effect.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

General Comments. This section blithely assumes that, should High Ross Dam turn out to be an environmental disaster, the dam can simply be removed and the former resources of the valley be somehow replaced. Though the flooding behind High Ross will of course not change, except in rare circumstances, the land forms behind the dam, the flooding will mean an end to the biotic and wildlife communities which exist on the land. The flooding of, for example the Big Beaver Valley and the Canadian Skagit Valley, will cause these areas to lose all trace of their former habitat and become simply mudflats with a vast brownish-gray expanse. This effect may be seen during drawdown at Low Ross Dam, especially in the northern section of the reservoir. The DEIS also fails to note that prior to raising the dam reservoir, clearing operations will take place which will largely denude the present terrestrial habitat, making the removal of High Ross Dam at a later time a largely useless exercise.

VIII. ALTERNATIVES TO THE PROPOSED ACTION

General Comments. Intervenors will not comment specifically on this section. Specific comments are impossible with regard to the Commission staff's treatment of alternatives because there is a complete lack of any detail upon which comments may be based. This section relies entirely on generalized, conclusionary comments provided entirely without supporting data.

This inability of intervenors to comment is exemplified by the treatment of base load nuclear steam plants as found on page 8-9. The DEIS in some manner comes to an annual cost for such plants to be $10,650,000. Despite the production of this rather definite figure, there is no data given for how such a figure was calculated. For example, what size of nuclear plant is used to calculate this figure? It is generally known that the construction and operation of a thermal nuclear plant on the scale of High Ross Dam is economically not feasible. Rather, nuclear plants are constructed and operated on a scale beginning at a minimum of 100 mw. The construction of a 250 mw nuclear plant would naturally cause estimated annual costs of such a plant to skyrocket. The only feasible construction of a nuclear plant would possibly involve a joint venture between Seattle City Light and other utilities to produce power on an economical scale. None of the above concerns are addressed in the DEIS, leaving intervenors, government agencies and the public without a means by which to evaluate this alternative. The same criticism is true of all of the alternatives suggested by the EIS; all lack detail as to size of plants and a comparison with the energy output of such plants.

In other ways, the alternatives section of the DEIS is insufficient. The DEIS indicates that there are no potential economic hydroelectric sites available to the applicant. However, the alternative of a contract between the federal government and Seattle City Light for the installation of generating facilities on existing federal hydro projects on the Columbia River has not been considered. The extent of available slots for generators in Columbia River dams should also be considered by staff in its analysis of alternatives.

One of the most glaring omissions from the section on alternatives is a thorough consideration of pump storage sites. Recent studies available to the staff indicate that there are in excess of one hundred pump storage sites in the state of Washington which are potentially economically feasible. In addition, specific economic data as to the cost and benefits of such pumped storage plants is available from the FPC files from the application of Chelan County PUD for the Antilon Lake pump sotrage site. Further, the DEIS states that there is a potential unavailability of off-peak energies with which to operate a pumped storage plant. The staff should review the availability of such off-peak energy over the life of the license, with particular regard to those base load plants which will come on line within the planning period. Intervenors note that in the present winter, there is an abundance of secondary energy and several projects on the Columbia River have been spilling water because of the inability to sell or transfer such power.

In addition, the alternative section fails to consider other particular policy alternatives available. First, it is known that the Bonneville Power Administration continues to enter into large scale energy contracts with industry. An example of such policy is the Addy plant of the Aluminum Company of America. The EIS should analyze the policy decision which would provide for the elimination or termination of large scale energy contracts, which, by their energy needs, require the construction of new hydro and thermal plants, Further, the EIS should analyze other alternatives which may constrain the operation of High Ross Reservoir as a power facility. The requirement, in the FPC license, that the Ross Lake Reservoir be maintained at full pool for recreational purposes for a period extending from June 1 to September 15 certainly will affect the outputs of Ross plants. This alternative is not considered in the DEIS.

Energy conservation is briefly mentioned, but is not given thorough treatment. Alternatives for energy conservation should include not only volumtary measures, but forced reduction in electrical energy. Alternatives such as the forced reduction of peak load demand must be considered. On of these alternatives would be the establishment of or installation of peak load metering systems for customers in the city of Seattle. These meters would price power differently for peak and off peak use and would put a premium on the use of peak time power. The pricing mechanism may also be used through a restructuring of the rates of Seattle City Light to reflect increasingly more expensive costs for electric power by additional purchases. The present rate structure of Seattle City Light reduces unit cost for purchase of greater amounts of power. The section on alternatives suffers from the common failing of the DEIS to provide basic studies for evaluation. The DEIS indicates that studies show that the boundary project of the City of Seattle is more expensive than High Ross. However, the studies are not referenced or available to commentors such as the intervenors.

CONCLUSION

As specified in the introduction to intervenors' comments, intervenors believe that this draft environmental impact statement is insufficient to meet the requirement of the National Environmental Policy Act. The complete failure to consider Canadian effects, the failure to describe adequately the outputs of the high dam and the failure to give detail and thorough consideration to alternatives, makes intervenors' conclusion evident. Thus, intervenors suggest that, following the comments of this document, and other comments, a new draft environmental impact statement be prepared and recirculated to allow all commentors the opportunity to comment on a thoroughly prepared draft environmental impact statement.

Respectfully submitted,

J. Richard Aramburu

J. Richard Aramburu

Counsel for North Cascades Conservation
Council et al., Intervenors

December 31, 1973

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL POWER COMMISSION

CITY OF SEATTLE) Project No. 553

COMMENTS OF THE CITY OF SEATTLE ON THE
STAFF'S DRAFT ENVIRONMENTAL IMPACT STATEMENT

In general these comments of the City of Seattle, as Applicant for an amendment to its license in these proceedings, will follow the format of the Staff's Draft Environmental Impact Statement (DEIS). Where possible, however, we will attempt to cover all references to a particular subject in the DEIS in one comment. Page references in the margin are to the Staff DEIS.

At the outset it should be observed that the testimony and exhibits filed by the City on January 29, 1973 provide the background for these comments and should be referred to for greater detail on the City's views. That testimony stands and will not, of course, be duplicated here. Rather, these comments will highlight specific areas for further consideration of the Staff in its final EIS.

Pages 1 to 3 The DEIS notes that the project would result in "significant environmental impacts" in both the United States and Canadian sections of the project area and refers to the IJC report of 1971. A summary assessment in that report of the impact in Canada noted however:

> . . . Measured either by the amount of use, or weighted by dollar values, the overall impact of changes in the total environment is not significantly large. (Report 29)

The DEIS also notes the IJC report as valuable for identifying environmental impacts "which would be expected in Canada." Whether those impacts "would" result should be viewed in light of the IJC's statement that under normal conditions an environmental and ecological study should encompass three full years, whereas the investigation by their advisers was conducted over a period of only four months, from early June to early October 1971, and consisted mainly of an interpretation of raw and sometimes incomplete data collected by others (Report 8). In contrast, the City's studies have now been in process well over the three year period recommended and formed the basis for the four volumes of sworn testimony and exhibits presented last January.

The DEIS appropriately notes (p. 2) that the City's studies do represent the most current studies of the environmental resources in the U.S. section of the area. Those studies are similarly the most current for the Canadian section as well. As the testimony based on these studies shows, rather than a decline in the deer population (IJC Report 16), the deer herd can be increased through providing additional browse area in conjunction with reservoir clearing; and the reservoir fishery may be enhanced by as much as 50% (not worsen, IJC Report 17). The higher lake will increase the food supply available for the fish without reducing the growth rates; further, the majority of spawning activity in the Skagit and in the Klesilkwa and other tributary streams in Canada occurs above the proposed higher lake level of elevation 1725, and the gravels above that elevation throughout the Ross Lake basin will be more than sufficient to handle the enhanced fishery population. The detailed findings by independent experts which support these conclusions concerning the fishery resource in Canada are contained in the International Skagit-Ross Fishery Committee reports cited in the DEIS (p. 3).*

The enhancement of these resources would naturally enhance recreational use of hunting and fishing, rather than lessen it, as forecast by the short term study of the IJC. Thus rather than the damage to the value of recreation in hunting and fishing which the IJC forecast, the enhancement of these resources would bring increased recreational use and a consequent increase in recreational values.

Page 1-1 The description of the present Ross development

*The reference to the November 1972 report should properly be Interim Report No. 1, Vols. I & II; and the May 1973 report should be shown as Interim Report No. 2, Vols. I & II.

should reflect that it presently contains four units (line 5)*, with a dependable capacity at plant of 232 mw (line 6), increasing to 524 mw (line 9) with High Ross. The existing turbines will remain but the runners of the existing turbines will be replaced with new runners (lines 11-12)* to accommodate the increased head.

Page 1-2 Applicant has contracted for 126 mw (line 6) of hydroelectric capacity from others (72 mw from Priest Rapids and 54 mw from Box Canyon). High Ross would add, at plant, 292 mw, which would produce 274 mw and about 305,000,000 kwh of annual energy at Seattle (lines 9-10).

Page 1-6 In discussing reliability it is significant to note that the Ross increment adds capacity on the west side of the Cascade Mountains and is free of the outage problem which can affect transmission through the mountains.

Page 1-22 Transformers will be modified to handle increase in capacity, not to step up voltage (line 11).

*See also these same items on the Summary Sheet.

Page 2-3 The commercial cabin and boat rental development on Ross Lake is leased to a concessionaire by the National Park Service and is not associated with the City(lines 6-9).

Pages 2-18, 2-19 As the testimony indicates there is a substantial amount of detail available on the soils of the area including a soil map for the Canadian portion of the basin. The DEIS discussion of biotic communities notes that only natural forces have shaped the biotic evolution of the basin because logging has never occurred (2-19, line 6). Although no continuous commercial logging has occurred in the U.S. portion of the basin, limited logging was done in some areas between elevations 1600 and 1725 when the present reservoir site was cleared. Extensive logging has, however, continued over the years in the Canadian portion of the Skagit basin and is still being carried on.

Page 2-20 In addition to the College of Forest Resources, University of Washington and State of Washington,Department of Game, the F.F. Slaney Company, Vancouver, B. C. should be recognized as being under contract with the City to do similar studies in Canada and in coordination with these Washington State agencies. (See also 2-22 and 9-2).

Page 2-26 The sightings of elk and mountain goat have resulted in a population estimate by University of Washington researchers of 25 - 50 for goats and less than 10 for elk.

age 2-26 o 2-28 & ppendix D The species of fish noted at 2-27 (last line) do not include golden trout although that species is shown in Appendix D. No golden trout have been found in the Ross Lake basin. The record indicates golden trout were once planted in a high elevation lake in the basin. The rest of the species listed represent all species found present after three years of investigations. It is unlikely any other species are present in Ross Lake, the Canadian Skagit River, or the other tributaries.

The International Skagit-Ross Fishery Committee has not found any suitable spawning gravel at the mouth of Big Beaver Creek (lines 6, 10), and has not listed this site as a trout spawning location in International Skagit-Ross Fishery Committee Interim Report No. 2, Vol. 1. The trout residing in the ponds adjacent to Big Beaver Creek (line 16) are cutthroat.

ages -28 -31 hru -33, -37 Several of these ponds appear to contain no fish at all. This same report has more current, although not greatly different, information on length-weight relationship, mean calculated length and fecundity than the 1971 information given by figures 2-9, 2-10 and 2-11. This report also estimates the Ross Lake rainbow trout population at 206,000.

'ages 2-35, 2-36 Creel data from 1941 through 1970 and the qualification quoted (paragraph 2 and table 2-3) were received directly from the Washington Department of Game and are based on historic data collected by the Washington Department of Game largely prior to the beginning of the coordinated research effort funded by the City.

Pages 2-37, 2-39, 2-58 The Forest Service has had no responsibility for Big Beaver Valley since the establishment of the Ross Lake National Recreation Area by Congress in October, 1968. Although the City worked closely with the Forest Service prior to 1968, the City has never received from, nor been advised by, that agency of any report of the type described. However, similar unofficial comments by one Forest Service employee were offered to Seattle City Council hearings in 1971 on raising Ross Dam. Investigation on behalf of the City reveals that the observations of the Forest Service employee are erroneous. The City investigations included five valleys in the North Cascades National Park. They revealed that there are several stands of western redcedar that are similar to the one which will be partly inundated in Big Beaver Valley by the high reservoir. The City's studies also extended to areas other than the North Cascades. A number of other large stands of western redcedar in the public domain were found, including stands totalling 17,300 acres in Olympic National Park, one of which is over 8,000 acres in size

Page 2-58 The Forest service employee indicated that he did not have sufficient information for deciding whether the Valley was in fact uniquely valuable as a scientific and educational reserve and suggested that a multi-disciplined committee study the Valley to determine whether it might have unique attributes which would lend it to designation as a Research Natural Area. Actually, there are already nine separate western red-cedar stands which receive special recognition for such purposes as nature interpretation, scenic areas and botanical areas. In addition, the City's detailed studies of Big Beaver Valley identified no plant species there which might be uncommon or rare. As for plant communities as a whole, while no two are exactly alike in every detail, all communities examined in the Ross Lake basin, including those in Big Beaver Valley, fall into general categories also found elsewhere. The only unusual ecological item in the Ross basin is the influence of eastern slope vegetation on the west side of the Cascade crest. This influence, however, is not present in Big Beaver Valley, where typically westside vegetation occurs.*

Pages 2-56, 2-57, 3-15, 5-2, 9-3

The data described at pages 2-56 and 2-57 show the extreme high and low temperatures for a period subsequent to the construction of the present Ross Dam and, of course, do not reflect those extremes for any period prior to that construction. The City's studies indicate that the initial stages of Ross Dam have increased the temperatures in the Skagit River as a consequence of releasing impounded waters which tend to be warmer than natural stream flow. The City's studies also show that it is probable that the extreme low in the Skagit River prior to Ross Dam was lower than the post-Ross Dam low. It is thus unlikely that Skagit River temperatures

*For further details see testimony of Drs. G. W. Sharpe and D.R. M. Scott of the University of Washington, filed by the City last January.

at the point six miles below Newhalem will be below "natural" river temperature (3-14) although the City's studies show that at times they will be below present river temperatures.
It is not expected that the historic high temperatures will be changed by the project because the high temperatures result from spilling excess water from the surface of the reservoir, and reservoir surface temperatures are not expected to change.

The City's studies further indicate that the mean water temperatures of the Skagit River six miles below Gorge Dam would be warmer, rather than colder, during the months of January through March with Ross reservoir at elevation 1725. These studies indicate that the increase in mean water temperature would be approximately 1° F. (or 1/2° C.). This indication is in effect reflected in DEIS figure 3-2, at 3-15.

The temperature regime described for existing conditions (p. 3-13) probably shows tailrace water temperatures, as distinguished from powerhouse discharge temperatures, where, as indicated by the City's testimony, the high temperature is reached in October. This is consistent with the DEIS <u>projected</u> powerhouse discharge regime and has been substantiated by additional studies conducted for the City.* Assuming that Figure 3-2 shows tailrace temperatures, it appears that aside from the effects of spilling, that the

*See Reference 1.

discharge temperatures then begin to increase steadily to their maximum in October. Significant spilling does not occur in most years; and there is no consistent pattern as to the years in which spilling occurs or as to the quantities spilled when it does occur. Spilling probably will occur even less often in the future because the opportunity to sell secondary power will increase substantially. Thus, the analysis of river temperature characteristics should be made using the basic temperature profile, derived from powerhouse discharge temperatures, without superimposing the erratic and occasional effects of spilling.

As far as the downstream situation is concerned, six miles below Newhalem, the City's studies indicate that the maximum reduction shown in the DEIS of 3° to 4° F. (p. 3-13) might occur only during August to November. The amount of the change during the greater part of the year would be much less, amounting to 1° F. or less, up as well as down. The resulting temperature regimen will be favorable to the fishery and as a consequence will not constitute an "unavoidable adverse" effect as characterized at 5-2. The City's studies indicate that the "average" reduction would be considerably below either the "less than five degrees" indicated (p. 9-3), or "as much as 3° F. to 4° F." (p. 3-13), probably no more than 2° F. (1°C).

Pages 3-2 to 3-4, 3-11, 4-2, 5-3, 6-3, 9-5

These various references relate principally to recreation in the Ross Lake National Recreation Area and in the adjacent North Cascades National Park, both established by the Congress in 1968 (P. L. 90-544) (p. 1-11). The City based its Exhibit R on the Master Plan of the National Park Service*, and included parking area, boat launching facilities and other accommodations for the general public at the left abutment of the dam at the specific request of the NPS and the Bureau of Outdoor Recreation. The City of course will incorporate or exclude these facilities as it may be directed. It may be noted, however, that such facilities are not out of character in Congressionally designated National Recreation Areas, which were evolved to permit more intensive recreational development for the general public than is normally the case in a National Park. As the DEIS indicates, the Ross Lake National Recreation Area was established with Congressional recognition of the contribution to recreation which the higher reservoir would bring (p. 6-3). At the same time and in the same legislation Congress provided for wilderness values by establishing two wilderness areas totalling almost 1,000,000 acres adjacent to the Ross Lake National Recreation Area of 107,000 acres and the North Cascades National Park of 505,000 acres (p.2-1).**

*The NPS plan proposes three hostels for future development by the NPS (not the City) near Dry Creek, Lightning Creek and Hozomeen (p.3-3).

**Tabulation of acreages on Fig. 2-1 (p. 2-2) incorrectly shows area of North Cascades National Park as 585,000 acres.

Considerations of protecting a wilderness experience within the National Recreation Area, which would in effect restrict its use for the general-purpose recreation intended, should be considered in the totality of the park-wilderness recreation area complex established in 1968.

Page 3-6 The maximum vertical drawdown will be reduced from the present 127.5 ft. to 56.2 ft. with High Ross (paragraph 2).

Page 3-7 The removal of vegetative cover and land clearing (see also p. 9-2) will not in itself have a detrimental effect on all wildlife habitat but, of course, inundation of the land will eliminate terrestial habitat. The City's research, however, indicates that the higher reservoir will push back the snow melt zone to a higher elevation which will establish new winter habitat not considered in the DEIS. The loss by inundation therefore will be somewhat offset by the greater shoreline length and resultant snow melt zone area for the higher reservoir.

Page 3-8 The falls on Big Beaver Creek (last line, see also p. 5-2) will not represent a barrier to spawning fish during the construction period. The investigations show that Big Beaver is an insignificant spawning stream for Ross Lake fish. Fish can be passed around the falls at Lightning Creek (p. 3-9, line 1) with nominal effort.

Page 3-9 Difficulty of access for fishermen during the construction period would of course result in a lower take but at the same time benefit the fish population (line 9: see also 5-2).

Page 3-10, 4-1, 2, 9-2 Raising the elevation of Ross Lake will inundate flowing streams but only certain of these streams and limited lengths thereof are now used by the lake fish for spawning. The significance of these existing spawning areas that will be inundated does not appear to be critical. Generally speaking, the lower reaches of those U. S. streams used for spawning are legally closed to fishing year round and thus do not contribute to stream fishing recreation. Applicant's studies indicate that about two-thirds of the spawners using the Canadian Skagit River and its tributary streams spawn above elevation 1725. There is also much suitable spawning gravel existing above the High Reservoir that is not now being used. The International-Skagit-Ross Fishery Committee Report No. 2, Vol. I, shows that spawning area in the U. S. tributary streams, with nominal stream bed improvement effort, will be increased by approximately 30%.

Page 3-10 The expected reduction of mean water temperatures in the river (paragraph 3) will move river temperatures more closely to the natural river (without reservoir) temperatures, according to Applicant's studies. The temperature regimen which these studies indicate will probably result will delay emergence of salmon fry from the gravels, and will create a spawning environment, for all species of salmon which spawn in the Skagit River below Gorge Dam, which will be more favorable than at present and which will approach the conditions which existed prior to construction of dams on the river. The later emergence of the fry from the gravel will mean emergence more in tune not only with increasing natural stream flows and consequent increase in food supply, but with their arrival in the river mouth estuary during the high flow, high turbidity period. High flows and turbidity in the estuary may be an important factor in minimizing losses due to take by natural predators.*

Page 3-11

Noise from added pleasure craft operation (line 15) will be a factor determined by the NPS, the recreation area management agency, and should be independent of reservoir level.

Pages 4-1, 5-3

The University of Washington study team report says that changes in the shrub successional communities due to natural growth patterns will mean a reduction in deer browse with resultant habitat loss independent of and with greater impact than the raising of the lake. Natural growth patterns of these successional shrub communities can be managed by a combination of cutting, controlled burning and fertilization to enhance deer habitat. Browse can thus be developed to more than offset that lost by flooding.

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* See Reference 2.

Page 4-3 An archaeological survey of the area to be inundated (paragraph 4; see also p. 9-6, paragraph 2) has been completed by Applicant and was forwarded to the Federal Power Commission. The survey covered by the report turned up no significant archaeological finds.

Page 5-2 & 5-3 Comments on the spawning, Big Beaver and Lightning Creek Falls and fishing access covered by 5-3 FISH AND WILDLIFE (5-2) are included in our comments relative to page 3-8 and page 3-9. Temperature regimen changes incurred by the high dam will not, in Applicant's opinion, be an adverse impact, but will create an improved river temperature environment. See our comments to page 3-10.

Page 5-3 While inundation of lowlands around Ross Lake would eliminate some deciduous shrubs and trees, there would be the offsetting effect of a higher snow melt zone as discussed for page 3-7; further, the inundation may have less impact than the natural plant succession event discussed for page 4-1.

Page 5-3 In Big Beaver Valley about one half of the 35 to 40 beavers, not beaver colonies (line 11), will be inundated. The figure is correctly used at page 2-26 of DEIS.

Pages 8-17 to 8-20 On July 17, 1973, Seattle City Light initiated a conservation effort called "Kill-a-Watt . . . a Program for Energy Ethics." This program is aimed at three areas: City Light's own consumption of electric energy, all customer consumption, and research support for projects which highlight new techniques and areas for conservation, more efficient energy use, and new methods of generation. "Kill-a-Watt" is an effort intended to save energy by discouraging wasteful energy use habits and offering positive suggestions for cutting energy consumption.

Seattle City Light believes its "Kill-a-Watt" effort is among the most far-reaching yet attempted. It involves plans for evaluation of major energy-consuming appliances, research into consumer use habits and ways to improve consumer energy practices, and specific outreach programs. City Light has already formed a Consumer Education Unit to work with schools, community groups, and individual customers on the conservative, wise use of electric energy.

The "Kill-a-Watt" program includes a major public information campaign which has resulted in direct contact with industrial and commercial customers, coordination of individual industrial conservation campaigns, special conservation efforts directed at public facilities, conservation advertising, speaking groups, news media attention, distribution of special printed materials* and individual conservation assistance. The initial short-term effect of this program has been a 5-7% reduction in loads. While the long-term effects are difficult to assess because of changing patterns in the total energy picture, even assuming the reduction in 1980 indicated in the DEIS (p. 8-20) the capacity to be produced by Ross High will be required to meet the City's

*See Reference 3.

peak loads well in advance of that time. The nation's energy posture is such that all aspects of energy conservation and development are needed. Any hydroelectric site which is only partially developed results in a waste of resources - good conservation practice requires avoiding such a result. This Seattle proposes to do by completing the Ross project to elevation 1725, the same elevation contemplated in some 11 FPC Orders issued over the period July 23, 1937 to July 14, 1967 which dealt with the first three stages of the project. Ross High will fully utilize major facilities which were authorized and built into the project over this period for ultimate high head operation at elevation 1725. The energy gain to be obtained will be a factor in the region's total energy picture.

Page 9-1, 9-2

Applicant's fishery studies as reported in International Skagit-Ross Fishery Committee Interim Report No. 1, Vol. I and Interim Report No. 2, Vol. I, plus expert testimony submitted to the Federal Power Commission in January, 1973, indicate that even though there will be a reduction in Ross Lake tributary stream mileage, and to a lesser degree a reduction in existing spawning areas, new spawning areas will be opened up providing more than ample spawning opportunity for a larger fish population than at present. Applicant's studies also show that winter range for deer can readily be increased through minor clearing and retardation of plant succession which will offset range areas to be inundated.

The improved aquatic environment and enhanced fishery which will result from the higher lake thus do not mean the reduction of any part of the deer herd.

Page 9-3 As discussed for pages 3-13 to 3-15, the average water temperature for the Skagit River below Gorge Dam will be reduced by probably no more than 2° F. The expected temperature changes will result in a temperature regimen more nearly that of the natural river, and will create a more favorable environment for spawning, incubation and rearing of the anadromous fish stocks.

Page 9-5 As previously noted for page 3-2, the NPS is implementing plans for the 107,000 acre Ross Lake National Recreation Area pursuant to the establishment of the area as an NRA by Congress in 1968. At that same time Congress established adjacent wilderness areas of almost 1,000,000 acres as well as the North Cascades National Park of 505,000 acres. The resulting recreation-park-wilderness complex was presumably intended by the Congress to be operated so that each of these values would be protected in the areas set apart for each.

Page 9-6 An archaeological survey and report (see also p. 4-3) has been prepared by Applicant and submitted to the Federal Power Commission. That report indicates nothing of archeological significance has been noted. The IJC report (p. 93) also noted that the Skagit Valley in Canada was not significant from an archeological or cultural viewpoint and that the Provincial Archeological Sites Advisory Board had not recommended any further work in the area.

REFERENCES

1. King, Ian P. and Orlob, G. T. Simulation of the Temperature Effects of the Proposed Ross High Dam, Water Resources Engineers report to the City of Seattle Department of Lighting 1973.

2. Burgner, R. L. Potential Effects of Temperature Changes on Salmon and Trout with Construction of Ross High Dam. Report to City of Seattle Department of Lighting, December 1973.

3. City of Seattle, Kill-a-Watt, A Program for Energy Ethics, a kit of materials widely distributed by City Light containing a brochure with full details on the program, posters, energy saving recommendations, etc.

Respectfully submitted,

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Special Counsel

December 28, 1973

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon all parties of record in this proceeding in accordance with the requirements of §1.17 of the Rules of Practice and Procedure.

Dated at Washington, D.C., this 28th day of December, 1973.

Signature

1. (DOCKET) ORIGINAL
2. CENTRAL FILES

H-91

THE CITY OF SEATTLE

WES UHLMAN, MAYOR

BOARD OF PUBLIC WORKS

BETTY L. McFARLANE, SECRETARY

303 Seattle Municipal Building • Seattle, Washington 98104 • 583-2040

Re: Ross High Dam

December 19, 1973

Federal Power Commission
General Accounting Office Building
441 - G Street Northwest
Washington, D. C. 20426

P-553

Attention Mr. Kenneth F. Plumb, Secretary

Gentlemen:

The Board of Public Works, in regular session today, reviewed the Federal Power Commission's Draft Environmental Impact Statement on Ross High-Dam.

The Board wishes to reaffirm its position of March 29, 1972, which was directed to the Seattle City Council.

The Board supports the raising of Ross Dam. Extensive environmental, economic and engineering studies have been undertaken by the Department of Lighting since it was authorized in October 1969 to apply for permission to the Federal Power Commission to raise the height of Ross Dam. As we stated in our communication to the City Council, the Board considers that the results of these studies to date indicate that the Project shows promise of providing the needed addition to Seattle's future energy requirements and consideration of the alternatives to utilizing this energy source indicates that it is the least damaging to the environment.

It is, therefore, our recommendation that the Project be approved.

Yours very truly,

BOARD OF PUBLIC WORKS

Alfred Petty

Alfred Petty
Chairman

BLM:lm

cc: Mayor Wes Uhlman
City Council Members
Board of Public Works Members

RECEIVED
JAN 21 3 25 PM '74

H-92

OFFICE OF THE MAYOR · CITY OF SEATTLE

WES UHLMAN MAYOR

December 28, 1973

RECEIVED
JAN 25 1974
DIVISION OF LICENSED PROJECTS

Mr. Kenneth Plumb, Secretary
Federal Power Commission
General Accounting Office Building
441 G Street Northwest
Washington, D. C. 20426

Dear Sir:

I appreciate the opportunity you have given the City of Seattle to extend comments on the Draft Environmental Statement on the proposed "Ross Development of Project No. 553 Skagit River, Washington".

Pursuant to established procedures, the Department of Community Development holds the general responsibility for coordinating such comment activities for the City of Seattle. It has circulated the draft statement to various City departments and compiled a report reflecting the various points raised. I am enclosing for you a copy of the response developed by the Department.

You will also be receiving a comment on the draft statement by the Department of Lighting of the City of Seattle, as the applicant before your Commission. Those comments were among those reviewed by the Department of Community Development.

The proposal to raise Ross Dam dates back several years and several City administrations. When I took office in the fall of 1969 I initiated a thorough-going review of the entire proposal. I concluded that raising Ross Dam would not sufficiently contribute to providing a solution to Seattle's need for additional electrical power to outweigh the negative impacts on wilderness and recreational resources of the higher reservoir. I then directed the Superintendent of the Lighting Department to withdraw the application for High Ross.

However, a majority of the City Council did not agree with my evaluation. Following public hearings they directed, by ordinance, the filing of the application. Thus, in this matter, the Lighting Department acts independently.

FEDERAL POWER COMMISSION
DOCKETED
JAN 21 1974
DOCKET SECTION

of the policies of the executive.

I hope the enclosed remarks will be useful to you in drafting the Final Environmental Statement.

Sincerely yours,

Wes Uhlman

Wes Uhlman
Mayor

WU:do
Enclosure

CITY OF SEATTLE
DEPARTMENT OF COMMUNITY DEVELOPMENT

MEMORANDUM JAN 21 3 18 PM '74

FEDERAL POWER COMMISSION

December 28, 1973

To: Wes Uhlman, Mayor

From: James Braman, Director, Department of Community Development

Subject: Comments on Draft Environmental Impact Statement, Ross Development of Project No. 553

All City departments have been given an opportunity to review the referenced Draft Environmental Statement. Their comments raise several points which should be discussed further in the Final Environmental Statement.

The review of the Lighting Department has identified several items of numerical or factual inaccuracy. It is our understanding that the comments of the Lighting Department will be forwarded to the Federal Power Commission independently, so those items will not be repeated here.

The environmental losses of the proposed action are principally a reduction in wildlife and fisheries habitat, a reduction in de facto wilderness and public recreation space and a potential change in the nature of the public use of Ross reservoir. The benefits of the proposed action are an increase in the peaking power generation capability of the Lighting Department and a slight lowering of downstream temperatures. Whether or not there is an increase in reservoir recreation uses is not clear.

The benefits of the raising of Ross Dam are clearly stated in the draft statement. The High Ross project would increase the generating capacity of the Lighting Department by about 275 megawatts, or roughly 20%. It would increase the total energy available by, at minimum, 295,000,000 kilowatt-hours annually.

The report goes on to relate these figures to the estimated needs and capabilities of the "West Group", sixteen public and private power companies operating in Washington, Oregon, Idaho and northern California. These figures rest on projections of past experience and are therefore open to argument. Some would argue that the experience this past fall demonstrates that a continuing load growth is neither inevitable nor desirable, and that projections based on no load growth may be as self-fulfilling as projections based on growth. Others will argue that the continuing rise in petroleum prices and the coming shortages in natural gas will shift substantial numbers of users to electricity and these require almost unimaginable increases in electric power capability in future years. While the former may indeed be true over the near term, the latter is most certainly true over the long term.

As a fraction of the 142,200,000,000 kilowatt-hours of energy estimated available to the West Group in 1977, High Ross represents about .2% (less than 1%). In fact, the FPC estimate of excess of capability over needs (assuming a 7% average annual growth in demand) is 8,200,000,000 Kwh, or thirty times the output of the High

Ross addition. This estimate does not include the surpluses which are anticipated in British Columbia in the same time period.

The "costs" of the proposed action are not as clearly stated in the draft statement. In particular the statement does not discuss the loss of de facto wilderness in the Big Beaver valley or the loss of recreation space in the Canadian Skagit valley.

The Federal Power Act requires that inundation of land in a reserve, withdrawn from the public domain, must not be inconsistent with the act establishing the reserve. The report of the Senate Committee in reporting S.1321, 90th Congress, made the following observation regarding power project proposals in the Ross Lake National Recreation area (at pg. 31):

> "Court decisions on recent controversies, particularly on High Mountain Sheep and Storm King issues, have indicated that the FPC must take into consideration the aesthetic and recreational potential of sites before granting licenses for power projects. While this application is pending and if the FPC should deny the license, the National Park Service should exercise its discretion to administer this 3,500 acre basin in much the same manner as it would if the basin was within the park. (emphasis added)"

Later, Senator Henry Jackson, the author of S.1321, was quoted in the Seattle Post-Intelligencer (November 16, 1969) as follows:

> "Senator Henry Jackson said yesterday Congress has not approved Seattle City Light's proposal to raise Ross Dam in the North Cascades area.
>
> On the contrary, City Light probably will have to provide more proof than ever for the necessity to flood valuable ecology in the Ross Dam area, the Senator said."

Thus, the Congressional mandate which must be examined by the FPC to meet the statutory requirements is at least the stated purposes of the Ross Lake National Recreation area ("the public outdoor recreation use and enjoyment . . . and . . . the conservation of the scenic, scientific, historic and other values . . .") and may include the stated purposes of the North Cascades National Park ("to preserve for the benefit, use and inspiration of present and future generations . . . ")

Such an examination must also include an examination of wilderness values, as established by the de facto wilderness case, Sierra Club vs. Butz. The Congressional mandate is set forth in the Wilderness Act (Public Law 88-577):

> "In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations an enduring resource of wilderness."

The author of the High Mountain Sheep court decision referred to by the Senate Committee above, Justice William O. Douglas, expanded on this theme in his Forward to The Wild Cascades:

"Our time, in America, is pivotal in regard to wilderness. Pockets of wilderness remain--bypassed and surrounded by the waves of civilization. But those islands are now in the mopping up stage. Roads are moving inward on these surrounding pockets, up a valley here, over a mountain there, along rivers. Yet though these pockets of wilderness are small by comparison with the frontier days when most of the continent was wild, until very recently--and strongly in the memory of many of us--they seemed very large and indestructible by virtue of their size and because they were rugged and forbidding.

Two alarming things are happening. First, the pockets of wilderness have been eroded at an increasing rate, with the help of our new technology. Second, as the population rises and the crowding intensifies, the need for wilderness grows. And looking forward into the years of the yet-uncontained population explosion, we can see that before control devices become operative (as they must become, or the whole question of wilderness becomes moot, and all our heirs will live in tall apartment houses and Central Park will be the wilderness prototype) the population will reach a point where far more wilderness is needed than is now planned to be saved.

Today we look backward to a time when there was more wilderness than the people of America needed. Today we look forward (and only a matter of a few years) to a time when all the wilderness now existing will not be enough.

It would, I think, be wise right now to stop all new roadbuilding into wild lands, all damming of wild rivers, all logging of virgin forests. The Americans of 2000 A.D. will thank us if we take that course.

If we do not preserve the remaining samples of primitive America, we will sacrifice traditional American values, the values of frontier America. Not every citizen goes to the wilderness--and they did not even 300 years ago. But so long as there is the presence of wilderness and the option of going to see it, a certain number of citizens do go there and bring back a message for their fellows. As long as that continues we will retain a historic connection with the past of our nation--and our race.

To repeat, what wilderness we decide to save within the next critical decade or two of decision-making will be all we will ever have. Probably it will not be enough. Probably it will be necessary, during the next century, to institute a program of reconstructing wilderness--that is to say, of setting areas aside and leaving them absolutely alone, after first removing such evidences of human "culture" as can be removed. We can evacuate the sheep and people and let the grass grow. But only nature can rebuild the ecological community proper to that individual area, and this takes many, many years--in some places, centuries. It will not happen at all if man has removed and destroyed building blocks without which there can be no complete restoration. For all our science and technology, there is undoubtedly far more that we do not know about the critical elements of an ecosystem than we have yet learned.

The Northern Cascades happen to include a number of pockets of wilderness that for one reason or another have been bypassed, but are now under threat. Some say there is too much wilderness in the state of Washington. Parochial people say that Washington has so much that saving a certain percentage is enough. The wilderness of the North Cascades ia a national resource of the future, not merely a local commodity, and we need it all, as a nation."

The flooding of Big Beaver valley represents a significant penetration into the de facto wilderness of the Pickett range and should be viewed with the same eye that one would view a proposal to construct a road five miles long and make a 1,250 acre clear-cut in any other de facto wilderness. The draft statement reveals no examination of this issue by the FPC staff.

Nor does the draft statement reveal any examination by the FPC staff of the recreation resources of the Canadian Skagit. In fact, the statement seems to deliberately ignore the Canadian Skagit area in almost all discussions. The National Environmental Policy Act, however, clearly requires an extra territorial outlook and Section 102(E) imposes such as a responsibility on the FPC.

That the loss of recreation resource would be great has been demonstrated by the Skagit Valley Study Group of the University of British Columbia. While the Group makes no pretensions to having conducted a definitive study, the conclusion that the Canadian Skagit "is indeed a significant [recreation] resource in the context of the Lower Mainland Region" is well supported. Their report, The Future of the Skagit Valley, carefully examines the recreational supply and demand in the Lower Mainland of British Columbia, particularly as it relates to the Vancouver metropolitan area. Their studies found "few areas of accessible, level land, rich in scenic and wild life resources" and an ever increasing demand for just such resources. Their study evaluates the recreation resources in the valley and proposes a development scheme to include nature study, fishing, hunting, camping, hiking, canoeing and beach activities development.

Their conclusions have obviously found support in the government of British Columbia, for a provincial park has been recently announced which encompasses the entire valley, including the portion proposed to be flooded.

The attitudes of the government of British Columbia and the government of Canada are strangely not recognized by the draft statement. They have been plainly expressed, most recently in a unanimous vote of the House of Commons. Briefly put they are "that the flooding of the Upper Skagit Valley in Canada should not take place".

The complete disregard for the existence of this dispute between the government of Canada and the Department of Lighting is doubly strange when one observes that the Charter of the United Nations (Article 33) imposes on the United States, and thus the Federal Power Commission (through Article VI, Section 2 of the Constitution) the duty to "seek a solution by negotiation, enquiry, mediation, conciliation, arbitration, judicial settlement, . . ." Recognition of the existence of the dispute would appear to be a minimal first step in the path to an amicable solution.

Two last points merit some attention in the Final Environmental Statement. First, the calculations on the economic cost of the High Ross addition do not appear to take into account the cost of the land to be flooded in the Ross Lake National Recreation Area. While no charge is actually being made, a value should be imputed for it will deny to the people of the nation their use of the land and does constitute a "taking".

Finally, the requirement that the Federal Power Commission act pursuant to a "comprehensive plan for improving or developing a waterway" would appear to require the existence of a comprehensive plan for the river, with the power development project one element in an overall scheme. Indeed the draft statement does recognize downstream problems although it does not discuss the proposals for the inclusion of portions of the Skagit in the Wild and Scenic Rivers System or the proposal to construct a nuclear power plant on the Skagit near Mt. Vernon.

In land use planning law the term "comprehensive plan" and its relation to the rest of the planning process is clearly defined. Department staff investigated the legislative history of this provision in the Federal Power Act to determine if the same concept should apply here. Our investigation revealed no reference to this particular section when these amendments to the Federal Water Power Act were debated in Congress. The Public Utilities Holding Companies provisions and the historic speeches of Senators Norris and Borah completely occupied the nation's attention. During the House hearings one comment by staff on this provision indicated that the purpose was to extend to the Federal Water Power Act the lessons learned in the TVA debates. The report of the House Military Affairs Committee on the TVA legislation saw that effort as more than a series of navigation and power projects and envisioned TVA "encouraging and guiding . . . . the orderly and balanced development of the diverse and rich resources of the region." The Committee credited the earlier Inland Waterways Commission with spelling out the basic principles which TVA was built upon. A river, they said, was "essentially a unit from source to sea."

This historic background, coupled with the broad Congressional mandate ("use or benefit of interstate or foreign commerce, for the improvement and utilization of water power development, and for other beneficial public use, including recreational purposes . . .") and the requirements of the National Environmental Policy Act (particularly Section 102(A)) seem to imply that the development of a broad comprehensive plan for the entire Skagit River, built on the policies of not only the Federal Power Act, but also the Wild and Scenic Rivers Act and other recent legislation, is necessary prior to consideration of this application.

We would note, in closing, that <u>not</u> constructing the High Ross addition at this time preserves this option for future generations. Constructing it now forecloses the opportunity for choice among the various costs and benefits for an extremely long time.

JB:do

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JAN 9 1974

P-553

Dear Mr. Plumb:

This is in reply to your letter of October 24, 1973, requesting our review and comments on the draft environmental statement for the Ross Development for FPC Project No. 553, Skagit River, Washington. This project is located within the Ross Lake National Recreation Area which is administered by the National Park Service. Our comments follow.

In the Summary, page ii, it should be pointed out that environmental impacts (5) and (6) will probably occur whether or not the dam is raised.

1. DESCRIPTION OF THE PROPOSED ACTION

Following the paragraph concerning a proposed recreational development plan, page 1-8, it would be appropriate to include a paragraph outlining the intent of the applicant to provide compensatory measures for fish and wildlife losses anticipated with the project. Although such measures could not be described in detail at this time, an intention to implement any feasible plan found satisfactory to all involved State and Federal conservation agencies should be indicated.

With regard to clearing the reservoir site up to elevation 1, 727 (1-26, par. 2) it is indicated that the felled material would be floated by the rising reservoir. If it should be floated as described, particulate and organic debris washing from the felled material could cause water quality problems, ultimately affecting aquatic life. These problems constitute impacts and should be fully covered in Section 3 and Section 4 or 5.

We are very concerned about any Copper Creek regulating structure (1-33, par. 1), its relationship to the proposed High Ross project, and their combined effects on fish and wildlife resources. If consideration of this possible development should proceed beyond the mentioning stage, we presume we would have an opportunity to review and comment on the plans.

On page 1-7, second paragraph, it should read, "normal maximum pool elevation of 1,725.0 feet" rather than "1,275.0 feet."

On page 1-11, second paragraph, Hope, British Columbia, is located 40 miles by road northwest of Ross Lake, rather than 35 miles.

The map on page 1-17 needs to be corrected--three existing NPS facilities are missing, two NPS facilities designated as proposed are existing, and one NPS facility marked to be inundated will remain.

Fourteen public campgrounds operated by NPS would be inundated by the proposal rather than nine, as stated on pages 1-18 and 2-3.

Page 1-18, paragraph 1--Restrooms will also be included in the development at the left abutment of the dam.

On page 1-20 in Table 1-2, the length of the existing reservoir is stated as 22 miles, but on page 2-3 the reservoir is said to be 24 miles long.

Page 1-23, third paragraph--it should be pointed out that the Crane Gravel Bar is located on land administered by Seattle City Light.

Page 1-23, fourth paragraph--a recommended borrow pit is said to be located near Colonial Creek on land administered by NPS. However, the NPS has not given permission for gravel to be removed from this area.

We think there should be more discussion of the unique Big Beaver Valley ecosystem in Sections 2, 3, and 4. The adverse effects which would result from the inundation of this area should be clearly stated. It should also be pointed out that since the ecosystem cannot be duplicated elsewhere there is no mitigation possible.

2. DESCRIPTION OF THE EXISTING ENVIRONMENT

Although the environmental statement mentions gouge-filled shear zones associated with some of the joints at the dam site (p. 2-13), there is no discussion of the possible age or extent of movement or of any implications for the safety of the dam and reservoir. Since the age of the Custer gneiss cut by the shear zones is variously described in the environmental statement as "Cretaceous and older" (p. 2-11) and "Pre Cretaceous" (fig. 2-6), the age of the movement cannot be determined without additional data. However, the history of geologically late tectonic activity in the Cascada Range points up the need for a full discussion of these matters, including regional as well as local faulting, in the environmental statement.

A considerable weight of water will be added to the reservoir area with the completion of the proposed project. There is a need in the statement for adequate discussion of the potential for earthquakes resulting from the loading of the reservoir area.

We note the following errors in the text:

Page 2-53, table 2-8, line 3: The item "total discharge (ac. ft.)" should be "average discharge (ac. ft./yr.)".

The table lists streamflow data for the period of record and values given are not the total discharge for the period of record. The values for this item are also in error. The average discharge for the Skagit River above Alma Creek (1950-72) is 4,126,000 acre-feet per year. (The value sited in the table--5,215,000--is the total discharge for the 1972 water year). The average discharge for Big Beaver Creek is also in error. It is 299,900 acre-feet per year for the period of record.

Page 2-53, table 2-8, line 6: The main discharge for the Skagit River above Alma Creek (1950-72) is 5,695 cfc.

Page 2-54, line 13: "October 1962" should be change to "November 1972."

Page 2-54, line 18: The average annual discharge for Big Beaver Creek is 299,900 acre-feet per year.

Page 2.55, line 5: The maximum stage of Ross Reservoir at the international gaging station near Hope, B.C., was 21.37 sometime between August 6 and August 23, 1972.

Estimates of the deer population that would be affected by the project, and the winter range that would be flooded (2-23, par. 1 and 2) are somewhat short of ours. Our population estimates run closer to 800-850, and the amount of winter range that would be affected by the proposed reservoir closer to 40 percent.

Although the Bureau of Sport Fisheries and Wildlife is listed as a participating agency in the International Skagit-Ross Fishery Committee (2-27), the Bureau did not concur in the committee report because it believed there was insufficient evidence to support many of the conclusions concerning project impact on fish resources in the system.

The species of trout residing in Big Beaver Valley ponds (2-28, par. 2) should be identified as being cutthroat, and their unusual size and quality should be mentioned.

Page 2-3, first paragraph--Although there were ten campgrounds, totaling approximately 17 acres in existence when the applicant's Exhibit R was prepared, the NPS has since developed five more, resulting in a total of 15 campgrounds, totaling approximately 25 acres. The five new campgrounds should be added to Figure 2-3 on page 2-5 also.

Page 2-3, first paragraph--A third bridge is under contract across Big Beaver and will probably be built during the summer of 1974.

Page 2-7, paragraph 1--There is no bus service to Concrete. A passenger steam railway is being planned between Sedro Woolley and Concrete.

Page 2-26, second paragraph--Are there an estimated 35 beavers or 35 beaver colonies in Big Beaver Valley? The same question is applicable on pages 3-7 and 5-3 also.

Page 2-40, first paragraph--Greater economic development should be generated in Skagit County than Whatcom County because larger portions of Whatcom County are federally owned.

Page 2-55, first paragraph--Only Concrete has a small water supply system.

The City of Seattle's original application for amending FPC license No. 553 was reviewed by the Bureau of Mines on June 22, 1971. At that time we had no knowledge of any economic mineral deposit within the proposed reservoir site. We do not have any new information that would alter this assessment.

3. Environmental Impact of the Proposed Action

As a general comment, the final statement should contain substantial additional detail on the many impacts identified in this section. Narrative phrases such as, "a major impact," "would increase," "would alter," "large volumes," "would be less," "would result in more," etc., provide inadequate assessments on the significance and degree of impacts to be expected. This type of narrative approach only leaves reviewing agencies and the public asking questions such as:

1. How and how much would the proposal affect the economies of surrounding areas of private land?

2. Since it is mentioned, what is newly opened State Highway 20's relationship to raising Ross reservoir, how much has traffic increased, and what has its economic impact been?

We believe availabe data and reports offer specific and quantitative answers to these and many other questions on overall project impacts. In addition, a graphical or quantitative method (several have been developed) for impact assessment would be a substantial improvement over the mostly narrative approach in the draft statement. One basic method is to plot resources vs. proposed actions on a matrix and numerically rate the relative significance of identified impacts.

Subsection 3.2, Recreation, pages 3-2 to 3-4, speaks of two impacts resulting from the proposed FPC licensing action which need consideration. One is the impact of raising Ross Dam and Reservoir and the second "...results from the National Park Service's (NPS) administration of the lands surrounding the project as a National Recreation Area for high-intensity public use." The final statement would be improved if it focused primarily on impacts of raising the reservoir and secondarily on impacts of future intensive recreation use. It should be pointed out that:

1. NPS's general plans for administering the Ross Lake National Recreation Area (NRA) are proposed to be implemented whether or not Ross Reservoir is raised. In fact, without a rise in reservoir elevation the National Park Service would have greater options to expand recreational facilities at better locations. A statement pointing out that the National Park Service can implement their recreational development plans without the proposed project should be included here.

2. The recreation facilities to be developed by the Applicant and managed by NPS could in all probability be included in an Exhibit R for relicensing the existing project when its license expires in 1976.

It appears the impacts of intensive recreational use in the NRA may come to pass, regardless of FPC's action on the application for amendment of license. We suggest, therefore, that the final statement identify impacts of NPS administration as secondary effects of the proposed licensing action.

The final statement should include more detailed information on the primary impacts of raising Ross Reservoir on recreational resources and opportunities. How many acres suitable for recreation development would be flooded and how many would become available at the higher lake elevation? Would the recreation use capacity of Ross Lake NRA be diminished or increased? Additional quantitative information on recreation-related impacts is available and should be included in the final statement.

Page 3-3, second paragraph--Of the 15 NPS campgrounds along the reservoir, 14 would be inundated. In the third paragraph, same page, the three hostels are proposed by NPS and not by the applicant.

Page 3-4, paragraph 2--We feel it should be pointed out that the road between Ross Lake and the North Cascades Highway is proposed to provide an access for boat launching.

Page 3-7, fourth paragraph--We estimate that 75 percent or more of the best beaver habitat in Big Beaver Valley would be inundated--not 50 percent as stated.

Page 3-11, last sentence--"The possible increased use of rough terrain vehicles and motorcycles, unless prohibited, would also alter the wilderness-type environment of the area." We feel this is not a significant factor.

We suggest that the word "would" in the last sentence on page 3-6 be change to "may." There are clear examples of severe shoreline deterioration in the existing reservoir, which would indicate to us that the shoreline vegetation stabilization is not as easily attained as projected. Many small slides have occurred due to slippage and undercutting of banks by wind and wave action. In our view, regardless of the plant communities along the shoreline, slippage, slides, and wave action will continue to cause erosion until the slopes of these banks decrease enough to allow soil stabilization.

Subsection 3.4 (3-7) suffers from oversimplification. "...little survival of the least fit individuals..." connotes the loss of a small number of diseased animals--a healthful situation. In fact, the result of imposing additional animals on an area occupied by stabilized populations would result in a general loss of vigor and subsequent loss of at least as many animals as are displaced. Habitat may be damaged in the meantime, and the affected area's former carrying capacity might not be recovered for some time. The loss of deer winter range would be even more serious. The size of a deer herd is limited by the number and vigor of animals that are able to survive the winter season. Crowding results in range deterioration and an increase in the rate of winter loss. This is the place to make these phenomena clear.

The effects of inundating Big Beaver Valley beaver ponds and the subsequent loss of the cutthroat population there have not been discussed in Subsection 3.5 (3-8, 9, 10). Competition by other species introduced through flooding would eliminate this unique cutthroat stock. This should be covered. Problems of public access and navigation hazards caused by tree stumps (3-9, 2nd full par.) could be resolved without a rise in reservoir level. Those options exist with the reservoir at its present elevation. The last paragraph (3-10) should be expanded to adequately identify the detrimental effects of low water temperatures on survival of anadromous fish eggs and fry. Under certain conditions, such temperatures could conceivably cause total mortalities, eliminating entire anadromous stocks.

The first paragraph on page 3-13 states that increased pollution from an increased use of motor boats will be minor. We feel this point should be investigated further. Data is available and should be presented to indicate the degree of water pollution that can be expected rather than an unsupported statement with a conclusion of a minor degree of pollution.

4. MEASURES TO ENHANCE THE ENVIRONMENT OR TO AVOID OR MITIGATE ENVIRONMENTAL EFFECTS

We have certain misgivings concerning this section. The expected accomplishment of each of the measures proposed under that section should be identified. One of our major concerns is the loss of deer winter habitat, and we have no idea what part of our problem would be relieved by measures designed to "...enhance successional communities..." We seriously doubt that a habitat manipulation program (4-1, par. 2) could compensate for animal losses in Ross Basin. In our view, weather conditions and physiographic features of the Basin limit options for increasing the carrying capacity of some two-thirds of the present deer wintering range to the point that it would adequately support the present population. Even if it were possible, there are no specific detailed compensation plans mentioned in this statement, nor have any been analyzed and approved by concerned State and Federal agencies. Further, it is not clear whether such plans would be desirable and/or compatible with National Park Service plans for recreational development and use.

We see no way that the unique ecological values of Big Beaver Valley can be replaced. The fact that stands of western red cedar and California rhododendron, both of limited distribution, are found in other locations in no way resolves the question of preserving these species in Big Beaver Valley. On page 4-2, transplanting of rhododendrons is mentioned. This may not be practical. Are areas known where this species can survive? It is said to be a rare plant species, so a suitable habitat may be difficult to locate. However commendable the effort, we cannot visualize a rhododendron transplant program that would compensate for the California rhododendron stand that the project would destroy. We note that such is not claimed.

According to our calculations, 620 acres or 64 percent of the western red cedar in the valley will be lost, and with it, habitat for several species of raptors and their prey. This value apparently has been ignored. We believe the specific details regarding fish and wildlife and related habitat in Big Beaver Valley has been inadequately treated.

The archeological survey of the area to be inundated has already been accomplished. On page 4-3, paragraph 4, mention is made of a future survey.

5. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Siltation and turbidity (5--1, par. 2) that would occur as a result of clearing the reservoir site also should be accounted for.

The hazard of tree stumps (5-2, par. 3) need not be unavoidable. These stumps could be removed during winter drawdown of the existing reservoir. The loss of the Big Beaver Valley cutthroat trout population and the unusual wildlife values associated with the beaver ponds, marshes, meadows, and adjacent uplands, in addtion to those values touched upon, would be unavoidable and should be covered in this section.

The Eastern Brook trout would not be affected--in contrast to the statement in the first paragraph on page 5-2. Section 5.3 does not mention the resident cutthroat populations in the Big Beaver ponds.

6. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

"Recreation," as used throughout this section obviously is intended to apply only to non fish and wildlife related activities. This distinction should be made clear.

We agree that it would be technically difficult to return the area to near-natural conditions (6-2, par. 3), and we believe perspective would be improved by some reference to the time-frame for such a return following inundation for at least 500 years.

Pages 6-2--It should be pointed out in the first paragraph that access to the lake will be developed whether the dam is raised or not.

7. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

There is an important concept missing from this section. The fish and wildlife productivity foregone during the life of the project, and for as long afterward as would be required to reestablish natural conditions, would be lost forever; hence would be irretrievable. This should be covered.

Section 7 should include the fact that resident cutthroat trout populations in Big Beaver Valley ponds would be lost and an important gene pool destroyed. The Big Beaver Valley ecosystem is an irreversible and irretrievable commitment of resources which is not mentioned in this section.

8. ALTERNATIVES TO THE PROPOSED ACTION

This section considers a broad variety of alternative means for generating power. The additional alternative of raising Ross Reservoir to a lower elevation than the proposed 1,725.0 feet also needs consideration. A concise analysis of environmental effects and economic aspects of raising the reservoir only to the 1,660 or 1,700 foot elevations, for example, is needed. A comparison of environmental impacts for raising the reservoir to two or three different levels would improve the statement.

We take exception to considering the baseload plants as an alternate to the High Ross Plant, particularly as related to the manner in which the comparison is prepared.

The High Ross Plant addition has about a 14 percent plant factor. The baseload oil-fired steamplant and nuclear steamplant alternatives have been calculated assuming the same plant factor without taking into consideration any benefits that would be achieved from their higher plant factor capability. This fact was pointed out in paragraph 8.3 "Baseload Oil-Fired Steamplant" in the first sentence:

> "The advantages of a baseload cil-fired steam electric plant alternative are that it would add a high load factor power source to the system and could be used to firm dump and secondary hydro energy in the Pacific Northwest."

Our review indicates that even if these benefits were added to the baseload oil-fired steamplant and the baseload nuclear steamplant, they could still be higher costs than the High Ross addition. However, if a similar application is made in other instances, the reverse could be true.

Our analysis of the alternative gas turbine and alternative combined cycle plant indicated a somewhat lower annual cost than that developed by the Federal Power Commission. However, they are also higher than the High Ross annual costs.

9. STAFF DISCUSSION OF SIGNIFICANT ENVIRONMENTAL MATTERS

Subsection 9.2, Recreation, states: "...Staff is concerned that the existing wilderness quality of the area could change with additional access to the Lake and would recommend that future recreation planning and development protect the near-wilderness experience which is now enjoyed by visitors to Ross Lake." This comment needs clarification since use of the term "wilderness" might confuse reviewers and the public who are not acquainted with the Skagit River project. The FPC Staff should understand that Ross Lake is a man-made reservoir, subject to extensive seasonal drawdown, and does not qualify as an area for wilderness management. However, part of the slopes above the lake surface are proposed for inclusion within the wilderness proposal for North Cascades National Park, Lake Chelan National Recreation Area, and Ross Lake National Recreation Area. This proposal has been recommended by the President to the Congress.

Sincerely yours,

William A. Vogely

Acting Deputy Assistant Secretary of the Interior

Honorable Kenneth F. Plumb
Secretary
Federal Power Commission
Washington. D.C. 20246

DEPARTMENT OF STATE
Washington, D.C. 20520

RECEIVED
NOV 28 1973
SECRETARY'S OFFICE

NOV 27 1973

RECEIVED
DEC - 6 1973
DIVISION OF LICENSED PROJECTS

Mr. John N. Nassikas, Chairman
Federal Power Commission
825 N. Capitol Street, N.E.
Washington, D. C. 20426

Dear Mr. Chairman:

The Canadian Government on November 15 delivered to our Embassy in Ottawa the text of a resolution relating to the flooding of the Canadian Skagit River Valley which had been passed by the Canadian House of Commons on November 2. The Canadian Government did this pursuant to the terms of the resolution requesting that it be forwarded to the Government of the United States, the Government of the State of Washington, and the Council of the City of Seattle. The resolution was adopted under the unanimous consent procedure of the House of Commons, which provides that a motion may be made and, if no member expresses objection, adopted without further deliberation. It therefore is to be taken as an expression of an opinion of the members of the House of Commons which does not have the force of law. The text is as follows:

> "That the House of Commons of Canada is unalterably and unanimously opposed to the flooding of the Canadian Skagit River Valley which will result from the proposed City of Seattle project to raise the height of the present Ross Dam situated in the State of Washington and downstream from the Canada-United States border; and
>
> That this House further resolves that the Government of Canada deliver the text of this resolution forthwith to the Government of the United States of America, and Government of the State of Washington, and the Council of the City of Seattle."

The Department of State has forwarded copies of the text to the Government of the State of Washington and to the Council of the City of Seattle. By this letter I am forwarding it to you, together with the record in Hansard relating thereto, for the attention of the Federal Power Commission. This material is forwarded for your use and consideration, and there is no limitation on its use.

Sincerely,

Rufus Z. Smith

Rufus Z. Smith
Deputy Assistant Secretary
for Canadian Affairs

Enclosure

Copy of November 2, 1973 resolution

[*English*]

PROTEST AGAINST FLOODING OF SKAGIT RIVER VALLEY BY PROPOSED HIGHER DAMS—REQUEST FOR UNANIMOUS CONSENT TO MOVE MOTION

Mr. John A. Fraser (Vancouver South): Mr. Speaker, pursuant to Standing Order 43 I rise to propose a motion of pressing and urgent necessity arising from the refusal of the city of Seattle in the state of Washington to cancel the proposed plan to raise the height of the Ross dam on the American Skagit River which will cause the flooding of the upstream Canadian Skagit River valley contrary to the protest against such flooding delivered by the government of Canada to the Seattle city council on March 31, 1972.

Recognizing the contribution of the hon. member for Kamloops-Cariboo (Mr. *Marchand*) who generously offered to join with others in seconding this motion, with unanimous consent I therefore move, seconded by the hon. member for Fraser Valley West (Mr. Rose):

> That the House of Commons of Canada is unalterably and unanimously opposed to the flooding of the Canadian Skagit River valley which will result from the proposed city of Seattle project to raise the height of the present Ross dam situated in the state of Washington and downstream from the Canada-United States border, and
>
> That this House further resolves that the government of Canada deliver the text of this resolution forthwith to the government of the United States of America, the government of the state of Washington, and the council of the city of Seattle.

Some hon. Members: Hear, hear!

Mr. Speaker: The hon. member's motion is proposed under the terms of Standing Order 43 and requires the unanimous consent of the House. Is there unanimous consent?

Some hon. Members: Agreed.

Mr. Speaker: Is there unanimity?

Some hon. Members: Agreed.

Mr. Speaker: Is it the pleasure of the House to adopt the said motion?

Some hon. Members: Agreed.

Motion agreed to.

* * *

FINANCE

STEPS TO PREVENT EXCESSIVE PROFITS—REQUEST FOR UNANIMOUS CONSENT TO MOVE MOTION

Mr. Terry Grier (Toronto-Lakeshore): Mr. Speaker, I ask leave of the House under the provisions of Standing Order 43 to move, seconded by the hon. member for Scarborough West (Mr. Harney):

> That the Minister of Finance make a statement on motions indicating what steps the government plans to introduce to prevent excessive profits being made.

Oral Questions

Mr. Speaker: This motion also requires unanimous consent. Is there unanimous consent?

Some hon. Members: Agreed.

Some hon. Members: No.

Mr. Speaker: There is not unanimity and the motion cannot be put.

* * *

ENERGY

OIL EXPLORATION AND DEVELOPMENT IN EASTERN CANADA—REQUEST FOR UNANIMOUS CONSENT TO MOVE MOTION

Mr. Elmer M. MacKay (Central Nova): Mr. Speaker, I also rise on a matter of urgent and pressing necessity pursuant to Standing Order 43. It has to do with the energy crisis which is particularly acute in its effects on eastern Canada.

In view of the extreme dependence of eastern Canada on foreign suppliers for our oil requirements and the desirability of developing our own offshore production capabilities, and in view of the reported detrimental effects on exploration and development projects by major oil companies caused by the jurisdictional disputes between federal and provincial governments, I move, seconded by the hon. member for St. John's East (Mr. McGrath):

> That the Minister of Energy, Mines and Resources meet immediately with the appropriate provincial ministers to resolve, once and for all, these jurisdictional disputes and procedural impediments which this nation as a whole can no longer afford.

Mr. Speaker: Is there unanimous consent?

Some hon. Members: Agreed.

Some hon. Members: No.

Mr. Speaker: There is not unanimity and the motion cannot be put.

ORAL QUESTION PERIOD

[*English*]

ENERGY

CONSERVATION PROGRAM WITHIN GOVERNMENT DEPARTMENTS AND AGENCIES—DIPLOMATIC EFFORTS TO AVOID POSSIBLE INTERRUPTION OF SUPPLIES FROM MIDDLE EAST

Hon. Robert L. Stanfield (Leader of the Opposition): Mr. Speaker, may I direct a question to the Prime Minister. In view of the statement of the Minister of Energy, Mines and Resources last evening and the concern he expressed about security of supply and the importance of conservation, and in view of his failure to indicate any measures that the government is taking within its own organization to conserve energy, can the Prime Ministe

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

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H-112

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APPROVED AND ORDERED -6 DEC 1973

EXECUTIVE COUNCIL CHAMBERS, VICTORIA -6 DEC 1973

Lieutenant-Governor

Pursuant to the Park Act, and upon the recommendation of the undersigned, the Lieutenant-Governor, by and with the advice and consent of the Executive Council, orders that

WHEREAS the following described lands within the watershed of the Skagit River have been examined and found to have high recreational values.

All Crown lands within that parcel or tract of land together with all that land covered by water, situated within Yale Division of Yale District and more particularly described as follows:
Commencing at the southwesterly corner of E.C. Manning Park, said corner being International Boundary Monument number 73; thence northerly along the westerly boundary of E.C. Manning Park in a straight line to the summit of Shawatum Mountain, thence easterly and northerly along the easterly boundary of the watershed of Shawatum Creek to the intersection of the southerly boundary of the watershed of Twenty-six Mile Creek with the easterly boundary of the watershed of Shawatum Creek; thence in a general easterly and northwesterly direction along the southerly and northeasterly boundaries of the watershed of Twenty-six Mile Creek to the intersection of the northeasterly boundary of the watershed of said creek with the easterly boundary of the watershed of Silverdaisy Creek; thence northerly along the easterly boundary of the watershed of Silverdaisy Creek to the summit of Silverdaisy Mountain, thence North 40° West approximately 2.8 miles to the boundary of E.C. Manning Park; thence southwesterly and northwesterly along the said boundary to its intersection with the easterly boundary of Section 13, Township 3, Range 24, W6M; thence southerly and westerly along the easterly and southerly boundaries of said Section 13 to the height of land that forms the northwesterly boundary of the watershed of the Skagit River; thence southwesterly and westerly along the northwesterly watershed boundary of the Skagit River and the northerly watershed boundary of the Klesilkwa River respectively to a point due north of the northeast corner of Lot 410, Y.D.Y.D.; thence due south to the said northeast corner; thence southerly and westerly along the easterly and southerly boundaries of said Lot 410 to the height of land that forms the easterly watershed boundary of Maselpanik Creek; thence southerly along the said height of land to the International Boundary, thence easterly along the International Boundary to Boundary Monument number 73, being the point of commencement, the whole containing 80,500 acres more or less.

AND WHEREAS the lands within the above described area are held by the Crown and available for public use

AND WHEREAS Skagit River Park within the above described area was created a provincial park of Class A pursuant to Order-in-Council 390, approved February 3, 1970

AND WHEREAS it is considered that the public need for recreational facilities in the Skagit Valley can best be met by giving the above described lands Recreation Area Status under the Section 6(1) of the Park Act.

AND WHEREAS it is considered preferable to administer all of the above described lands as a public recreation area.

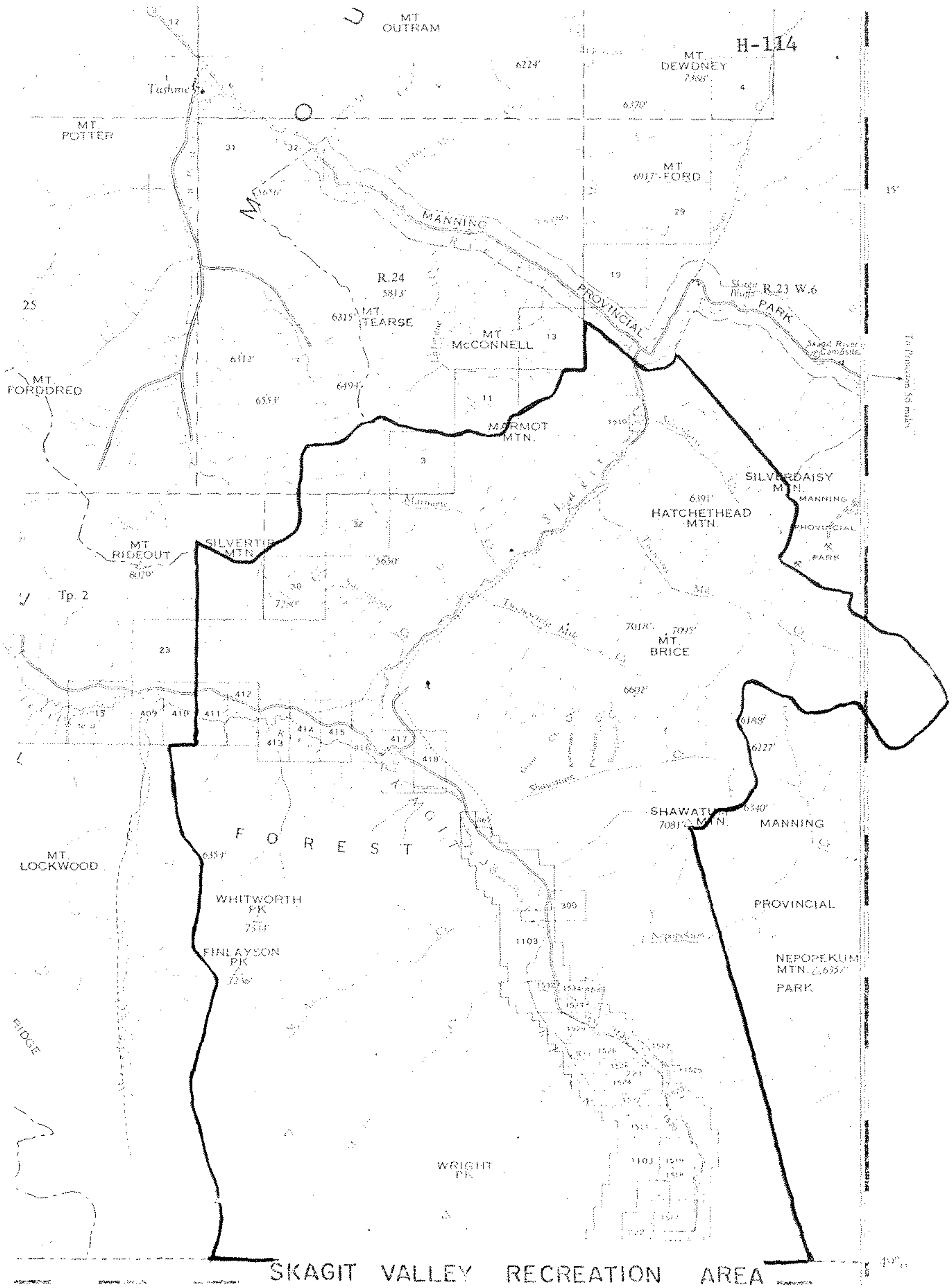
THE MINISTER of Recreation and Conservation be authorized to cancel Skagit River Park and to establish the above described lands within the Skagit Valley as a recreation area to be known as the Skagit Valley Recreation Area.

Jack Radford
Minister of Recreation and Conservation

Presiding Member of the Executive Council

5-7-5-63

WMS/cp



SKAGIT VALLEY RECREATION AREA

80,500 ACRES SCALE - 1" = 2 MI.

JAN. 1974

US FOREST SERVICE

H-115

Washington, D.C. 20250

2770 (7100)

FEB 14 1974

Honorable Kenneth F. Plumb
Secretary, Federal Power Commission
Washington, D.C. 20426

RECEIVED
FEB 21 1974
BUREAU OF POWER

Dear Mr. Plumb:

This is in reply to your letter PWR-LP, Project No. 553 - City of Seattle which transmitted the Draft Environmental Impact Statement for the relicensing of the project.

We have the following comments:

In general, the statement is weak on comparative statistics or values assigned to resource impacts. While general impacts are identified, it is difficult for a reader to grasp the significance of such impacts without some comparative quantification to the expected benefits of the project. The statement would benefit by the inclusion of values or value ranges for each impact involved.

The section on alternatives is particularly weak in this respect. There is very little discussion of the comparative environmental impact of various methods of generating electric power. The main thrust of this section is a description of the efficiency or economy of the alternative sources. While these are important, they do not satisfy the basic purpose of an environmental statement.

The statement does not always keep the action being described in perspective. The issue is not the total environmental impact nor the total benefit of the High Ross Project. It is the additional impact and the additional benefit that is the subject.

While the statement does not specifically say, we assume there will be no change in the diurnal fluctuation of the lower Skagit River as a result of project operation. The fluctuation caused by current project operation imposes some limits on recreational use of the river and has some deleterious effect on fisheries as well. Any wider or more rapid fluctuation would be highly undesirable.

Thank you for the opportunity to comment on the statement.

Sincerely,

Melvin L. Yuhas

RECEIVED
... 2 ... 1974
DIVISION OF LICENSED PROJECTS

for ... P. McParey
... Deputy Chief

APPENDIX G

KEY INDEX

H	Hydro	S	Steam
PG	Pump Generator	N	Nuclear
A	Alternate Plant	GT	Gas Turbine
J	Jointly Owned	IC	Internal Combustion

* All or part is under construction

Key	Name of Plant	Type	Mw Capacity Exist.	Mw Capacity Ult.
D-7	Aberfeldie	H	5	5
G-10	Acme	S	12	12
G-3	Albany	H	1	1
E-6	Albeni Falls	H	43	43
I-11	Alcova	H	36	36
F-3	Alder	H	50	50
C-2	Alert Bay	IC	2	2
G-9	Allenspur	H	0	250
D-3	Alouette	H	8	8
J-9	Altamont	IC	1	1
I-8	American Falls (USBR)	H	stor	60
I-8	American Falls (IPCO)	H	27	27
J-8	American Fork	H	1	1
H-6	Anderson Ranch	H	27	40
E-4	Antilon Lake	PG	0	1000
D-5	Arrow Reservoir	H	stor	0
D-2	Ash River	H	25	25
H-8	Ashton	H	6	6
F-6	Asotin	H	0	540
I-3	Aspen Lake	PG	0	36
F-3	Astoria	S	8	8
F-11	Baker (Mont.-Dak.)	S	1	1
G-9	Bald Ridge	H	0	23
C-7	Barrier	H	10	10
J-6	Battle Mountain	IC	8	8
B-8	Battle River	S	216	366
I-9	Bear Lake	H	stor	0
I-3	Bear Springs	H	0	25
C-7	Bearspaw	H	15	15
E-4	Beaver Creek	H	0	12
J-4	Belden	H	118	118
B-2	Bella Coola	IC	3	3
F-5	Ben Franklin	H	0	848
H-4	Bend	H	1	1
G-3	Bethel	GT	110*	110
B-7	Big Bend	H	305	325
B-7	Big Bend	PG	20	
G-3	Big Cliff	H	18	18
F-7	Big Creek	H	1	1
E-7	Big Fork	H	4	4
B-7	Bighorn	H	108*	108
H-6	Black Canyon	H	8	8
F-8	Black Eagle	H	17	17
I-7	Bliss	H	75	100
B-5	Blue River	IC	2	2
G-5	Boardman	N	0	1150
H-6	Boise Diversion	H	2	2
E-6	Bonners Ferry	IC	1	1
G-3	Bonneville	H	518	1062
D-6	Bonnington Falls	H	9	9
E-6	Boundary	H	551	826
J-8	Bountiful	IC	8	8
E-6	Box Canyon	H	60	60
H-10	Boysen	H	15	15
C-4	Bridge River No. 1	H	180	180
C-4	Bridge River No. 2	H	248	248
J-8	Brigham	H	2	2
D-6	Brilliant	H	109	109
G-6	Brownlee	H	360	541
F-7	Buffalo No. 2	JH-A	0	120
F-7	Buffalo No. 4	JH-A	0	120
F-7	Buffalo No. 4 - high	H-A	0	516
D-6	Bull River	H	0	134
G-3	Bull Run	H	21	21
A-3	Burns Lake	IC	3	3
D-3	Burrard	S	750	900*
J-4	Butt Valley	H	36	36
I-6	C. J. Strike	H	83	83
E-6	Cabinet Gorge	H	200	200
C-6	Calamity Curve	H	0	120
E-6	Calispell Creek	H	1	1
H-6	Canyon Creek	H	0	25
F-8	Canyon Ferry	H	50	50
J-9	Carbon	S	189	189
J-4	Caribou No. 1	H	75	75
J-4	Caribou No. 2	H	110	110
J-6	Carlin	IC	3	3
H-3	Carmen	H	80	80
C-7	Cascade (Calgary)	H	34	34
H-6	Cascade (USBR)	H	stor	0
H-6	Cascade (IPCO)	H	1	1
G-3	Cascadia	H	0	48
J-8	Castilla	H	0	6
F-4	Cedar Falls	H	23	23
E-3	Central	S	12	12
F-3	Centralia (PP&L Co.)	J-S	665	665
F-3	Centralia (WWP Co.)	J-S	210	210
F-3	Centralia (PSP&L Co.)	J-S	98	98
F-3	Centralia (PGE Co.)	J-S	35	35
F-3	Centralia (Seattle)	J-S	112	112
F-3	Centralia (Tacoma)	J-S	112	112
F-3	Centralia (Snoh. PUD)	J-S	112	112
F-3	Centralia (Grays PUD)	J-S	56	56
F-5	Chandler	H	12	12
D-3	Cheakamus	H	140	140
E-4	Chelan	H	48	96
E-5	Chief Joseph	H	1024	3642
G-6	China Gardens	H	0	550
E-4	Chiwawa	H	0	stor
H-8	Clark Ranch	H	0	30
I-7	Clear Lake	H	2	2
H-3	Clearwater No. 1	H	1.5	15
H-3	Clearwater No. 2	H	26	26
H-4	Cline Falls	H	1	1
B-7	Clover Bar	S	330*	330
D-3	Clowhom	H	30	30
F-8	Cochrane	H	48	48
J-3	Coleman	H	14	14
G-10	Colstrip (Mont. Co.)	J-S	350*	2100
G-10	Colstrip (PSP&L)	J-S	350*	
G-4	Condit	H	10	10
I-3	Copco No. 1	H	20	20
I-3	Copco No. 2	H	27	27
E-4	Copper Creek	H	0	83
F-3	Cosmopolis	S	3	3
D-6	Corra Linn	H	40	40
H-3	Cougar	H	25	60
I-8	Cove (UP&L)	H	8	8
J-3	Cow Creek	H	1	1
F-3	Cowlitz Falls	H	0	45
G-6	Crevice	H	0	1015
F-4	Crystal Mtn.	IC	3	3
F-3	Cushman No. 1	H	43	43
F-3	Cushman No. 2	H	81	81
I-8	Cutler	H	30	30
H-11	Dave Johnston	S	750	750
J-8	Deer Creek	H	5	5
G-3	Detroit	H	100	100
H-3	Dexter	H	15	15
E-4	Diablo	H	120	240
E-4	Dirtyface Mtn.	H	0	69
E-4	Dirtyface Mtn.	PG	0	57
C-5	Downie Creek	H	0	1000
C-8	Drumheller	S	18	18
A-1	Dry Dock	IC	6	6
F-4	Dryden	H	0	17
J-9	Duchesne	IC	1	1
D-6	Duncan	H	stor	0
I-5	Duncan Ferry	H	0	14
F-6	Dworshak	H	400*	1060
J-9	Dyne	H	0	33
I-3	Eagle Point	H	3	3
I-3	East Side	H	3	3
E-3	East Sound	IC	1	1
H-2	Eden Ridge	H	0	77
H-2	Eden Ridge	S	0	100
F-3	Electric Park	S	12	12
F-3	Electron	H	26	26
D-2	Elk Falls	S	4	4
E-7	Elko (B.C. Hydro)	H	10	10
J-6	Elko (Nev. P. Co.)	IC	5	7
F-6	Enaville	H	0	70
E-6	Erickson	H	1	1
H-3	Eugene	S	25	25
I-3	Fall Creek	H	2	2
A-1	Falls River	H	10	10
G-3	Faraday	H	34	34
H-3	Fish Creek	H	11	11
J-9	Flaming Gorge	H	108	108
F-7	Flint Creek	H	1	1
I-9	Fontenelle	H	10	10
E-10	Fort Peck	H	165	165
G-3	Foster	H	20	20
G-10	Frank Bird	S	69	69
G-6	Freedom	H	0	450
I-11	Fremont Canyon	H	48	48
E-3	Friday Harbor	IC	1	1
J-8	Gadsby	S	252	252
H-6	Garden Valley	H	0	175
H-6	Garden Valley Rereg	H	0	36
J-8	Gateway	H	4	4
E-3	Georgetown	S	21	21
E-3	Georgia	GT	75	75
C-7	Ghost	H	47	47
H-11	Gillette	J-S	0	330
G-3	Ginger Peak	H	0	10
F-11	Glendive	S	7	7
I-11	Glendo	H	24	24
C-6	Golden	GT	5	8
C-6	Golden	IC	3	
A-4	Gordon M. Shrum	H	2043	2270
E-4	Gorge	H	134	134
I-8	Grace	H	44	55
E-5	Grand Coulee	H	5880*	9780
E-5	Grand Coulee	PG	100*	
J-8	Granite (Murray)	H	1	1
J-8	Granite (UP&L)	H	2	2
G-3	Green Peter	H	80	80
I-3	Green Springs	H	16	16
E-3	Grisdale	IC	1	1
I-11	Guernsey	H	5	5
H-6	Guffey	H	0	85
J-8	Hale	S	59	59
J-4	Hamilton Branch	H	5	5
G-3	Harborton	GT	220*	220
J-3	Hat Creek No. 1	H	10	10
J-3	Hat Creek No. 2	H	10	10
F-8	Hauser Lake	H	17	17
H-9	Heart Mtn.	H	5	5
J-8	Heber	H	1	1
G-8	Hebgen	H	stor	0
G-6	Hells Canyon	H	392	522
H-3	Hills Creek	H	30	30
B-6	Hinton	S	22	24
B-6	Hinton	IC	2	
F-8	Holter	H	38	38
C-7	Horseshoe	H	18	18
J-2	Humbold Bay	S	102	162
J-2	Humbold Bay	N	60	
E-7	Hungry Horse	H	285	285
G-9	Hunter Mtn.	H	0	14
J-9	Huntington Canyon	S	400*	800
I-8	Hyrum	H	1	1
F-5	Ice Harbor	H	603*	603
H-8	Idaho Falls	H	2	2
H-8	Idaho Falls	IC	2	2
H-8	Idaho Falls, Lower	H	3	3
H-8	Idaho Falls, Upper	H	2	2
J-3	Inskip	H	6	6
D-7	Interlakes	H	5	5
J-3	Iron Gate	H	18	18
G-10	J. E. Corette	S	173	173
J-3	James B. Black	H	155	155
B-5	Jasper	IC	5	5
I-10	Jim Bridger (IPCO)	J-S	508*	508
I-10	Jim Bridger (PP&L)	J-S	1017*	1017
I-3	John Boyle	H	80	80
G-4	John Day	H	2160	2700
D-2	John Hart	H	120	120
J-8	Jordan	S	25	25
E-3	Jordan River	H	150	150
J-3	Judge F. Carr	H	142	142
C-7	Kananaskis	H	16	16
E-6	Katka	H	0	100
A-2	Kemano	H	813	813
A-3	Kenney Diversion	H	stor	0
I-3	Keno	H	0	100
F-7	Kerr	H	168	168
J-3	Keswick	H	75	75
J-3	Kilarc	H	3	3
D-6	Kimberley	S	4	4
A-1	Kitimat	IC	5	5
F-7	Knowles	H-A	0	512
C-2	Kokish River	H	0	37
E-6	Kootenai Falls	H	0	360
D-6	Kootenay Canal	H	500*	500
I-11	Kortes	H	36	36
D-2	Ladore Falls	H	54	54
F-3	LaGrande	H	64	64
C-3	LaJoie	H	22	22
D-3	Lake Buntzen No. 1	H	50	50
D-3	Lake Buntzen No. 2	H	27	27
E-6	Lake Creek 1	H	1	1
E-6	Lake Creek 2	H	4	4
E-3	Lake Union	S	30	30
J-6	Lamoille	H	1	1
I-10	Lander	IC	1	1
H-3	Leaburg	H	14	14
E-4	Leavenworth	H	0	104
H-3	Lemolo No. 1	H	29	29
H-3	Lemolo No. 2	H	33	33
F-6	Lenore	H	0	300
D-8	Lethbridge	S	13	33
D-8	Lethbridge	GT	20	
E-11	Lewis & Clark	S	50	50
J-3	Lewiston Diversion	H	1	1
E-7	Libby	H	420*	840
E-6	Libby Rereg	H	0	44
E-6	Libby (ML&P)	S	13	13
E-6	Libby (PP&L)	GT	26	26
G-3	Lincoln	S	36	36
E-5	Little Falls	H	32	32
F-5	Little Goose	H	405	810
J-8	Little Mountain	GT	16	16
I-8	Logan (City)	H	1	8
I-8	Logan (City)	IC	7	
E-5	Long Lake	H	70	70
E-6	Long Meadows	H	0	9
F-3	Longview	S	27	27
H-3	Lookout Point	H	120	120
I-3	Lost Creek	H	49*	49
E-4	Lower Baker	H	64	128
D-6	Lower Bonnington	H	47	47
G-6	Lower Canyon	H	0	1280
F-6	Lower Granite	H	405*	810
I-7	Lower Malad	H	14	14
F-5	Lower Monumental	H	405	810
I-7	Lower Salmon	H	60	75
H-6	Lower Scriver	H	0	120
H-6	Lucky Peak	H	stor	92
J-9	Lyman	IC	2	2
H-8	Lynn Crandall	H	0	240
G-8	Madison	H	9	9
F-3	Mayfield	H	121	166
B-5	McBride	IC	3	3
G-3	McMinnville	IC	3	3
G-5	McNary	H	980	1400
F-3	Meadows, Lower	H	0	55
F-4	Meadows, Upper	H	0	30
D-9	Medicine Hat	S	38	38
F-3	Merrill Lake	PG	0	1000
F-3	Merwin	H	135	180
E-5	Meyers Falls	H	1	1
C-5	Mica	H	stor*	2610*
C-5	Mica Creek	IC	11	11
G-6	Middle Snake	H-A	0	1950
G-6	Mid. Snake Rereg	H-A	0	400
E-4	Mile 5.9	H	0	30
F-11	Miles City	GT	0	20
F-7	Milltown	H	3	3
I-7	Minidoka	H	13	13
F-6	Monroe Street	H	7	7
C-4	Moran	H	0	682
F-8	Morony	H	45	45
F-3	Mossyrock	H	300	450
E-6	Moyie, Lower	H	2	2
E-6	Moyie, Upper	H	1	1
F-3	Muddy	H	0	110
E-5	Murphy Creek	H	0	300
J-8	Murray	IC	8	8
G-9	Mystic Lake	H	10	10
G-9	Mystic Lake	PG	0	72
F-4	Naches	H	6	6
F-4	Naches Drop	H	2	2
I-9	Naughton	S	707	707
E-4	Newhalem	H	2	2
E-6	Nine Mile	H	12	12
G-4	Ninefoot Cr. Div.	H	0	stor
F-7	Ninemile Prairie	H	0	92
E-4	Nooksack	H	2	2
H-2	North Bend	S	15	15
G-3	North Fork	H	38	38
E-4	N. Fk. Snoqualmie	H	0	20
E-6	Noxon Rapids	H	283	354
G-3	Oak Grove	H	51	51
J-8	Olmsted	H	13	13
I-8	Oneida	H	30	40
H-11	Osage	S	34	34
H-11	Osage	IC	1	1
G-6	Oxbow	H	190	238
F-4	Packwood Lake	H	26	26
H-9	Palisades	H	119	254
I-9	Paris	H	1	1
G-4	Pelton	H	108	108
H-10	Pilot Butte	H	2	2
J-8	Pioneer	H	5	5
J-3	Pit No. 1	H	56	56
J-3	Pit No. 3	H	80	80
J-3	Pit No. 4	H	90	90
J-3	Pit No. 5	H	141	141
J-3	Pit No. 6	H	79	79
J-3	Pit No. 7	H	104	104
C-7	Pocaterra	H	14	14
C-1	Port Hardy	IC	5	5
C-1	Port Hardy	GT	46*	86
D-3	Port Mann	GT	100	100
G-3	Portland "L"	S	75	75
F-6	Post Falls	H	11	11
G-4	Powerdale	H	6	6
E-6	Priest Lake	H	stor	0
F-4	Priest Rapids	H	788	1262
A-4	Prince George	IC	9	9
A-1	Prince Rupert	GT	57*	57
I-3	Prospect No. 1	H	4	4
I-3	Prospect No. 2	H	32	48
I-3	Prospect No. 3	H	7	7
I-3	Prospect No. 4	H	1	1
J-8	Provo	S	14	14
D-2	Puntledge	H.	27	27
B-5	Pyramid Mtn.	H	0	96
F-7	Quartz Creek	H	0	104
F-7	Quinn Springs	H	0	108
F-8	Rainbow	H	36	36
J-10	Rangley	IC	15	15
C-5	Revelstoke	IC	2	2
C-5	Revelstoke Canyon	H	0	630
J-8	Riverdale	H	4	4
G-3	River Mill	H	19	19
G-6	Rock Creek	H	1	1
F-4	Rock Island	H	212	576
F-4	Rocky Reach	H	1213	1213
J-9	Roosevelt	IC	2	2
B-7	Rosedale	S	345	405
B-7	Rosedale	H	60	
E-4	Ross	H	360	360
G-4	Round Butte	H	247	247
F-4	Roza	H	11	11
C-7	Rundle	H	47	47
D-3	Ruskin	H	106	106
C-7	Russell	H	0	75
F-8	Ryan	H	48	48
H-8	St. Anthony	H	1	1
G-7	Salmon	IC	7	7
I-3	Salt Caves	H	0	80
I-11	Seminoe	H	32	45
C-4	Seton	H	42	42
E-6	Seven Mile	H	0	372
J-3	Shasta	H	422	422
G-10	Sheridan	H	0	25
G-9	Shoshone	H	6	6
I-7	Shoshone Falls	H	12	12
E-3	Shuffleton	S	87	87
D-5	Shuswan Falls	H	5	5
J-9	Sixth Water	H	0	90
H-3	Slide Creek	H	18	18
E-7	Smoky Range	H	0	330
J-8	Snake Creek (Heber)	H	1	1
J-8	Snake Creek (UP&L)	H	1	1
F-4	Snoqualmie Falls 1	H	12	12
F-4	Snoqualmie Falls 2	H	30	30
J-11	Snyder	IC	10	10
I-8	Soda	H	14	14
H-3	Soda Springs	H	11	11
J-3	South	H	4	4
D-6	South Slocan	H	47	47
C-6	Spillimacheen	H	4	4
F-6	Spokane	H	4	4
C-7	Spray	H	81	81
J-3	Spring Creek	H	150	150
H-3	Springfield	S	5	5
E-7	Spruce Park	H	0	380
J-8	Stairs	H	1	1
D-2	Stamp River	H	0	26
D-3	Stave Falls	H	53	53
G-3	Stayton	H	1	1
E-4	Stehekin	IC-H	1	1
D-2	Strathcona	H	68	68
J-9	Strawberry	H	stor	0
I-9	Strawberry Creek	H	2	2
H-3	Strube	H	0	5
G-3	Sullivan	H	15	15
E-6	Sullivan Creek	H	stor	20
E-4	Sultan No. 1	H	0	84
E-4	Sultan No. 2	H	0	32
E-4	Sultan No. 3	H	0	24
G-4	Summit	IC	6	6
A-7	Sundance	S	572*	1322
G-9	Sunlight	H	0	15
H-6	Swan Falls	H	10	10
F-3	Swift No. 1	H	204	204
F-3	Swift No. 2	H	70	70
J-9	Syar	H	0	8
F-3	Tacoma No. 1	S	9	9
F-3	Tacoma No. 2	S	50	50
H-8	Teton	H	20*	30
G-4	The Dalles	H	1807*	1807
G-9	Thief Creek	H	0	125
F-7	Thompson Falls	H	30	30
I-7	Thousand Springs	H	8	8
C-7	Three Sisters	H	3	3
E-4	Thunder Cr. Divers.	H	0	stor
G-4	Timothy Meadows	H	stor	0
H-3	Toketee	H	42	42
H-3	Trail Bridge	H	10	10
G-3	Trask	H	0	76
G-8	Trident	S	0	330
J-3	Trinity	H	106	106
F-3	Trojan (PGE) Co.)	J-N	763*	763
F-3	Trojan (PP&L Co.)	J-N	28	28
F-3	Trojan (Eugene)	J-N	339	339
I-9	Trona	S	16	16
G-4	Trout Creek	H	0	40
E-6	Troy	S	3	3
I-7	Twin Falls	H	14	14
H-6	Twin Springs	H	0	90
A-8	Two Hills	S	2	14
A-8	Two Hills	IC	3	
A-8	Two Hills	GT	9	
J-9	Uintah	H	1	1
E-4	Upper Baker	H	94	94
D-6	Upper Bonnington	H	55	55
F-6	Upper Falls	H	10	10
I-7	Upper Malad	H	7	7
I-7	Upper Salmon "A"	H	18	18
I-7	Upper Salmon "B"	H	17	17
H-6	Upper Scriver	H	0	38
B-5	Valemount	IC	4	4
B-8	Vermilion	S	9	9
J-3	Volta	H	6	6
A-7	Wabamum	S	582	582
D-4	Wahleach	H	60	60
G-6	Wallowa Falls	H	1	1
C-5	Walter Hardman	H	8	8
H-3	Walterville	H	8	8
F-4	Wanapum	H	831	1330
E-6	Waneta	H	292	292
J-9	Wanship	H	1	1
F-4	Wapato Drop No. 2	H	2	2
F-4	Wapato Drop No. 3	H	1	1
I-3	Warm Springs	H	0	38
F-5	WPPSS No. 1 (Hanford)	N	860	1233
F-5	WPPSS No. 2 (Hanford)	N	1100*	1100
F-5	WPPSS No. 3	N	0	1100
J-8	Weber	H	3	3
E-5	Wells	H	774	774
J-7	Wells No. 1	H	1	1
G-6	Wenaha	H	0	201
I-3	West Side	H	1	1
D-5	Whatshan	H	50	50
J-10	White River (MOLE)	S	0	100
F-4	White River (PSP&L)	H	70	119
E-11	Williston	S	2	2
E-11	Williston	GT	8	8
J-5	Winnemucca	GT	15	15
J-5	Winnemucca	H	1	1
J-5	Winnemucca	IC	1	1
F-3	Wynoochee	H	stor*	66
H-11	Wyodak	S	28	28
F-3	Yale	H	108	216
J-9	Yellowstone	H	1	1
G-9	Yellowstone Lake	IC	3	3
G-10	Yellowtail	H	250	250
F-3	Yelm	H	9	9