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Chapter 1: Purpose of and Need for Action

1.1 Need for Action

The Columbia River Treaty (Treaty) between Canada and the United States of America required three storage dams to be constructed on the Columbia River system in Canada and allowed for one in the United States. The dams help control floods in both countries, and the regulated streamflow provided by the three Canadian Treaty reservoirs enables dams downstream in the United States to produce additional power ("downstream power benefits"). Canada and the United States share the downstream power benefits equally under the Treaty. Figure 1-1 shows major dams and rivers in both countries.

Figure 1-1

In subsequent agreements based on the Treaty, Canada sold its half of the extra power produced to a consortium of U.S. utilities for 30-year periods. The first 30-year sale will begin to expire in 1998, at which time the first installment of the "Canadian Entitlement" (Entitlement)--Canada's share of the downstream power benefits--must be delivered to Canada.

The United States Entity designated by the Treaty to represent United States interests needs to fulfill the United States' obligations under the Treaty to deliver Canada's share of the downstream benefits. The United States Entity is the Administrator of Bonneville Power Administration (BPA) and the Division Engineer, North Pacific Division of the U.S. Army Corps of Engineers (Corps).

1.2 Purposes

Any plan for meeting the United States' obligations under the Treaty is expected also to fulfill the following purposes:

- Meet the Treaty obligations cost-effectively.
- Avoid or minimize adverse environmental effects of fulfilling the Treaty obligation.
- Develop means for fulfilling the Treaty that are acceptable to the Canadian and United States Entities.
- Maintain the reliability of BPA's power system.

1.3 Background

The Columbia River Treaty

The Columbia River Treaty between Canada and the United States was signed in 1961 to share the benefits of flood control and power production by regulating the flow of water in the Columbia River. It required that three dams--Duncan, Keenleyside (formerly Arrow), and Mica--be built in British Columbia (BC) for flood control and to increase hydroelectric power generating potential in both countries. Together, these three dams are known as the "Treaty projects" (Figure 1-1). It also allowed the United States to build Libby Dam, which was included as part of the Treaty because its reservoir, Lake Koocanusa, backs into Canada.

Including the storage at Libby Dam, altogether, 25.3 cubic kilometers (km3) (20.5 million acre-feet (MAF)) of water storage were developed under the Treaty. The Treaty dams more than doubled the storage capacity of the Columbia River Basin. Holding the water behind the dams until it is needed to generate electricity allows a greater amount of power to be generated throughout the year downstream.

In exchange for providing 19.1 km3 (15.5 MAF) of the water storage from the three Canadian projects, Canada received $64.4 million for flood control for a period of 60 years and entitlement to half of the extra power produced at hydroelectric plants in the United States (the "downstream power benefits") attributable to the operation of the Canadian storage sites. The power is generated at Federal and non-Federal hydroelectric projects throughout the Columbia River Basin (Figure 1-1).

The Canadian Entitlement

In the 1960s, Canada did not need the additional power to which it was entitled. In August of 1964, its 50-percent share of the downstream benefits was sold to the Columbia Storage Power Exchange, a nonprofit corporation. The "Canadian Entitlement" was sold for $254 million for 30-year periods coinciding with the scheduled completion dates of each of the three Canadian dams. The 30-year sale is now nearing expiration. Nine (9) percent of the power entitlement is due to be returned to BC in 1998, the 30-year anniversary of the scheduled completion of Duncan Dam; an additional 46 percent in 1999, the 30-year anniversary of Keenleyside's scheduled completion; and the remaining 45 percent in 2003 for Mica's anniversary. The Treaty specifies that the Entitlement must be delivered at a point on the Canada-United States boundary near Oliver, BC, unless other arrangements are agreed upon by the two Entities. A subsequent interim agreement, signed by the Entities in 1992, allows the Entitlement to be delivered over existing transmission facilities between 1998 and 2003 unless the agreement is terminated by either party on 7 years, 3 months notice.

Calculating the Value of Downstream Benefits

In general, the downstream power benefits are the firm power that can be generated, because of the water storage provided by the Canadian Treaty dams, at United States dams that existed in the Columbia River Basin at the time the Treaty was signed, and at all dams constructed on the mainstem of the Columbia since then. Two measures are used to gauge the downstream power benefits: average annual usable energy and dependable capacity.

Energy is the increase in total number of megawatthours delivered over a specified time--usually a year--that results from the operation of Canadian storage sites. Typically it is characterized as the average rate of delivery over such a period, or "average megawatts (aMW)." **Capacity** is the maximum rate of delivery allowed in megawatts (MW), usually measured for a short period of time, such as an hour. The capacity number is usually larger than the energy number, allowing the flexibility to "shape" the energy into time periods that more closely reflect when the energy is needed.

The United States and Canadian Entities (see section 1.4) determine the downstream power benefits 5 years in advance based on estimated loads, resources, and system conditions. Current estimates of the Entitlement are approximately 550 to 600 aMW of energy and 1,200 to 1,500 MW of capacity (*Entitlement Forecast Studies,* Columbia River Treaty Operating Committee, April 1993 and recent Assured Operating Plan and Determination of Downstream Power Benefit Documents). As loads increase and the United States relies on thermal resources to meet them, the magnitude of the downstream benefits is expected to decrease. At the time the Treaty was signed, however, the Entities had predicted a faster decrease in magnitude than has actually occurred, primarily because they predicted greater Pacific

Northwest (PNW) load growth and thermal resource development than materialized. This means that the Entitlement is more than originally anticipated. Procedures for calculating the downstream power benefits are documented in Annex B of the Treaty. They are further clarified in the Protocol to the Treaty and in subsequent reports, including the December 1991 *Columbia River Treaty Principles and Procedures for Preparation and Use of Hydroelectric Operating Plans*, prepared by the Columbia River Treaty Operating Committee.

As noted previously, the Canadian Entitlement is computed each year for the sixth succeeding operating year; the magnitude depends on a variety of study assumptions such as load growth and available resources. To reflect the uncertainty of predicting future computations, a range of values for both the capacity and energy is stated. However, to compare alternatives with simplicity and clarity, a single value of 1,400 MW of capacity and 550 aMW of energy is used throughout the remainder of this document. The uncertainty surrounding these values is well within the tolerances of the analysis presented in this EIS.

1.4 Scope and Decisionmaking Process

As part of Treaty agreements, each country designated the parties responsible for implementing the Treaty. The United States Entity is the Administrator of BPA and the Division Engineer, North Pacific Division of the Corps. British Columbia Hydro and Power Authority (BC Hydro), a provincial Crown corporation, is the Canadian Entity.

BPA, which markets and transmits power from United States Federal hydroelectric projects in the PNW and California, may need to implement some portions of the United States Entity's decision. The agency is providing its expertise in evaluating the alternatives and has prepared this Environmental Impact Statement (EIS). In Canada, the government of British Columbia is leading the consultation team; BC Hydro may need to implement some portions of the Canadian Entity's decision.

The Treaty specifies that the Entitlement be delivered to Canada at a point on the border near Oliver, BC, unless the Entities agree to other arrangements. Because neither BPA nor BC Hydro presently has transmission facilities to support delivery of the Entitlement to Oliver, either new transmission facilities must be built, or alternative arrangements must be made. In order to allow enough time to complete either the transmission facilities or negotiations for an alternative arrangement, the United States and Canadian Entities signed an interim agreement in July 1992 to deliver the Entitlement over existing transmission facilities to the Canadian border at points near Blaine, Washington, and Nelway, BC, between 1998 and 2003. (See chapter 3, Figure 3-1.)

In April 1993, consultations began between the United States and Canadian Entities on how to accomplish delivery of the Entitlement through 2024, the earliest the Treaty can be terminated. Several other organizations actively participated in this process, including the mid-Columbia generating utilities (those who own and operate hydroelectric dams in the region)<1> and the U.S. Department of State, which is a cooperating agency. Depending on the alternative chosen, the Department of State would conduct negotiations to authorize the disposition of benefits within the United States, since a disposition must be evidenced by an exchange of notes between the respective governments. As a result of these consultations, the United States and Canadian Entities and the Province of British Columbia executed a non-binding Memorandum of Negotiators' Agreement and Principles for Delivery and Disposition of the Canadian Entitlement (MONA) on September 9, 1994. Together, these established a framework for detailed negotiations of comprehensive agreements for delivery of Canada's Treaty power.

Major components of the MONA included: a one-time $180 million payment by the United States to Canada to reduce the amount of the Capacity Entitlement obligation to 950 megawatts (MW); delivery of the remaining Canadian Entitlement--approximately 950 MW of capacity and about 550 average MW of energy--over existing transmission facilities or its resale by Canada in the United States; and other provisions needed to implement the Treaty.

Execution of the MONA was followed by extensive negotiations to draft final, detailed, binding agreements. While

negotiating with the Canadians, the United States Entity also worked with the mid-Columbia utilities to negotiate their share of the Entitlement obligation; negotiations included a proposal for the utilities to make the $180 million payment in lieu of their obligation to deliver their portion of the capacity obligation.

After the MONA was signed, the electric utility market changed dramatically resulting in a significant reduction in the value of the proposed Entitlement agreements to the United States. The key factor responsible for this change is the dramatic reduction in the value of capacity in the western United States. Electricity from gas-fired combustion turbine power plants, once priced well-above hydropower, is now priced competitively with, and in some cases, below the price of hydropower. That situation, coupled with requirements imposed on Columbia River hydropower operations as a result of listings under the U.S. Endangered Species Act, resulted in a significant drop in the value of capacity. The mid-Columbia utilities advised the United States Entity that they could not go forward with the $180 million payment under the MONA. Following a thorough review of the economics of the MONA, the United States Entity and BPA concluded that the agreement contemplated by the MONA no longer had an economic advantage over building the required transmission facilities to deliver the Entitlement to Oliver, BC, and that they could not complete the agreements with the Canadian Entity and the Government of British Columbia [If agreement cannot be reached between the United States and Canada regarding alternative arrangements for delivery of the Canadian Entitlement, the Entitlement will be delivered to Oliver, BC in accordance with the terms of the Treaty.]

This EIS is being prepared to aid the decision the United States Entity must make on how best to meet the United States' Treaty obligations to deliver Canada's share of the downstream power benefits from the Treaty projects (the Entitlement). While this document, and input from all interested parties, will inform the United States' decision makers, any decision, other than delivery to a point near Oliver, BC, must be acceptable to both the United States and Canadian Entities.

A Notice of Intent to prepare an EIS on the Delivery of the Entitlement was signed on May 24, 1993. Scoping meetings were held in June 1993 in Portland, Oregon; and in Pasco, Seattle, and Spokane, Washington. The comments received during scoping were considered in the preparation of the Draft EIS, which was circulated for review in April 1994. Comments on the draft were incorporated, where applicable, into the Final EIS. Comments are reprinted in full and responded to in Appendix A.

The scope of the EIS is limited to analyzing the effects of various options to deliver the Entitlement to BC. Because, at the time the Draft EIS was prepared, the components of possible alternatives were known, but not whether or how they might be combined, the EIS focuses on the potential environmental impacts of each of the various components. The environmental consequences of each alternative (made up of one or more components) are determined by combining impacts of the components. In some cases, additional National Environmental Policy Act (NEPA) documents may be tiered to this one, to address issues such as the site-specific impacts of transmission line construction. Such documents would examine routing alternatives, non-Federal use of specific transmission lines, or other site-specific issues.

The environmental analysis in this document examines effects in Canada, as well as within the United States. Executive Order 12114 allows examination of environmental impacts outside the United States, but does not require it. Because the Canadian Entity is a partner in the decision process, and any decision other than delivery at Oliver must be acceptable to that country as well as to the United States Entity, this analysis does not imply that the United States is trying to direct Canadian decisions. It is done in the spirit of providing full and complete information to the United States Entity on the consequences, both direct and indirect, of U.S. actions.

The assessment of impacts in Canada is based on the United States Entity's perspective and interpretation of the Treaty requirements. The Canadian Entity does not necessarily agree with or endorse this analysis of the environmental effects in Canada.

Related Actions

Other decisionmaking processes in which BPA is engaged could affect or be affected by Entitlement decisions (Figure 1-2). They are:

Resource Planning

Resources available to meet BPA's load obligations will be determined by BPA's resource planning decisions. Alternatives to deliver the Entitlement that include development of new resources would be within the scope of options considered in the *Resource Programs Final EIS* (DOE, February 1993). That document analyzed the environmental effects of resource acquisitions, based on the assumption that the Entitlement would be delivered to Canada. Specific acquisitions and their effects are considered in subsequent resource planning processes.

System Operation Review

Three Federal agencies--BPA, the Corps, and the Bureau of Reclamation--are examining the operation of the Columbia River hydro system in a process called the System Operation Review (SOR). The alternatives available to meet Treaty obligations would fall within the range of river operations parameters considered in the Draft SOR EIS, published in July 1994 (see section 4.1.3.1). The SOR process is also considering new Allocation Agreements that will specify how the Entitlement will be allocated to each of the 11 Federal and non-Federal projects downstream of Treaty storage following expiration of existing agreements.

Non-Federal Participation in the AC Intertie

Alternatives that consider repurchase of all or parts of the Entitlement for resale to California must consider effects on the PNW Intertie and the environmental effects of Intertie use. The *Final EIS on Non-Federal Participation in AC Intertie* addressed the effects of generic Pacific Northwest-Pacific Southwest Intertie (PNW-PSW Intertie) contracts, some of which could include power from Canada (DOE, January 1994). Related Records of Decision were issued by BPA between March and July 1994.

Cross-Cascades Transmission Line

Under some alternatives for delivery of the Entitlement, a new 500-kV transmission line from eastern to western Washington across the Cascade Mountains would be needed sooner than is otherwise anticipated. General environmental effects of construction of a cross-Cascades transmission line were evaluated in the *Puget Sound Area Electric Reliability Plan Final EIS* (DOE, April 1992). This document uses information from the Puget EIS in its impact analyses. If the selected alternative to deliver the Entitlement requires a cross-Cascades line, a NEPA document will be tiered to the Puget EIS to address site-specific impacts of transmission line construction.

Business Plan

BPA's Business Plan (September, 1995) defines the basic business direction BPA intends to pursue as it responds to the challenges of the dynamic electric utility industry. The *Business Plan Final EIS* (DOE, June, 1995) evaluates the environmental impacts of six alternative business strategies. The Business Plan Record of Decision was executed on August 15, 1995. The Market-Driven alternative was chosen. The information the EIS provides on current electric utility market conditions, loads, resources, and costs has been used in this EIS in the development and evaluation of alternatives for the Delivery of the Canadian Entitlement.

Other Actions

Two major transmission lines have been proposed in the study area, both of which are justified independently of the need to deliver the Entitlement. One is the Northwest Washington Transmission Project, approximately 70 km (44 mi) of new or rebuilt line proposed by BPA and Puget Sound Power and Light Company in the Bellingham, Washington area. While part of the need for the line is to enhance Northwest access to Canadian power, the full Entitlement could be delivered to Canada at Blaine on the Canadian border without construction of the Bellingham lines (although a major line across the Cascade Mountains would be needed sooner than required without the Entitlement--see Section4.1.1.3). The *BPA/Puget Power Northwest Washington Transmission Project Final EIS* (DOE, August, 1995)

examines the effects on the power system of power contracts that may use the north-south capacity of the Northern Intertie. It also considers the effects of increased levels of energy storage transactions that the new line would allow. A Record of Decision for this project was signed September 21, 1995.

The second line is a double-circuit 230-kV transmission line proposed by Washington Water Power (WWP) between the Spokane area and the Canadian border near Boundary Dam. Environmental analysis of the proposal is complete and WWP has received a Presidential Permit to build the line, but construction has not yet begun. Information from the 1992 *Washington Water Power/BC Hydro Transmission Interconnection Project Final EIS* was used in this document. See sections 2.2.1.1 and 4.1.1.4(B) for further discussion of this line.

Figure 1-2

<1> These utilities are: Grant County PUD, Douglas County PUD, and Chelan County PUD.

Chapter 2: Alternatives Considered

Figure 2-1

A number of alternatives to deliver the Entitlement were analyzed. Each alternative is made up of **components** and **actions** (Figure 2-1, opposite page). Components are the building blocks of the alternatives; they include different delivery points for the Entitlement, as well as different purchase and resource development choices. Actions are the activities that must occur in the United States to implement each component. For example, the delivery of 600 to 1,400 MW at Oliver (a component) requires the construction of a new 500-kV transmission line from Grand Coulee Substation to the border (the supporting action). For most alternatives, a **connected action in Canada** would also be required. For example, if the full Entitlement were delivered at Oliver, BC, the construction date for new lines from the interior near Oliver to the Lower Mainland near Vancouver, BC, could be accelerated several years from what is currently planned.

Focusing the analysis in terms of components, actions, and connected actions in Canada allows decisionmakers to understand the environmental impacts of the full range of alternatives for the delivery of the Entitlement. In this chapter, the components are identified individually (section 2.2), assembled into alternatives (section 2.3), and compared in terms of environmental impacts (section 2.4). In Chapter 4, the environmental impacts of each component are reviewed in more detail. Because alternatives are described in terms of components, readers can "assemble" and evaluate alternatives other than those described in Chapter 2. In addition to the Base Case, and four alternatives evaluated in this EIS, other alternatives for delivery of the Entitlement could exist. They can be derived and compared by selecting components from those described in Chapter 4 and by reviewing their associated environmental impacts. The alternatives evaluated represent a range of possible alternatives. The alternative of returning the power to Canada at Oliver was chosen as the base case or "benchmark" alternative because it is specifically mentioned in the Columbia River Treaty.

For most actions, either BPA in the United States or BC Hydro in Canada would implement the decisions of the United States and Canadian Entities. Therefore, these chapters describe actions and planning criteria of the two utilities rather than of the Entities.

2.1 No Action

The National Environmental Policy Act (NEPA) requires an agency to consider the consequences of not taking a proposed action (that is, the No Action Alternative). The rationale for evaluating the no action alternative for an action such as the delivery of the Canadian Entitlement, where the action is mandated by a treaty, is not to promote the no action alternative but to provide a benchmark, enabling decisionmakers to compare the magnitude of environmental effects of the no action alternative. In this case, No Action would mean that the United States Entity would not deliver the Entitlement to Canada, as required by the Columbia River Treaty. Not delivering the Entitlement would violate the Treaty, and would have unacceptable social, political, and legal consequences on both sides of the border. In addition, Canada would not have access to a substantial block of energy and capacity resources that, based on its Treaty rights, it has planned for serving its loads. Without these resources, BC Hydro would have to develop and operate replacement resources. Replacing the Entitlement power with generation in Canada might also require BC Hydro to construct new transmission lines to link generation to loads. For these reasons, the No Action Alternative is not acceptable to either the United States or Canadian Entity and is dismissed from further consideration.

2.2 Components of Action Alternatives

2.2.1 United States Components

2.2.1.1 Transmission Construction

BPA identifies transmission requirements on the basis of several factors:

Loads: BPA's transmission requirements are based in part on its predictions of the location and pace of future load growth. The Entitlement is one load that BPA must plan to serve; others include growing loads in the region west of the Cascade mountains in Washington's Puget Sound and Oregon's Willamette Valley. BPA's transmission system must be able to serve peak winter loads in these population centers.

Generation: BPA's high-voltage system links loads to generation. A key issue for transmission planning in the PNW is whether future generation will occur on the west side of the Cascades near load centers, or east of the Cascades. The *Puget Sound Area Electric Reliability Plan EIS* pointed out that if new generation were added primarily east of the Cascades (or in some load-growth scenarios, partially east and partially west), new high-voltage transmission lines would be needed across the Cascades.

Existing Transmission Capacity: Clearly, transmission line requirements depend in part on existing transmission capacity. For example, no high-voltage transmission currently exists at the United States-Canadian border near Oliver, whereas 300 MW of south-to-north capacity exists at the border near Selkirk.

Transmission Reliability Criteria: Utilities strive to provide reliable service at best value for their customers. The level of reliability a utility strives for directly affects the transmission facilities it must build and operate. BPA's reliability criteria require that if one transmission line is out, the transmission system should be able to serve loads and maintain voltage levels even during abnormally cold weather. If both a power plant and one transmission line are out, or if two transmission lines are out, the transmission system should serve loads and maintain voltage levels for normal (but not extreme) cold weather.

Based on these transmission planning objectives, different transmission facilities could be required, depending on the amount of capacity and energy to be delivered to Canada at different delivery points. Timing of transmission facilities in the United States and Canada to deliver the Entitlement could also be affected by the planning variables described above.

Oliver Point of Delivery. A point on the United States-Canada border near Oliver, in the Okanagan Valley in BC, is the place the Treaty specifies as the delivery point for the Entitlement. Transmission system analysis has shown that, to deliver the entire Entitlement amount (up to approximately 1,400 MW), a new 135- to 155-km (85to 95-mi) single-circuit 500-kV transmission line would be required from the Grand Coulee area north to the Canadian border (Map 1).

Delivery of less than 600 MW could be made to Oliver with fewer transmission system improvements. To deliver up to 600 MW, the existing 34-km (21-mi) East Omak to Tonasket 115/230-kV transmission line would have to be reinsulated for 230-kV operation, and a new 32-km (20-mi) double-circuit 230-kV line from Tonasket to the border

would need to be constructed. To deliver up to 300 MW, a single-circuit line would be needed. However, BPA is unlikely to construct a line capable of delivering only the smaller amount when the obligation exists to deliver much more than 300 MW.

Blaine Point of Delivery. At a point on the international border north of Blaine, Washington, BPA's two existing 500-kV transmission lines interconnect with BC Hydro's system. Adequate existing south-to-north capacity exists on the BPA transmission system so that no additional transmission facilities would be needed in the northern Puget Sound area to deliver the entire Entitlement amount (approximately 1,400 MW) to the Blaine point of delivery.

However, delivering the Entitlement at Blaine might require accelerating the construction date of a new 500-kV transmission line across the Cascade Mountains in Washington. This new line was identified as one possible contingency to meet Puget Sound loads if they grow faster than expected and if most new generation is located east of the Cascades. Delivering the Entitlement at Blaine would represent a new load in the Puget Sound area, and a cross-Cascades line might have to be built several years earlier than would otherwise be the case. This line would be either a new double-circuit 500-kV line or an upgrade of an existing 345-kV line to 500-kV double-circuit. Depending on the route selected, the line would be 200 to 240 km (125 to 150 mi) long, and would originate near Chief Joseph Substation in central Washington (Map 1).

Selkirk Point of Delivery. Delivery of Entitlement amounts of 600 MW to 1,400 MW to the border near Selkirk Substation (near Nelway, BC) would require construction in the United States of a new 3- to 8-km (2- to 5-mi) double-circuit 230-kV line from Boundary Substation to the border (Map 1). Delivery of between 300 and 600 MW would require construction of the same transmission facilities except that single-circuit (rather than double-circuit) lines would be required. No new transmission facilities would be required in the United States to deliver up to 300 MW at Selkirk.

WWP has received a Presidential Permit to construct a 163-km (102-mi) transmission line between the Spokane area and the Canadian border near Boundary Dam. While it is possible that this line could be used to deliver Entitlement power, it has been justified independently of Entitlement needs and would not likely be built primarily for Entitlement delivery. Other alternatives for returning the Entitlement at Selkirk, as discussed in section 4.1.1.4, are more economical and would have fewer environmental consequences than the WWP line.

2.2.1.2 Transmission Use

Transmitting power across the Canadian border would require use of the Northern Intertie, and delivering power south to California would require use of the PNW-PSW Intertie. Delivering power for parties other than BPA (e.g., transmitting power to California for BC Hydro) would require BPA to wheel power over its transmission system and/or to grant access to the PNW-PSW Intertie.

2.2.1.3 Resource Development and Operation

Delivering the Entitlement to Canada must be supported by conservation and/or generation resources in the PNW. BPA's Resource Program load and resource projections assume that the PNW will deliver the Entitlement to Canada and show the Entitlement as a resource "loss" that must be replaced by new resources (up to 1,400 MW capacity and 550 aMW energy for the full Entitlement). However, the Entitlement is a system obligation, and would be served by the entire mix of resources that serve regional loads (that is, the hydroelectric system plus existing and new conservation, renewable, and thermal resources).

One alternative that has been discussed is for the United States to pay for the Entitlement obligation by funding the development of an energy resource in BC. This option could eliminate the need to construct new transmission in Canada or the United States to deliver the Entitlement to BC load centers.

2.2.1.4 Purchases

Instead of the PNW delivering the entire Entitlement to Canada, the Entities could agree for United States utilities to purchase all or part of the Entitlement (as is currently the case). These utilities could be in the PNW or the PSW.

2.2.2 Connected Actions in Canada

A number of the alternatives would require actions in Canada by BC Hydro and the British Columbia government. Canadian utilities base their identification of future transmission needs on criteria similar to those listed in section 2.2.1.1 for BPA. Depending on the alternative finally negotiated, the following connected actions in Canada could be required.

2.2.2.1 Transmission Line Construction

New Oliver Transmission Line and Substation. If the Entitlement were delivered to the border near the town of Oliver, BC, a new single-circuit 13- to 46-km (8- to 29-mi) transmission line would need to be built from the border north to a new substation near Oliver (Map 1).

New Selkirk Transmission Line. If Entitlement power were delivered to the border near Nelway, BC, a new

8- to 15-km (5- to 9-mi) single- or double-circuit 230-kV transmission line would have to be constructed from the border north to the Selkirk Substation (Map 1).

Change in Construction Dates of Interior-to-Lower-Mainland Transmission Lines. If the full Entitlement were delivered at Blaine, 500-kV transmission lines from the interior to load centers on the Lower Mainland near Vancouver, BC, would be deferred several years. Conversely, the construction dates of these lines could be accelerated slightly if the Entitlement were delivered at Selkirk. Several different configurations could be affected, including entirely new lines in new corridors, and/or new lines paralleling existing lines (Map 1).

2.2.2.2 Resource Development and Operation

If the Entities decide to resell the Entitlement to the United States, in whole or in part, Canada could require new resources equivalent to the Entitlement (that is, up to 1,400 MW capacity and 550 aMW energy). Canada would have

to acquire and operate the resources to serve the additional load.

2.3 Alternatives

2.3.1 Base Case: Full Delivery at Oliver (Proposed Action)

The Treaty specifies that the Entitlement shall be delivered "to Canada at a point on the Canada-United States of America boundary near Oliver, BC, or at such other place as the entities may agree upon. . . " (Article V (1)). The Base Case for the analysis in this EIS is that the Entitlement is delivered in its entirety at Oliver (Figure 2.31). The Base Case is also the Proposed Action.

The following actions would be required:

Base Case (Proposed Action) Components

UNITED STATES

Transmission Construction. One new single-circuit 500 -kilovolt (kV) line from Grand Coulee Substation to the United States/Canada border near Oliver by 2003:

135 to 155 kilometers (km)--85 to 95 miles (mi) long.

Right-of-way (new or expansion of existing): 38 meters (m)--125 feet (ft) wide for standard lattice steel structures.

New or upgraded access roads: 2 km/km of line--(2 mi/mi of line).

Potential improvements at or expansions of existing substations.

East-West Standby Transmission. The United States would provide East-West Standby transmission service in accordance with Article X of the Columbia River Treaty. It appears that no new transmission facilities would be required to provide this service.

Base Case Construction Date Assumptions for Cross-Cascades Transmission Lines. Two 200- to 240-km (125- to 150-mi) cross-Cascades lines are needed by the end of the second and third decades of the 21st century.

Resource Development and Operation. The PNW would develop 550 aMW of energy and 1,400 MW of capacity by 2003 and would operate the system to serve Entitlement load.

CANADA

Transmission Construction. Border-to-Oliver: One new single-circuit 500-kV line and substation by 2003:

13 to 46 km (8 to 29 mi) long.

Right-of-way (new or expansion of existing): 49 to 64 m (161 - 210 ft) wide.

New or upgraded access roads: Likely.

New 500 -kV switching station or substation (approx. 9 hectares (ha) (22 acres).

Base Case Construction of Interior-to-Lower-Mainland Transmission Lines. The following transmission lines may be needed to transmit the Entitlement to Canadian load centers in the Lower Mainland. These lines are not anticipated before 2008, but they may be required before the end of the study period (2024). The need is related to the location of future generation in BC.

Oliver-to-Nicola: 138-km (86-mi) 500-kV line.

Nicola-to-Lower-Mainland: 248-km (154-mi) 500-kV line.

Figure 2.3-1

2.3.2 Alternative A: Partial Purchase and Partial Delivery at Blaine

This alternative combines several delivery and purchase components (Figure 2.3-2). Specifically:

The United States would deliver to Canada the energy component of the Entitlement (approximately 550 aMW) and 650 MW of its capacity component.

The United States would purchase, with a single payment, the balance of Canada's entitlement to capacity (approximately 750 MW).

Deliveries would be to Blaine or other points on BPA's existing transmission system as specified by Canada. For purposes of analysis, it is assumed here that deliveries would be at Blaine.

The following actions would be required:

Alternative A Components

UNITED STATES

Transmission Construction. One cross-Cascades 500-kV transmission line would be accelerated by 3 to 4 years compared to the Base Case if the majority of future generation occurs east of the Cascades. A second cross-Cascades line may also be accelerated.

Transmission Use. BPA would deliver power over the Northern Intertie at Blaine and BPA could purchase the right to store energy on the BC Hydro system for return at a later date.

Resource Development and Operation. The PNW would develop up to 550 aMW of energy and 650 MW of capacity, probably combustion turbines (CTs), and operate the system to serve Entitlement load.

Purchases. The PNW would purchase approximately 750 MW of capacity.

CANADA

Resource Development and Operation. In the long term, Canada would develop and operate 750 MW of capacity resources, probably new generators at existing hydroelectric facilities.

Transmission Construction. Compared to the Base Case, the need for the Nicola-to-Lower-Mainland (Meridian) and Oliver-to-Nicola 500-kV lines would most likely be delayed by several years.

Figure 2.3-2

2.3.3 Alternative B: PNW Purchase

In this alternative, PNW utilities would purchase the entire Entitlement (Figure 2.3-3). The following actions would be required:

Alternative B Components

UNITED STATES

Purchases. The PNW would purchase up to 1,400 of capacity and 550 aMW of energy.

Transmission. Requirements for cross-Cascades transmission are the same as the Base Case.

CANADA

Resource Development and Operation. In the long term, Canada would develop and operate up to 550 aMW of energy and 1,400 MW of capacity resources (probably CTs and new generators at existing hydroelectric facilities) to replace the Entitlement energy and capacity sold to the PNW.

Transmission Construction. Compared to the Base Case, the need for the Nicola-to-Lower Mainland (Meridian) and Oliver-to-Nicola 500-kV lines most likely would be delayed by several years. The need for a third 500-kV line segment, Selkirk-to-Oliver (164 km, 102 mi) may be slightly accelerated from when it might otherwise be needed.

Figure 2.3-3

2.3.4 Alternative C: PSW Purchase

In this alternative, the PSW would purchase the entire Entitlement, which would be delivered to the PSW over the PNW-PSW Intertie (Figure 2.3-4).

The following actions would be required:

Alternative C Components

UNITED STATES

Transmission Use. BPA would deliver power over the PNW-PSW Intertie to the PSW. In addition, BPA could purchase the right to store energy on the BC Hydro system, or could sell surplus energy to BC when transmission was constrained. Requirements for cross-Cascades transmission are the same as the Base Case.

Resource Development and Operation. The PNW would develop up to 550 aMW of energy and 1,400 MW of capacity resources (probably CTs) and operate the system to serve the Entitlement obligation.

Purchase. The PSW would purchase up to 1,400 MW of capacity and 550 aMW of energy.

CANADA

Resource Development and Operation. Canada would develop and operate up to 550 aMW of energy and 1,400 MW of capacity resources (probably CTs and new generators at existing hydroelectric facilities) to replace the Entitlement energy and capacity sold to the PSW.

Transmission Construction. Requirements are the same as for Alternative B. Specifically, compared to the Base Case, the need for the Nicola-to-Lower Mainland (Meridian) and Oliver-to-Nicola 500-kV lines most likely would be delayed by several years. The need for a third 500-kV line segment, Selkirk-to-Oliver (164 km, 102 mi) may be slightly accelerated from when it might otherwise be needed.

Figure 2.3-4

2.3.5 Alternative D: Partial Purchase and Partial Delivery at Blaine and Selkirk

This alternative (Figure 2.3-5) would combine purchase and sale components:

The PNW would deliver 650 MW capacity and a portion of the 550 aMW energy over existing facilities at Blaine.

The PNW would deliver 300 MW capacity and the remaining portion of the 550 aMW of energy over existing facilities at Selkirk.

The PNW would purchase 450 MW of capacity.

The following actions would be required:

Alternative D Components

UNITED STATES

Transmission Construction. One cross-Cascades 500-kV transmission line would be accelerated 3 or 4 years compared to the Base Case if the majority of future generation occurs east of the Cascades. A second cross-Cascades line might also be accelerated.

Transmission Use. BPA would deliver power over the Northern Intertie at Blaine and Selkirk.

Resource Development and Operation. The PNW would develop up to 550 aMW of energy and 950 MW of capacity resources (probably CTs) and operate the system to serve 550 aMW/950 MW of Entitlement load.

Purchase. The PNW would purchase 450 MW of capacity.

CANADA

Resource Development and Operation. In the long term, Canada would develop and operate 450 MW of capacity resources, probably new generators at existing hydroelectric facilities.

Transmission Construction. Requirements are nearly the same as for Alternatives B and C.

Figure 2.3-5

2.4 Environmental Impacts of Action Alternatives

Figure 2.4-1 summarizes the environmental consequences of the action alternatives and their component actions, and Figure 2.4-2 compares the action alternatives with the Base Case (the Proposed Action) in terms of the principal environmental impacts. Both figures appear at the end of this section.

Land Use, Biological, and Cultural Impacts

Land use, biological, and cultural resources impacts could be caused from two sources: new transmission line construction, and the construction and operation of new generating resources.

Transmission Line Construction. The Base Case would require the construction of new transmission lines in Canada and the United States, and may require acceleration of construction dates for two major lines in Canada. Some uses of the land would be precluded or changed, and impacts to vegetation and wildlife, water and fish, wetlands, and cultural and aesthetic resources could occur from clearing, erosion, and the physical presence of the line. While some impacts could be largely mitigated by location and design choices, others could be significant.

Because Alternatives A, B, C, and D do not directly require the construction of new transmission lines, they do not have the direct impacts associated in the Base Case with the construction of new transmission lines and substations in the United States and Canada. However, in Alternatives A and D, which involve partial deliveries at Blaine, the impacts from the construction of one or two cross-Cascades lines in Washington State would be accelerated 3 to 4 years, or maybe more. (Due to uncertain load growth and generation development scenarios, a cross-Cascades line without the Entitlement delivery may not be needed until after 2024.) The Entitlement delivery at Blaine makes impacts already predicted more likely to occur. In Canada, the land use, biological, and cultural resources impacts associated with the construction of new transmission lines from the interior to load centers on the Lower Mainland could be deferred by several years. Alternatives B and C, which consist of purchases of the Entitlement by the PNW and PSW, respectively, would also require no new transmission line construction in the PNW, and thus would have fewer of the land use, biological, and cultural resources impacts of transmission lines. In Canada, these two alternatives may delay the impacts of two Interior-to-Lower Mainland 500-kV lines by several years but slightly accelerate the need for the Selkirk-to-Oliver line, compared to the Base Case.

Generating Resources Construction and Operation. In the Base Case, the PNW probably would construct new combustion turbines (CTs) to support the delivery of Entitlement energy and capacity (see section 4.1.3.1). According to the *Resource Programs Final EIS* (DOE, February 1993), CTs typically require 0.06 hectares (ha) per MW (0.15 acres/MW) of capacity, or up to 84 ha (210 acres) for 1,400 MW capacity. Delivering the Entitle-ment to Canada would lead to the typical impacts of combustion turbines; however, if Canada re-marketed the Entitlement power south to the PNW or California, a similar amount of generation-related impacts might be avoided or deferred in the region that purchased the Entitlement power, as that region deferred acquiring its own generation.

In Alternative B (PNW purchase), these land use requirements would not occur in the PNW. Instead, Canada would develop resources to support a sale of Entitlement energy and capacity to the PNW. It is likely that Canada would use a combination of new generating units at existing hydroelectric facilities (for capacity) and CTs (for energy). Assuming that CTs were constructed to provide energy only, as much as 33 ha (83 acres) of land might be required for 550 MW.

In Alternative C, the PSW would purchase the entire Entitlement amount. The PNW would have to develop capacity and energy resources to support the Entitlement sale to the PSW, and Canada would have to develop capacity and energy resources to replace the Entitlement. Both the PNW and Canada would experience the land use and other impacts associated with the construction and operation of these new generation resources. In the PSW, some new CTs might be deferred, thereby avoiding their land use and water impacts; however, it is likely that, instead, the operations of some existing thermal resources would be displaced (and, therefore, there would be no avoided land use impacts).

In Canada, Alternatives A, B, C, and D would require the development of new resources to support capacity purchases

by the United States (more for Alternatives B and C, in which the United States would purchase 1,400 MW capacity from Canada, and less for Alternatives A and D, which involve smaller capacity amounts). Although in the short term the BC Hydro system may have surplus capacity, in the long term, additional capacity resources would need to be developed to support the sale. It is likely that these capacity resources would be new generators at existing hydroelectric facilities. While land use requirements should be minimal, new generators could affect dissolved gas concentrations and water temperature at existing hydroelectric facilities. Depending on the design and operation of the existing and new facilities, dissolved gas concentrations and water temperatures could increase or decrease, with the potential to affect resident fish. The Base Case would not cause these impacts.

Air Quality

The major air quality impacts of all of the alternatives would result from the operation of thermal generation.

In the Base Case (the Proposed Action), the PNW would deliver the entire Entitlement to Canada. While the Entitlement delivery would be a system transaction, supported by the entire generation system, it is likely that the capacity and energy resources added in the PNW to replace the Entitlement would be CTs. Gas-fired CT emissions include nitrogen oxides, carbon monoxide, and carbon dioxide. The amounts and environmental impacts of such emissions can vary considerably according to the CT's design, air pollution controls, and location. Delivering the Entitlement to Canada would lead to the typical air quality impacts of combustion turbines; however, if Canada re-marketed the Entitlement power south to the PNW or California, a similar amount of generation-related air quality impacts might be avoided or deferred in the region that purchased the Entitlement power, as that region deferred its own generation acquisitions.

In Alternative B, the PNW would purchase the entire Entitlement, and the CT emissions in the PNW associated with the Base Case would be avoided entirely and would instead occur in Canada, which would likely develop and operate CTs to replace the energy component of the Entitlement.

In Alternative C, the PNW would deliver 1,400 MW of capacity and 550 aMW of energy to the PSW and both the PNW and Canada would experience the air quality impacts of new generation. In the PSW, the Entitlement energy and capacity would be used to defer the development of new thermal resources, or to displace the operations of existing thermal units (which are often older, less efficient, and more polluting than the new CTs being developed in the PNW). Compared to the Base Case, the net effect of Alternative C transactions would be greater air quality impacts in Canada, approximately the same impacts in the PNW, and fewer impacts in the PSW.

Although in Alternatives A and D less capacity would be delivered than in the Base Case, the same amount of energy would be delivered (550 aMW). For that reason, it is likely that the same amount of CT emissions would be generated in the PNW in Alternatives A and D as in the Base Case.

Several of the alternatives may affect Intertie use in ways that lead to off-setting impacts on air quality. In Alternative C, the Entitlement would be delivered over the PNW-PSW Intertie to the PSW. Some other BPA sales of economy energy to the PSW would probably be displaced because either the Intertie capacity was used up, or the economy energy market in the PSW was exhausted. If the economy energy could not be sold to the PSW, it would probably be sold on the economy energy market in the PNW to displace generating resources with higher marginal costs, or spilled. Because PNW thermal resources tend to be the region's higher-marginal-cost resources, economy energy sales within the region would probably displace PNW thermal generation (typically coal and older, less efficient CTs), reducing air impacts from those sources. If, as in Alternative C, the entire Entitlement were sold to the PSW, as much as 1,400 aMW of thermal resources could be displaced in the PNW.

In Alternatives A and D, the Entitlement would be delivered to Blaine over the existing Northern Intertie, precluding some other south-to-north transactions, such as storage agreements, over that facility. Some of the energy that could not be transmitted north for storage on the BC Hydro system would probably be sold on the spot market as economy energy. Purchasers of economy energy would probably use it to displace higher-cost thermal generation units in the PNW or PSW, potentially leading to reductions in air emissions compared to the Base Case.

Figure 2.4-1, page 1

Figure 2.4-1, page 2

Health and Safety

BPA recognizes the strong public concern regarding the possible effects of transmission line electric and magnetic fields (EMF) on public health and safety (see section 4.1.1.1). In Alternatives A, B, C, and D, new transmission construction would not be immediately required, as in the Base Case, and public health and safety from EMF would not be an issue. However, as explained above, in Alternatives A and D, impacts of cross-Cascades transmission lines in the United States would be accelerated several years, and the impacts of Interior-to-Mainland transmission lines in BC would be deferred several years.

Socioeconomics

In terms of socioeconomic impacts, the principal difference between the Base Case (the Proposed Action) and the other alternatives relates to their different costs, which stem from a number of factors. In all the alternatives to the Base Case, in the United States, a new transmission line from the Grand Coulee area to the Canadian border would not have to be constructed, a potential cost savings in the United States, depending on the price and quantity and power purchased under the other alternatives. However, in Alternatives A and D, accelerating by several years the major investment for a cross-Cascades transmission line could, in present-worth terms, have a real cost impact. Also, in Alternatives A and D, BPA delivery of the Entitlement over the existing Northern Intertie could preclude other south-to north transactions and potentially reduce BPA's or other Northwest utilities' revenue. In Alternative C, use of the PNW-PSW Intertie to deliver the Entitlement to the PSW could preclude other transactions with the PSW and potentially reduce BPA revenues. In Alternatives A and C, provisions for BPA to store or exchange energy with BC Hydro in certain circumstances might reduce those revenue impacts.

Because none of the alternatives to the Base Case would require construction of a new transmission line in Canada from the border to a new substation near Oliver (as in the Base Case), Canada's construction costs for that line could be avoided. In addition, those alternatives would not incur the costs of new Interior-to-Lower-Mainland transmission lines as soon as in the Base Case, a real cost savings.

Section 4 of the Delivery of the Canadian EIS contains preliminary costs estimates for U.S. transmission construction required or potentially required, if applicable, for the base case and each of the alternatives. These estimates represent only the capital cost to build the facilities. When comparing socioeconomic of Alternatives A, B, C, and D, where the United States purchases all or a portion of the Canadian Entitlement, to the Base Case, considerations other than the construction costs estimates must be included. These considerations include but are not limited to:

- allocating costs and benefits to other uses of the transmission facilities,
- transmission stability, reliability, and loss benefits resulting from new transmission construction,
- new market opportunities arising from new transmission facilities, and
- The cost of purchasing all or some of the Canadian Entitlement under alternatives A, B, C, and D, and how these costs compare to the cost of alternative resources available in the PNW and BC.

Figure 2.4-2

Cumulative Impacts

Each of the components that make up alternatives for the delivery of the Entitlement has the potential to contribute to cumulative impacts on the environment. Transmission construction could in some cases create impacts to land use, soils, water bodies, and fish that in and of themselves are not major, but which may become major when added to the impacts of other construction activities. This would be particularly true for construction that would take place in areas where transmission line or other construction has already occurred (such as the cross-Cascades transmission line). The cumulative impacts of transmission construction would be addressed more specifically in the NEPA review that would be conducted before any such alternative would be implemented.

Some Entitlement delivery alternatives would make use of the BPA transmission system and/or the Northern or PNW-PSW Interties. This use of the transmission system would occur in addition to, and could displace, other uses of the transmission system. This potential is discussed in this EIS (section 4.1.2).

The cumulative impacts of resource development and operation are addressed in the *Resource Programs Final EIS* (DOE, February 1993), which provides information about the cumulative environmental impacts of adding different sets of conservation and generation resources to the existing power system.

Relationship Between Short-Term Uses of the Environment and the Maintenance of Long-Term Productivity

Alternatives for Entitlement delivery may involve both short- and long-term uses of the environment. All of the alternatives that involve the construction of new transmission facilities or new generation would cause short-term impacts, including noise, soil compaction and erosion, and water and air quality degradation. In the long term, there could, in some cases, be loss of habitat for wildlife, altered land uses, degradation of air quality, and contributions to global warming. Many of these impacts would be site-specific or mitigable, and would be addressed in site-specific environmental documentation prepared for specific alternatives, should such an alternative ultimately be selected.

Both the short-term and long-term uses of the environment will, however, have a beneficial effect on long-term productivity. Fulfilling the United States' Treaty obligations with Canada will allow the continued joint operation of the Columbia River hydroelectric system. Joint operations with shared reservoir storage greatly increase the productivity and efficiency of electric systems in both countries, and reduce by several hundred megawatts the amount of generation or conservation resources that would otherwise be required to serve electric loads in the PNW and BC.

Irreversible or Irretrievable Commitments of Resources

Each alternative that involves the construction of new transmission facilities or the development and operation of new generation resources involves irreversible and irretrievable commitments of resources. In the case of transmission facilities construction, materials involved (e.g., the metals, concrete, and other materials used to construct transmission lines and substation equipment) would be irretrievably committed. Similarly, the materials and fuels used to construct and operate new generation resources would be irretrievably committed.

2.5 Environmentally Preferred Alternative and the Preferred Alternative

A review of the environmental impacts of the alternatives documented in Figures 2.4-1 and 2.4-2 shows that Alternative B--PNW Purchase, is the environmentally preferred alternative. Impacts of new generation would shift from the United States, where they are likely to be primarily the air quality impacts of new CT generation, to Canada, where new CTs and/or new generators at existing hydroelectric facilities would be likely to be developed to serve the Entitlement loads. It is not clear whether this shift of the location and type of generation would be environmentally preferable. However, the reduction in environmental impacts of transmission line construction associated with this alternative is clearly environmentally preferable. In the United States, the land use, biological, cultural, and visual impacts associated with new transmission lines would not occur, and in Canada, similar impacts of transmission line construction would not take place (Oliver to the border) or, for the most part, would be delayed (i.e., the Oliver-Nicola-Meridian segment).

The United States Entity has identified the Base Case (Proposed Action) as the preferred alternative.

The Treaty specifies that the Entitlement be delivered to Canada at a point on the border near Oliver, BC (the Base Case), unless the Entities agree to other arrangements. In April 1993, consultations began between the United States and Canadian Entities on how to accomplish delivery of the Entitlement through 2024, the earliest the Treaty can be terminated. At the conclusion of these consultations, the United States and Canadian Entities were unable to agree on

alternative arrangements for delivery and disposition of the Canadian Entitlement.

Because the only unilateral action that the United States Entity can take to fulfill its Treaty obligations is to deliver the Canadian Entitlement to Oliver, BC, the Base Case (Proposed Action) is selected as the preferred alternative.

Chapter 3: Affected Environment

The environment affected by the alternatives is quite broad. Northern Washington and southern BC could be affected by transmission line components of delivery alternatives. The generation projects that would be built to support the block of power represented by the Entitlement, and the projects that would be deferred because of the availability of the Entitlement power, could be located in the PNW, BC, California, or the Inland Southwest (ISW).

This chapter describes elements of the environment relevant to the types of environmental impact created by the various components. For example, the descriptions of land uses, vegetation, and wildlife focus on the regions that may be affected by transmission line construction (that is, northern Washington and southern BC), whereas the summary of air quality issues includes California and the ISW (where air emissions from thermal power plants might change because of purchases of Entitlement power).

Because many alternatives for Entitlement delivery would require follow-on site-specific NEPA analysis, this description gives only a general picture of the environment that may be affected. Source documents include the *Resource Programs Final EIS* (DOE, February 1993), the *Puget Sound Area Electric Reliability Plan Final EIS* (DOE, April 1992), and the *Non-Federal Participation in AC Intertie Draft EIS* (DOE, August 1993).

3.1 Geography and Land Use

Pacific Northwest. The Columbia River system and the Cascade Mountains define the geography and land uses of the study area in the PNW. Beginning in southeastern BC, the Columbia River flows generally south and west for 1,942 km (1,214 mi) to the Pacific Ocean (1,197 km (748 mi) in the United States). It passes through scenic and recreation areas and irrigates agricultural land in the plateaus east of the Cascade Mountains on its way to the Pacific Ocean.

The Columbia River cuts one of the few passes through the Cascades, which run north to south and divide Oregon and Washington into two unequal and widely different climatic regions. The coastal climate is mild and wet, with only occasional extremes of temperature. The Cascades, with their high point at Mount Rainier in Washington (4,323 m; 14,410 ft), prevent much of the moist Pacific Ocean air from reaching the east side of the Cascades. There, most of the precipitation occurs in the winter in the form of snow, and summer months are hot and dry.

Much of the region is forested, primarily with Douglas fir or varieties of pine (Map 2). The higher rainfall west of the Cascades produces denser forests. Agriculture is centered in the Willamette Valley of Oregon and on the Columbia River Plateau and the Yakima River Valley in Washington. The largest urban/industrial centers are in the Interstate 5 corridor from Puget Sound to the southern Willamette Valley. The major population center east of the Cascades is Spokane, Washington, although towns near recreation areas such as Yakima, Washington, and Bend, Oregon are growing rapidly.

The study area is rich in visual beauty. Mountain ranges, forests, and alpine environments dominate the western half of the study area; valleys and rolling hills with pastures, cultivated fields, or open stands of trees predominate in the eastern portions. Recreation is dispersed throughout the region's forests, mountains, and rivers. State and Federal governments have designated many special status areas, including national and state parks, wilderness areas, wild and scenic rivers, and national trails and historic sites. Other special status areas, including national forests, wildlife refuges, and the Colville Indian Reservation, provide for multiple uses (Maps 3 and 4).

British Columbia. The geography and land uses of BC, like the PNW, center on mountain and river systems. The Columbia River is born in Columbia Lake, in the Canadian Rocky Mountains in southeastern BC. The river flows north, then turns sharply south to the international border, for a total of 745 km (463 mi) and a drainage area of 102,830 km2 (39,550 mi2) in Canada. Near the border, it is joined by the Kootenay River, which begins in the Canadian Rockies, proceeds south into Montana and Idaho (where it is called the Kootenai), then returns north into Canada before joining the Columbia. The Peace River, which also begins in the Canadian Rockies in eastern BC, flows north and east into Alberta, eventually emptying into the Arctic Ocean. Regulation of these river systems by dams has reduced seasonal flow variations and, on the Columbia, reduced the occurrence and severity of floods. Dams on the rivers also produce power.

In general, land uses in BC include forestry, mining, and mineral processing, as well as some cattle ranching and tourism. Because much of the terrain is mountainous, there is little arable land, although agriculture flourishes in a few river valleys in the southern part of the province. The forest industry dominates western BC; the eastern part includes a broader mix of uses, such as agriculture, forestry, mining, oil and gas, and transportation. BC's waters produce a rich harvest of fish, including salmon. Water resource uses also include recreation, transportation, and power production.

California and the Inland Southwest. The southern Cascade Mountains and the Sierra Nevada form California's backbone, a barrier the length of the state that is crossed in only a few places. Elevations reach over 4,267 m (14,000 ft) above sea level at Mt. Whitney and Mt. Shasta. The majority of the mountain ranges trend north-south and exert major influences on the climate of the region, with extremes in several areas.

To the west of the barrier lie the Great Valley and the California Coast Ranges. The valley contains the major population centers and is a high-value agricultural area, heavily irrigated. The Coast Ranges, mostly lower than 1,500 m (5,000 ft) support commercial forestry, grazing, and specialty crops such as wine grapes. To the east of the Cascades and Sierras is a semi-desert region of plateaus, basins, plains, and isolated mountain ranges.

In the ISW, the Colorado River Basin is the major drainage, rising on the Continental Divide and ending at the Pacific Ocean. It contains major multipurpose dams, such as Hoover Dam, which provide electric power, water supplies, and recreation areas. The land is arid, except for the Rocky Mountains, which are moderately wet; most precipitation in the region occurs in the mountains. Land use includes mining and mineral processing, cattle ranching, and farming. Most agriculture depends on irrigation.

3.2 Existing Power System

3.2.1 Load Centers

In the PNW, population centers around Seattle/Tacoma and Spokane (Washington), Portland/Vancouver (Oregon/Washington), and Eugene/Springfield (Oregon). Estimates indicate that the population in Washington grew from about 4.13 million in 1980 to about 4.87 million in 1990, a 17.9 percent net increase and an annual rate of growth of 1.7 percent. The population of Oregon increased from about 2.63 million in 1980 to an estimated 2.85 million in 1990, an 8.2 percent net increase and an annual growth rate of 0.8 percent.

In California, population is concentrated in Los Angeles, San Diego, San Francisco, San Jose, and Sacramento. The much smaller population of the ISW is clustered in the Salt Lake City, Phoenix, Tucson, Albuquerque, Santa Fe, Las Vegas, and Reno metropolitan areas. The population of the region as a whole is 36,264,000, with nearly 29,500,000 in California. (California State Department of Finance, Demographic Research Unit.)

Population in BC is centered in the Lower Mainland around Vancouver, Victoria, and a few smaller cities. The population of the province has grown from about 2.5 million in 1976 to about 3 million in 1990 (Canadian Consulate General, Office of Tourism). BC Hydro has projected an annual population growth of about 1.6 percent through 1999 and 1.3 percent for the following 10 years.

3.2.2 Energy Resources

Pacific Northwest. Hydroelectric projects produce about two-thirds of the total electricity used by the PNW. The 58 major hydroelectric dams, including 31 federally owned dams, have a combined capacity of approximately 22,000 MW (Figure 1-1)**.** In an average year, 16,400 aMW of hydropower are produced. In the United States, major Federal storage reservoirs exist behind Libby, Grand Coulee, Albeni Falls, Hungry Horse, and Dworshak Dams. The three Canadian Treaty dams (Mica, Keenleyside, and Duncan) also provide substantial water storage for the Columbia River Basin.

Streamflow and run-off in the system vary greatly according to weather and other natural conditions. The average annual run-off is about 165 km3 (134 MAF), but it has varied from about 96 to 238 km3 (78 to 193 MAF). The monthly mean natural streamflow at The Dalles, Oregon, ranges from 1,133 m3/sec (40,000 cubic feet per second (cfs)) in winter, to 16,992 m3/sec (600,000 cfs) in the spring.

The total usable storage capacity of the Columbia River system is about 52 km3 (42 MAF), or less than a third of average run-off. Half of that storage capacity is in Canada. The Canadian portion of the storage is operated by BC Hydro. The PNW and BC Hydro coordinate operation of the hydro system to increase flexibility and to enhance power production.

While the Treaty required a certain amount of storage behind Canadian dams (see Chapter 1), BC Hydro also built storage on the Columbia River system in excess of that amount. This non-Treaty storage includes Revelstoke Dam and an additional 5.55 km3 (5 MAF) of usable storage at Mica. BC Hydro and BPA have signed a Non-Treaty Storage Agreement, which captures some additional efficiencies due to diversities in loads, resources, and run-off patterns.

Electricity for the region is also produced at 14 coal units and 1 commercial nuclear plant. Another important part of the region's resource mix is energy conservation. Conservation programs are designed to improve the efficient use of electricity across all broad end-use categories (residential, commercial, industrial, and agricultural sectors).

British Columbia. BC Hydro, a provincial crown corporation, was established to generate, transmit, and distribute electricity. It serves almost 1.3 million customers in an area containing over 92 percent of BC's population. Remote communities that are not integrated into BC Hydro's transmission system are served by small, local generating plants. West Kootenay Power Ltd., a private utility, serves approximately 98,000 customers directly or through wholesalers in the south-central interior of BC Hydroelectric generation accounts for about 90 percent of the province's electricity production. The only major thermal plant is a natural gas facility on Burrard Inlet near Vancouver, BC

California and the Inland Southwest. Half of California's generating capacity consists of oil- and gas-fired power plants. The remainder includes hydro (about 20 percent), followed by nuclear, coal, geothermal, and cogeneration. Investor-owned and municipal utilities, the California Department of Water Resources, and the Western Area Power Administration (a Federal power marketing agency) together can generate 45,000 MW with their systems.

The peak load demands of the PNW and California occur at different times. The PNW peaks occur in winter, while California's demand peaks in summer. During the summer, the hydro-based systems in the Northwest tend to have excess capacity that could be used to help meet California's peak demands. Similarly, California's thermal-based system tends to have excess capacity in the winter, which can be used to help the Northwest meet its peak demands. BPA currently has several seasonal energy and capacity/energy exchange contracts with California utilities.

The ISW resource mix includes hydro, coal, gas, oil, and nuclear generation. Coal provides about 58 percent of the region's generation capacity. Oil- and gas-fired generation account for about 26 percent, hydropower produces about 17 percent, and the Palo Verde (AZ) nuclear plants 1 and 2 account for 9.3 percent of the region's installed capacity.

3.2.3 Transmission System

BPA owns and operates approximately three-quarters of the bulk transmission capacity in the PNW (Figure 3-1). With this capacity, BPA delivers power to its customers and makes transmission capacity available to other utilities.

The Federal transmission system is comprised of about 23,680 km (14,800 mi) of high-voltage transmission lines, about 390 substations, and other related facilities. Included in this system are BPA's portions of the PNW-PSW Intertie, which, by the end of 1993, had a combined capacity, on four high-voltage lines, of about 7,800 MW. BPA owns approximately 72 percent of the portions of the PNW-PSW Intertie located north of California and Nevada. The PNW-PSW Intertie provides the primary bulk transmission link between the two regions.

BPA's transmission system also includes interconnections with BC at the international border near Blaine, Washington, (two 500-kV lines), at Nelway, BC (one 230-kV line), and at Waneta, BC (one 230-kV line). These lines, which comprise the Northern Intertie, have a total north-to-south transfer capability of 2,300 MW. (South-to-north capability is 2000 MW.) After the Northwest Washington Transmission Project is completed, the lines will have a north-to-south capacity of 3,150 MW. The interconnections allow the PNW and BC to undertake many mutually beneficial arrangements.

3.3 Physical and Biological Environment

3.3.1 Biological Resources

3.3.1.1 Vegetation

Pacific Northwest. The northwest United States is among the more diverse regions of North America. It contains wet coastal and dry interior mountain ranges, miles of coastline, interior valleys, basins, and high desert plateaus. Moisture, temperature, and substrate vary greatly, as does the vegetation (Map 2).

Douglas fir forests dominate the native vegetation from the coast to about 1,500 m (5,000 ft) up the moist western slopes of the Cascades. The drier east side of the Cascades supports yellow pine/lodgepole pine forests.

The forests of the western Cascade Mountains comprise the most densely forested region in the United States. These forests are the most extensive and largest temperate coniferous forests in the world. The climax forests of this area are almost totally dominated by coniferous species. The climax forests found by the European migrants were comprised of trees several feet through at the base, several hundred feet tall, and several centuries old. Much of this virgin forest

was removed by forestry, wildfires, and clearing for agriculture and other development and is now second-growth forest.

Much of Washington and Oregon east of the Cascades is arid to semi-arid, with low precipitation, warm to hot summers, and cold winters. The region is dominated by shrubs and grasses. Juniper is an invading species. Forest vegetation is generally found in areas with more than 38 cm (15 in) of annual precipitation and at higher elevations.

Figure 3-1

Much of this area has been changed by wildfire and grazing. The two dominant native shrubs are sagebrush and rabbit brush. Both can be eliminated from an area for decades by fire. The major perennial grasses are bunch grass and fescue. Neither is adapted to heavy grazing. Two alien species that are well adapted to the region and able to invade burned or heavily grazed areas are cheatgrass and poa.

Forests, wetlands (including streams, lakes, and ponds), and shrub-steppe habitat types are classified as Priority Habitats by Washington State's Department of Fish and Wildlife.

British Columbia. The lands surrounding the headwaters of the Columbia and Peace Rivers in BC are heavily forested. Douglas fir is prominent in the mountains of this area, and the valley bottoms in most areas are characterized by stands of western hemlock. The south-central portions have dense forests on north-facing slopes, with scattered clumps of pines and open grassland on south-facing slopes. The upland, subalpine zone includes Englemann spruce and lodgepole pine.

3.3.1.2 Fish and Wildlife

Wildlife. The fish and wildlife of the Northwest are diverse, with creatures from large mammals, to fish, to birds, insects, and reptiles, all contributing to the ecological health of the region. Some arouse special interest because of their economic and recreational value, or because they are listed for protection by a State or the Federal Government (see Appendix A)**.**

Species considered important for recreation (hunting or watching) include mammals such as deer, elk, moose, pronghorn antelope, sheep, goats, and wild pigs; and all kinds of birds, including hunted species such as pheasants, geese, ducks, quail, and grouse. Many of these are Washington State Department of Fish and Wildlife Priority Species.

Protected animals under Federal and/or State laws include carnivores such as the gray wolf and the grizzly bear, as well as Columbia white-tailed deer, mountain caribou, pygmy rabbit, shrews, squirrels, gophers, chipmunks, a mouse, voles, and bats. Protected birds include the Aleutian Canada goose, peregrine falcon, sandhill crane, eagles, the spotted owl, and the white pelican. Other species, including several turtles, butterflies, beetles, snails, salamanders, and snakes, are also on protected lists. Additional species are candidates or are being monitored for either State or Federal protected status.

Wildlife in BC includes large populations of elk and deer, as well as mountain goats in higher elevations. Predators include the timber wolf, black and grizzly bears, and cougars. The area also supports raptors, including bald eagles, hawks, and falcons.

Fish. The PNW supports a large number of anadromous fish (species that migrate down river to the ocean to mature, then return upstream to spawn) (Map 5). The principal anadromous fish runs in the Columbia Basin are chinook, coho and sockeye salmon, and steelhead trout.

These fish are an important resource to the PNW, both for their economic value to the sport and commercial fisheries, and for their cultural and religious value to the region's Indian Tribes and others. Several species have been listed

under the Federal Endangered Species Act (ESA) as threatened or endangered, including Snake River sockeye and Snake River spring, summer, and fall chinook.

Northwest waters, including reservoirs behind dams, such as Lake Koocanusa, also support varied populations of resident fish-fish that live and migrate in fresh water. Popular resident game fish that could be affected by the Entitlement alternatives include western cutthroat trout, rainbow trout, Dolly Varden (bull trout), and kokanee salmon.

Anadromous fish have been blocked from the Columbia River above Grand Coulee Dam. However, in Canada the Columbia still supports stocks of rainbow trout, Dolly Varden char, kokanee, cutthroat trout, and mountain whitefish, although loss of reproductive habitat in tributary streams, elimination of productive littoral areas, and blockage of migration routes is affecting these populations as well.

The Mica Dam reservoir and its tributaries support populations of Dolly Varden char, rainbow trout, mountain whitefish, burbot, squawfish, and suckers. Duncan Reservoir supports small populations of rainbow trout and Dolly Varden char but is essentially unproductive due to glacial silt conditions. Duncan River, however, provides spawning habitat for the economically important Kootenay Lake rainbow trout and kokanee stocks. Changes in water flow and temperature have threatened these Duncan River stocks.

3.3.2 Cultural Resources

Cultural resources are the nonrenewable evidence of human occupation or activity as reflected in any district, site, building, structure, artifact, ruin, object, work of art, architecture, or natural feature that was important in human history at the national, state, or local level. Often these resources, especially Indian burials and ancient habitations, are found along rivers and streams and near reservoirs. Cultural resources that could be affected are located throughout the study area (Map 6).

3.3.3 Air Quality

United States. Pollutants of primary concern in this analysis are those produced by extracting, processing, transporting, and burning oil and gas to produce electric power. Principal pollutants produced are the federally designated "criteria pollutants": sulfur dioxide (SOx), nitrogen oxides (NOx), particulates, hydrocarbons, ozone, carbon monoxide (CO), and lead. Of these, particulates, CO, and NOx are common emissions from electrical generation relying on gas-fired combustion. Carbon dioxide (CO2), a major by-product of burning fossil fuels and other carbonaceous materials, may contribute to global climate change. Combustion generating plants may also emit heavy metals, radionuclides, and hazardous compounds.

Air quality is a concern in certain defined air basins-usually in and around large urban areas-and around certain existing generating plants. In these areas, more stringent controls are required for existing facilities, and any new major project must satisfy additional restrictions. Nonattainment areas have air pollution concentrations that do not comply with a portion of the National Ambient Air Quality Standards. In addition, California has adopted the California Clean Air Act, which established the most stringent air quality standards in the nation. Much of California currently violates both national and State of California air quality standards.

Pollutants of particular concern in this EIS and locations within the study area that have been in non-attainment in the recent past are as follows:

Carbon Monoxide (CO)

Major population centers of each state in the study area

Nitrogen Dioxide (NOx)

South Coast Air Basin in California

Atmospheric Ozone

Portions of Oregon, Washington, California, and Arizona (some areas are in violation longer or more often than others)

Although CO2 and other "greenhouse gases" concern many scientists and other people, no standards currently exist nor are concentrations monitored.

Detailed information about generating technologies and their associated emissions, as well as details of Federal and California air quality standards, are found in both the *Resource Programs Final EIS* (DOE, February 1993) and in the *Non-Federal Participation in AC Intertie Draft EIS* (DOE, August 1993) and their appendices.

British Columbia. Air quality over BC is generally in the "good" to "fair" ranges, with only occasional episodes of air pollution in the "poor" range and no episodes in the "very poor" range (Greater Vancouver Regional District Air Monitoring System, 1988). Emissions of carbon monoxide and nitrogen oxides make up the majority of pollutants in urban areas, while particulate matter from wood-burning appliances makes up the bulk of air pollution in rural areas.

3.4 Socioeconomic Conditions

Pacific Northwest. In the last 10 to 15 years, the resource-based economy of the PNW has developed more diversity. High-technology manufacturing has increased its percentage of total manufacturing employment, while the lumber and wood products industry and food processing have lost employment share. Overall, manufacturing employment fell from 19.4 percent in 1980 to 17.3 percent in 1990. In contrast, the non-manufacturing share of total employment rose from 80.6 to 82.7 percent. A rise in wholesale and retail trade and services accounts for most of the gain.

The advantage of low-cost energy relative to other areas has strengthened the region's economic base. Due to the availability of natural gas from Canada and the region's hydro base for electricity, the PNW has a long-term energy advantage. On average recently, the region's electricity prices ran 40 percent lower than the national average and natural gas prices were 16 percent lower.

California and the Inland Southwest. California has a rich endowment of natural resources, amenities, and climate. The state is a major source of the nation's fruits and vegetables. Its agricultural sector ranks first in the nation in cash value. Lumber production is second only to Oregon, and its mining production ranks among the top three states. Employment in manufacturing industries is the leading source of personal income, followed by government, wholesale and retail trade, and service occupations. The entertainment industry, although it has declined somewhat since World War II, is still a significant part of the State's economy, while tourism is one of the fastest growing sectors.

The economy of the ISW is based on mining and ore processing, manufacturing, services, agriculture, and tourism.

British Columbia. The economy of BC, especially the areas through which the Columbia and Peace Rivers flow, is heavily resource based. Forestry, mining, and mineral processing industries are important sources of income and employment. In many cases, these industries rely on the river system either for power or transportation. The river systems also are closely tied to another important economic base--tourism and recreation. Petroleum and natural gas

production also are important to the economy, and hydroelectricity, natural gas, and coal are abundant enough to export.

   

Chapter 4: Environmental Consequences

Figure 4-1

The alternatives for delivery of the Canadian Entitlement encompass a number of components, each involving actions in the United States and connected actions in Canada (Figure 4-1-Overview of Action Alternatives, Components, and Actions). This chapter describes the **components** and their environmental consequences. Chapter 2 summarizes the overall environmental effects of **alternatives** (that is, the sets of components that each provide a means to deliver the Entitlement).

For a number of the transmission components, only the broadest information about location and design is available, especially in Canada. Judgments about levels of impact are based on knowledge of the kinds of impacts transmission lines generally create, and on limited mapped information. While analysis at this level provides a picture of the relative impact levels among the alternatives, an additional, site-specific NEPA analysis would be required before transmission components could be implemented. Likewise (as described in more detail in the *Resource Programs Final EIS*), site-specific NEPA analysis would be completed for any generation resources that BPA would acquire to serve its loads, including the Entitlement.

The environmental analyses in this document use the following definitions of impact significance:

Major Impact

A major impact meets one or more of the following conditions:

1. Creates an impact that cannot be fully mitigated

2. Substantially reduces the quantity or quality of a regionally or nationally significant resource

3. Affects the long-term productivity of the environment

4. Irreversibly or irretrievably damages significant resources

5. Consumes significant quantities of non-renewable natural resources

Moderate Impact

A moderate impact meets one or more of the following conditions:

1. Creates an impact that can largely be mitigated

2. May affect the quantity or quality of a regionally or nationally significant resource

3. May affect the long-term productivity of the environment

4. May involve some irreversible or irretrievable damage to the environment

5. Consumes only moderate quantities of non-renewable natural resources

Little or No Impact

Little or no impact means an impact that meets one or more of the following conditions:

1. Creates few or no impacts that must be mitigated

2. Does not reduce the quantity or quality of a regionally or nationally significant resource

3. Unlikely to affect the long-term productivity of the environment

4. Involves little or no irreversible or irretrievable damage to the environment

5. Consumes only minor quantities of non-renewable natural resources

Figure 4.1-1

4.1 United States Components

4.1.1 Transmission Construction

Although the Treaty identifies Oliver as the delivery point for the Entitlement, the United States and Canadian Entities could agree to deliver at another location, or at a combination of several locations. The PNW and BC transmission systems currently connect at the international border near Blaine, WA and near Nelway, BC (north of Boundary Dam on the Pend Oreille River) (Figure 3-1). Depending on the amounts of Entitlement power delivered at each location, different new transmission facilities would be required on either side of the border to connect the mainstem United States Columbia River hydroelectric generation facilities and the major load centers in BC-primarily in the greater Vancouver metropolitan area, known as the "Lower Mainland." The following sections first describe the typical environmental effects of all high-voltage transmission facilities, and then identify the specific facilities required to deliver various amounts of power at each point of delivery and the environmental impacts associated with each (where known).

4.1.1.1 Environmental Impacts of Transmission Lines

A number of environmental impacts are typically associated with the construction and operation of high-voltage (230-kV and above) transmission lines, no matter where they are located, as illustrated in Figure 4.1-1.

Land Use. Land use impacts are directly related to the amount of new and existing rights-of-way used. Building a transmission line where none has existed before could have a major impact to residential, commercial, agricultural, and forest land because new line segments and access roads would intrude on existing land use or eliminate some uses altogether. A transmission project which proposes to widen existing right-of-way or rebuild a line within the same width creates fewer impacts to most, though not all, land uses. Where visual quality has already been affected by existing transmission lines, for example, adding another may not change conditions significantly. An expanded right-of-way on commercial forest or farmland, on the other hand, could have a major impact because new land would be

cleared or removed from production. High voltage lines create long-term visual impacts to most land uses, although they may be more compatible with industrial areas.

Agricultural land would be permanently removed from production where towers are placed in cultivated fields; however, most access roads in farmland, other than existing roads, are used only during construction, after which the land is restored to its original use. Although structures could interfere with farming operations, often they can be located or designed to reduce impacts. Transmission lines most significantly affect irrigated farmland and cropland with perennial crops such as vineyards or orchards. It is difficult for farmers to cultivate around tower sites in the middle of fields and difficult and expensive to adjust irrigation equipment to tower sites. Loss of orchard land or vineyards to tower sites represents loss of a long-term investment, in addition to loss of annual income from the crops.

Commercial forest land (except Christmas tree farms or nurseries) would be removed from production for any new or expanded right-of-way and access roads, because only low-growing trees and shrubs are allowed on the right-of-way.

Effects on recreational land use are primarily visual (see Visual Resources).

Transmission lines near airports create significant hazards to aircraft. Normally, such locations are avoided. However, if a line must be located near an airport, towers are marked to Federal Aviation Administration (FAA) specifications to make them clearly visible to pilots. These markings may be an unwelcome visual impact to other users.

Soils and Geology. If construction occurs in areas with steep slopes and moderate soil erosion potential, soil may erode. This is true for construction in new, expanded, or existing corridors, although the greatest potential for impact would be in a new corridor because new right-of-way generally requires new access roads. If erosion is severe, vegetation recovery may be slow, and slumping (mass movements of soil down slope) and sedimentation of nearby streams may occur. Because line maintenance requires using access roads, soil impacts may continue over a long period. Recreational use of access roads by off-road vehicles (ORVs) may increase erosion.

Areas of severe weather conditions can create problems in maintaining a transmission line's reliability. Heavy snow or ice loads and avalanches can cause a line to fail by toppling towers or causing conductors to sag to the ground. While engineers can design towers to withstand such forces, such structures increase a line's cost. If possible, lines are sited to avoid such conditions.

Floodplains and Wetlands. Construction of structures and access roads may adversely alter wetlands and destroy vegetation and fish and wildlife habitat unless special construction practices are used. Long-term impacts are caused when heavy construction equipment compacts the soil, which changes the drainage patterns and sometimes vegetation types. Often, however, transmission lines can span or avoid smaller wetlands altogether, thus eliminating impacts entirely. If structures must be placed in a wetland, contractors use special tracked machines or mats to minimize impacts. If impacts still occur, Section 404 of the Clean Water Act requires onsite or offsite mitigation or compensation.

Water and Fish. Clearing new right-of-way, expanding existing right-of-way, and constructing access roads can increase sediments in streams. The extent of the effect depends on the proximity of construction activity to a stream. Accumulation of sediment may change pool shape and size and may affect water quality. If sediment and turbidity are increased, then aquatic plant productivity is decreased. In turn, aquatic insect food sources are reduced. These impacts move up the food chain, eventually reducing fish numbers. The increased sediments hinder the emergence of alevins (baby fish) from their eggs in stream gravels and decrease winter survival by filling in channel pore spaces and reducing the channel's potential to produce food. In most cases, proper erosion control practices result in only short-term sedimentation increases. For example, to protect its structures, BPA does not normally place them close to stream banks because erosion could undermine them, and does not allow construction equipment in streams. In steep areas, small streams usually are spanned. Revegetation to stabilize the soil and use of fabric fences to hold back silt also prevent sedimentation.

Use of herbicides to clear vegetation may also affect fish by removing vegetation that shades the water and keeps it cool. BPA meets State and Federal regulations for buffers beside streams and, if herbicides are used in these areas, they are sprayed by hand.

Transmission line options that use existing corridors would have the lowest impacts to water quality and fish because the right-of-way already would be cleared and most access roads would be in place.

Vegetation and Wildlife. Clearing new and expanding existing rights-of-way can create major impacts to vegetation. Existing vegetation is removed, and vegetation composition may change, most notably in forested areas where all tall-growing vegetation must be removed. Maintenance practices, including herbicide use and danger-tree cutting, ensure that only low-growing vegetation survives over the long-term. The resulting loss of large wood in streams could affect the quality of fish habitat. Although disturbed areas can be reseeded with low-growing plants, success rates vary. If a line uses existing right-of-way, little or no additional clearing of existing vegetation is needed.

Right-of-way clearing for new corridors changes the habitat for wildlife and increases access for hunters. Expanding existing right-of-way would disturb wildlife or cause them to leave the area during construction. This impact can be especially severe during breeding, calving, or other critical seasons. Right-of-way expansion would change some habitat permanently. Due to the scarcity of snags, new clearing is especially detrimental to snag-oriented wildlife. Using existing right-of-way would disturb wildlife during construction only.

Visual Resources. In areas used for recreation, particularly in undeveloped places, studies show that many users find transmission lines to be an unwelcome visual intrusion. Also, many citizens feel strongly that transmission lines near their homes are visually intrusive, and some property values may be reduced. Adverse visual effects may be perceived up to several kilometers from the line. Transmission lines may be more compatible with industrial areas. The effectiveness of potential mitigation measures depends on the site, and some measures may substantially increase the cost of the project. Possible measures include darkened towers in forested areas; different tower designs more compatible with a particular environment; nonspecular (nonshiny) conductor; and locations that avoid visually sensitive areas.

Cultural Resources. Construction may disturb subsurface resources such as archeological sites and may intrude visually on historic buildings or districts. With careful preconstruction surveys and consultation with Native American and historical properties experts, impacts to most subsurface sites can be avoided or mitigated.

Air Quality and Noise. Construction of transmission lines has the potential to affect air quality of an area, particularly during dry periods in late summer, by disturbing the soil and raising fugitive dust. Standard construction practices keep such occurrences at a minimum. Construction contractors are required to comply with all Federal, State, and local air quality standards, including vehicle emissions standards.

Contractors must also comply with all noise regulations by observing maximum decibel levels for machinery and ceasing construction activity during certain hours to avoid disturbance to nearby residents.

Health and Safety. BPA recognizes strong public concern regarding the possible effects of the electrical properties of transmission lines on public health and safety. These effects include electric shocks, noise, and the potential long-term health effects of EMF.

Safety. All BPA lines are designed and constructed in accordance with the National Electrical Safety Code (NESC), which specifies the minimum allowable distances between the lines and the ground or other objects to minimize hazards from electric shocks. Grounding of certain objects near the line is standard construction practice to reduce the potential for shocks that may be induced by a line near objects such as wire fencing on wood posts. For more information, see the BPA publication, *Living and Working Around High Voltage Power Lines*.

***Corona Effects*.** Transmission lines produce corona, the molecular breakdown of air very near conductors that occurs when the electric field is greatly intensified at projections (such as water droplets) on the conductor. Although BPA lines are designed to meet all State and Federal audible noise standards, corona may cause noise and electrical interference to nearby homes or businesses. All problems are investigated and, if the BPA facility is involved, most effects can be mitigated by minor modifications to the lines or to the affected equipment. Studies have shown that the minute amount of ozone produced by corona generally is not detectable above average background levels.

Electric and Magnetic Fields. Both electric and magnetic alternating-current (AC) fields induce currents in conducting objects, including people and animals. These currents, even from the largest power lines, are too weak to be felt. However, some scientists believe that the currents might be harmful and that long-term exposure should be minimized.

Hundreds of studies on electric and magnetic fields have been conducted in the United States and other countries. Studies of laboratory animals generally show that these fields have no obvious harmful effects. However, a number of subtle effects of unknown biological significance have been reported in some laboratory studies (Frey, 1993).

Much attention at present is focused on several recent reports suggesting that workers in certain electrical occupations and people living close to power lines have an increased risk of leukemia and other cancers (Sagan, 1991; NRPB, 1992; ORAU Panel, 1992; Stone, 1992). Most scientific reviews, however, find that the overall evidence is too weak to establish a cause-and-effect relationship between electromagnetic fields (EMF) and cancer. For this reason, BPA is unable to predict specific health risks related to exposure to EMF.

There are no national standards for EMF. Some states have established electric or magnetic field standards; however, the State of Washington has not. BPA has an electric field standard of 9 kV/m maximum on the right-of-way and 5 kV/m at the edge of the right-of-way. Because a cause-and-effect relationship between EMF and health effects has not been established, we are unable to state, with absolute certainty, the health risks, if any, related to exposure to EMF. However, because of the scientific uncertainty and in response to public concern, BPA has taken additional steps. These include: developing Interim Guidelines on EMF that name EMF as a major decision factor to be considered in locating and designing new BPA facilities; discouraging intensive uses of rights-of-way that would increase human exposure to EMF; and not increasing public and employee exposure to EMF where practical alternatives exist.

More detailed information on effects of EMF or corona can be found in a BPA publication, *Electrical and Biological Effects of Transmission Lines: A Review*.

Socioeconomics. Typical construction costs for transmission lines range from $290,000 per kilometer ($475,000 per mile) of 230-kV double-circuit line to $725,000 per kilometer ($1.2 million per mile) of doublecircuit 500-kV line. How these costs are translated into the rates BPA charges its customers for transmission services depends on BPA's total costs and are decided in BPA's rate case process.

Construction crews for major lines would noticeably increase the population of some rural areas, a temporary effect. New access roads may increase access to private land, and individuals living near a transmission line may strongly object to the line's presence.

4.1.1.2 Oliver Point of Delivery

There are two possible transmission configurations, depending upon the amount of the Entitlement to be delivered at Oliver. For either of these delivery options, additional transmission capacity would be required in BC between the border and the Oliver area, as described in section 4.2.1.1.

A. Delivery of the Full Entitlement (1,400 MW) at Oliver (Base Case)

Because this is the point of delivery described in the Treaty, BPA has designated it as the transmission component for the Base Case Alternative (Figure 4.1-2).

2003: Grand Coulee or Chief Joseph Substation to Border: One new single-circuit 500-kV transmission line

135 to 155 km (85 to 95 mi) long

New or expanded rights-of-way: 38 m (125 ft) wide for standard lattice steel structures

New or upgraded access roads: 2 km/km of line (2 mi/mi of line)

Improvements at or expansions of existing substations may be required.

Assumes cross-Cascades lines are constructed on current schedule; the need for these lines is presently unrelated to the Entitlement.

Two conceptual corridors have been identified (Map 1), one east and one west of the Okanogan River. The line could originate at either Chief Joseph or Grand Coulee Substation. Two locations for crossing the Okanogan River have also been identified.

Locations are very preliminary and would likely change somewhat as more information becomes available during subsequent studies and public review. Should this line be one of the components of a proposed alternative, it would require site-specific environmental review (most likely an EIS). Such a document would evaluate in detail the environmental impacts of alternative routes and associated issues including non-Federal participation in use of the Intertie.

Figure 4.1-2, page 1

Figure 4.1-2, page 2

Environmental Consequences

Land Use. Major impact. Building a transmission line in a new corridor could have a major impact to residential, commercial, agricultural, and forest land because the right-of-way would intrude on existing land uses or eliminate some uses altogether. The conceptual corridors cross mostly rangelands; however, some rural residential, agricultural, orchard, and forested lands would also be crossed (Map 2). Most of the land is privately owned except for the portion of the eastside corridor that crosses the Colville Indian Reservation and a short portion of the westside corridor that crosses the Loup Loup State Forest (Map 4). If the line were sited within the landing patterns of the airstrips near the corridors (Map 3), hazards to aircraft could be created.

Soils and Geology. Moderate impact. The corridors cross mostly gentle to moderate slopes, with a few areas of steep slopes. Erosion could be minimized or avoided through mitigation.

Floodplains and Wetlands. Moderate impact. The line could probably be sited to avoid most wetlands and floodplains. The conceptual corridors would span the floodplain of the Columbia River with no impact; however, the westside corridor could impact the floodplain of the Okanogan River because it is so broad. The east and west corridors also each cross a pothole lake/wetland area, one on the Colville Indian Reservation and one east of Conconully (Maps 1 and 2). Numerous smaller streams with associated riparian wetlands and some small, isolated wetlands would be crossed as well.

Water and Fish. Moderate impact. Sedimentation from construction and access roads is the most likely source of impact. The westside corridor would cross the Okanogan River, which the Washington Department of Wildlife identified (October 1992) as a river that should be protected for its resource value. The Okanogan River drainage provides habitat for summer chinook and sockeye salmon and for steelhead, rainbow and bull trout. Measures to prevent soil erosion could minimize or eliminate most impacts.

Vegetation and Wildlife. Moderate impact. Most of the land crossed by the corridors is rangeland or open forested land where minimal clearing would be required. While little change to wildlife habitat is expected, construction during critical breeding or other periods could disturb certain species, and new roads could increase hunter access to game species. Potentially affected species in the Okanogan Valley include chukars (a game bird), golden eagles (which nest

there), western bluebirds, white-tailed deer, and bighorn sheep. The eastside corridor skirts a portion of the Okanogan National Forest (Map 4) and could cross critical breeding grounds for sharp-tail grouse. The westside corridor could cross Loup Loup State Forest/Wildlife Area and important mule deer habitat. It would also cross seasonal habitat for bald eagles and white pelicans along the Columbia River downstream of Chief Joseph Dam, increasing the potential for bird collisions with conductors. Bald eagles also are winter residents throughout the valley.

Cultural Resources. Moderate impact. Construction may disturb subsurface resources, such as archaeological sites, and a transmission line may intrude visually on historic buildings or districts. There are no known Historical Register sites located along any of the conceptual routes (Map 6). One of the crossover routes would cross a section of the Okanogan River identified as having high known or potential cultural resource value, including the historic Cariboo Cattle Trail that parallels the river, according to the Washington Office of Archaeological and Historic Preservation (1985). Cultural resources could exist on the Colville Indian Reservation. Surveys would be conducted for archaeological resources during a site-specific environmental process; any resources found would be properly treated, as required by law.

Visual Resources. Moderate impact. New transmission lines could create unwelcome visual intrusions. Potential corridors are in the foothills, away from the main travel routes in the Okanogan Valley. Darkened towers would blend in with the backdrop of the forested hills. Visual impacts could be intrusive at the Okanogan River crossing and near the town of Brewster on the westside corridor (Map 1).

Health and Safety. Little or no impact. See section 4.1.1.1.

Socioeconomics. Moderate impact. In 1995 dollars, to build the Coulee-Oliver line would cost $147 million with phase shifters to control flows and $110 million without phase shifters (the decision has not yet been made for or against phase shifters). Construction crews would noticeably increase the population of this rural area, a temporary effect. New access roads may increase access to private land. Some property values may be reduced, and individuals living near the line may strongly object to its presence. The line would add north-to-south transmission capacity, which would likely be used by BPA and others.

B. Delivery of up to 600 MW

Delivery of up to 600 MW of Entitlement energy or capacity at Oliver would require the following actions (Figure 4.1-3):

2003: E. Omak to Tonasket: Reinsulate existing line for double-circuit 230-kV operation.

34 km (21 mi) long

Existing right-of-way: 38 m (125 ft) wide (no change required)

Possible upgrade of some access roads

Two phase shifters may be needed at E. Omak

2003: Tonasket to Border: New double-circuit 230-kV line.

32 km (20 mi) long

New right-of-way: 38 m (125 ft) wide for standard lattice steel structures

New or upgraded access roads: 2 km/km of line (2 mi/mile of line)

Improvements at, or expansions of, existing substations may be required.

Assumes cross-Cascades lines are constructed on current schedule; need presently unrelated to Entitlement.

To deliver less than 300 MW would require only a single-circuit (rather than a double-circuit) 230-kV line. Although a single-circuit line would cost somewhat less and would cause slightly less impact to some resources (e.g., visual resources), BPA is unlikely to invest significant resources in that option when the obligation exists to deliver much more than 300 MW.

The existing substations and transmission facilities are shown in Map 1. The new lines from Tonasket north would probably follow the route shown for the 500-kV transmission line east out of Tonasket and up the east side of the river valley.

Figure 4.1-3, page 1

Figure 4.1-3, page 2

Environmental Consequences

The actions that make up this component and their likely environmental effects are shown in Figure 4.1-3.

Land Use. Moderate impact. Reinsulating the existing transmission line for the portion of the line south of Tonasket would cause little or no impact to existing land uses. North of Tonasket, the new corridor would cross mostly rangeland; however some rural residential, agricultural, and a small amount of orchard land would also be crossed (Map 2). The eastside corridor would also cross forested lands as it skirts the Okanogan National Forest. Most of the land that would be crossed is privately owned.

Soils and Geology. Moderate impact. The corridors cross mostly gentle to moderate slopes; a few areas with steep slopes would be crossed. Erosion potential could be minimized or avoided through mitigation.

Floodplains and Wetlands. Little or no impact. Site-specific routing would likely avoid impacts to most wetlands and floodplains. The reinsulated portion would cross the floodplain of the Okanogan River, but that would cause little or no impact because tower sites would not change. Smaller streams with associated riparian wetlands and some small, isolated wetlands would be crossed as well (Maps 1 and 2).

Water and Fish. Little or no impact. Any potential impact would be from sedimentation from construction and access road activities. The reinsulated portion would cross the Okanogan River, which has been identified by the Washington Department of Wildlife (October 1992) as a river that should be protected for its resource value. The reinsulation work would cause little or no soil disturbance with its resulting effect on fish habitat. Most impacts could be minimized or avoided through mitigation designed to prevent soil erosion.

Vegetation and Wildlife. Moderate impact. The only densely forested land crossed is where the eastside corridor skirts a portion of the Okanogan National Forest (Map 4). The location and distance involved mean minimal clearing would be required. Shrubsteppe habitat crossed could include critical breeding grounds for sharp-tail grouse. Overall, little change to wildlife habitat is expected, although construction during critical periods for wildlife could affect breeding or rearing, and new roads could increase hunter access.

Cultural Resources. Little or no impact. Although construction may disturb unknown subsurface resources, there are no known Historical Register sites located along any of the conceptual routes (Map 6). Surveys would be conducted for archaeological resources during a site-specific environmental process; any resources found would be properly treated, as required by law.

Visual Resources. Moderate impact. Reinsulating the existing line from East Omak to Tonasket would not perceptibly change how the line looks, so it would cause no new visual impact. Except for areas in and near Tonasket, the new line to the north would be located away from population centers and heavily traveled roads. With proper coloring of the towers, the line could blend into the backdrop of the hills in some areas. Visual impacts could be intrusive in and near the town of Tonasket, including at the Okanogan River, and in rural residential areas.

Health and Safety. Little or no impact. See section 4.1.1.1.

Socioeconomics. Moderate impact. Construction and reinsulation of the East Omak-to-Oliver 230-kV line would cost $57 million (1995 dollars). Construction crews would noticeably increase the population of this rural area, a temporary effect. New access roads may increase access to private land. Some property values may be reduced, and individuals living near the line may strongly object to its presence.

This alternative would also provide additional north-to-south transmission capacity, which would likely be used for a combination of BPA and other uses. BPA may be able to offer capacity ownership in this or other transmission alternatives, which would also produce revenues to offset costs.

4.1.1.3 Blaine Point of Delivery

Blaine is a point on the existing two 500-kV transmission lines at the United States-Canadian border near the town of Blaine in northwestern Washington (Map 1). At that point, BPA's transmission system connects with the BC Hydro transmission system. Sufficient south-to-north transmission capacity exists in the northern Puget Sound area to deliver the full Entitlement to Blaine; however, additional transmission capacity across the Cascades would be needed sooner than BPA now plans to add it.

The *Puget Sound Area Electric Reliability Plan EIS* (DOE, April 1992) addresses the need to balance east-west transmission capacity and the increasing demand to import power generated east of the Cascades into the Puget Sound area between 1994-2003. Because approximately two-thirds of the power used in the PNW is generated east of the Cascades, several high-capacity transmission lines cross the Cascades to serve electricity demand in the population centers to the west.

The Puget Sound EIS evaluated several alternative strategies to correct existing peak load reliability problems and to meet the projected growth in demand for electricity. A new cross-Cascades transmission line is one of the contingencies for the selected strategy. Since the need to implement this contingency is based on many variables, e.g., regional growth in demand for power and amount of new generation built in the Puget Sound area, BPA continues to monitor and update the projections. The latest studies show that additional cross-Cascade transmission capacity may be required by about 2012 or 2014 if medium load growth and minimal resource development occur west of the Cascades. As new generation is added on the west side, the construction date for this line could be delayed, possibly until after 2024.

If, however, the full Entitlement is delivered at Blaine, additional cross-Cascades 500-kV transmission line capacity would be required within a few years after the turn of the century, possibly as early as 2005. The exact date is very sensitive to different assumptions about load growth and the location of new generation; however, it is clear that delivering the full Entitlement at Blaine would require new transmission several years before it would otherwise be required. In general, for every 200 MW delivered at Blaine, the first crossCascades line would be accelerated by 1 year if most new generation is located east of the Cascades. Because the full Entitlement uses about 70 percent of the cross-Cascades line's capacity, Blaine deliveries may also accelerate the need for a second line. Each line would have the following characteristics:

Two cross-Cascades 500-kV lines:

200 to 240 km (125 to 150 mi) long

New, parallel, or rebuilt right-of-way: 38 m (125 ft) wide for standard lattice steel structures

New or upgraded access roads: 0.5 to 3 km/km (0.5 to 3 mi/mi) of line (depends if line is rebuilt or in new corridor)

Improvements at or expansions of existing substations may be required.

Full delivery at Blaine would accelerate construction of the first line 6 to 7 years under an eastside generation scenario, to as early as 2005. Blaine deliveries may accelerate a second line as well.

The line would most likely be between Chief Joseph Substation and either Monroe or Echo Lake substations, following one of several potential routes (Map 1).

Priority would be given to using existing corridors and replacing existing lines instead of constructing new lines in new corridors. In developed areas, most access roads would probably already exist. In more remote areas, new corridors could require new roads, although lines in especially steep or sensitive terrain may be constructed and maintained by helicopter. Construction of a new transmission line would require site-specific environmental review that would evaluate in detail the environmental impacts of alternative routes and associated issues, including non-Federal participation in use of the Intertie.

No new transmission would be required in Canada. The need for Interior-to Lower Mainland transmission lines would be deferred by several years in comparison to the Base Case need.

Figure 4.1-4, page 1

Figure 4.1-4, page 2

Environmental Consequences

Figure 4.1-4 and the following text summarize the environmental consequences of delivery at Blaine. Impacts would be caused primarily by a cross-Cascades line and were first described in the Puget Sound EIS. Construction of a new transmission line would require site-specific environmental review that would evaluate in detail the environmental impacts of alternative routes and associated issues, including non-Federal participation in use of the Intertie. Delivery at Blaine accelerates impacts already expected to occur.

Line alternatives would cross dryland agricultural and rangeland areas in the eastern portions; central and western portions contain extensive forested areas (Maps 1-6). All alternatives must cross the North Cascades, with their steep slopes, erodible soils, and severe weather. Habitat for spotted owl, big game, mountain goats, pileated woodpeckers, western gray squirrels, anadromous and resident fish, and various riparian/wetland species could be destroyed or altered, although clearing in some areas west of the Cascade crest could have some benefit for black-tailed deer and elk. Commercial forest and agricultural land could be removed from production. Some alternatives could be visible from significant cultural or visual resources, including a national historic district, wild and scenic rivers, a national trail, the Pacific Crest Trail, or other protected areas. Some residential areas or individual residents could experience aesthetic impacts or concern for health and safety. The corridors would affect late-successional reserves, adaptive management reserves, riparian reserves, and key watersheds identified in *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl*, April 1994. Consistency with this plan would be addressed in a site-specific environmental document to be prepared if and when a cross-Cascades line is proposed.

Acceleration of the impacts means that costs of $725,00 per kilometer ($1.2 million per mile) of line would be incurred sooner than otherwise planned. In general, near-term costs are valued higher than long-range costs. In addition, the use of resources is lost sooner, and the perception may exist that impacts occurring sooner are more significant than those predicted to happen years later.

4.1.1.4 Selkirk Point of Delivery

A. Delivery of the Full Entitlement at Selkirk

Selkirk Substation is a BC Hydro substation located 6 km (4 mi) north of the United States-Canada border west of Boundary Dam and Substation on the Pend Oreille River. Delivery of Entitlement amounts of 600 to 1,400 MW would require construction in the United States of a new line from Boundary Substation to the border. Two conceptual corridors--east and west--have been identified (Map 1). Figure 4.1-5 summarizes impacts.

2003: Boundary Substation to Border: One new double-circuit 230-kV line

3 to 8 km (2 to 5 mi) long

New or parallel right-of-way: 38 m (125 ft) wide

New access roads: 2.5 km/km of line

Two phase shifters in the United States or at Nelway, BC, to control flows

Assumes use of the existing 230-kV Boundary-Nelway lines.

Assumes cross-Cascades lines are constructed on current schedule; need presently unrelated to Entitlement.

In Canada, as described in section 4.2.1.2, a new line would have to be built from the border to the Selkirk Substation. In addition, new transmission lines between Selkirk and the Lower Mainland may be required between 2008 and 2024 (section 4.2.1.3).

Figure 4.1-5, page 1

Figure 4.1-5, page 2

Environmental Consequences

Land Use. Moderate impact. The conceptual corridors cross forested lands of the Colville National Forest and pass south and east of Crawford State Park (Map 3). The park is located over 300 meters (1,000 feet) north of the western corridor and views of the line would be screened by heavily wooded terrain. A Forest Service-designated semi-primitive, non-motorized recreation area to the south of the western corridor would also be screened and a transmission line in that corridor would not impact recreational use of the area. The western corridor would pass through about 1 km (0.6 mi) of Forest Service Class 5 land (Timber Management with Visual Resource Protection). The eastern corridor would pass through about 0.5 km (0.3 mi) of the same. Siting new right-of-way through these units is not consistent with Forest Service policy, although not administratively impossible. There would be no impact to residential, commercial, or agricultural uses or airports. The eastern corridor would cross industrial-type land uses related to the power generation facilities at Boundary Dam.

Soils and Geology. Moderate impact. The corridor crosses steep slopes where erosion potential may be high. Erosion could be mitigated through careful siting and soil erosion prevention practices.

Floodplains and Wetlands. Little or no impact. The eastern corridor spans the floodplain of the Pend Oreille River; no other floodplains or known wetlands would be crossed. A site-specific wetland survey would be completed before construction.

Water and Fish. Little or no impact. The eastern corridor would span the Pend Oreille River, which contains bull trout

and which the State of Washington designates as a "Shoreline of Statewide Significance." The designation permits transmission line crossings, although precautions to protect the trout may be necessary. The western corridor would cross or parallel three small streams; none contain anadromous fish or outstanding and substantial resident fish habitat (Map 5). Sedimentation would be minimized by using soil erosion prevention practices.

Vegetation and Wildlife. Moderate impact. Most of the length of both corridors would require timber clearing in mixed coniferous forests (Map 2). Wildlife species of state or Federal concern would not be affected by the western corridor; however, the section of the eastern corridor that crosses the Pend Oreille River could increase the potential for bald eagles to collide with conductors. Grizzly bear and mountain caribou recovery areas east of the Pend Oreille River probably would not be affected.

Cultural Resources. Little or no impact. No previously recorded sites were found along either corridor during a preliminary survey conducted for the *Washington Water Power/ BC Hydro Transmission Interconnection Project Final EIS* (Map 6). Intensive surveys would be conducted for archaeological resources during a site-specific environmental process; any resources found would be properly treated, as required by law.

Visual Resources. Moderate impact. The eastern route would cross 0.5 km (0.3 mi) of land the United States Forest Service (USFS) designates for retention of its visual quality; the western route would cross 3.0 km (1.9 mi) of such land. The remainder of both corridors crosses land where visual quality could be modified, according to USFS plans. Views of the lines in the "Retention" areas would result in long-term impacts; partial mitigation is possible with the use of non-nonspecular conductors and darkened tower steel.

Health and Safety. Little or no impact. See section 4.1.1.1.

Socioeconomics. Little to no impact. Construction a line would cost approximately $2 million (1995 dollars, not including the cost of phase shifters). Construction crews may temporarily increase the population of this rural area. The alternatives cross little private land; most of the land crossed is in the Colville National Forest. The line could have a small impact on timber revenues for the Colville National Forest, as 4.5 ha (11 acres) of commercial timber on the eastern corridor and 31 ha (76 acres) on the western corridor would be permanently removed. This alternative would not provide additional north-to-south transmission capacity.

B. Delivery of 300 to 600 MW at Selkirk

If the Entitlement delivery amount at Selkirk is between 300 and 600 MW, a new single-circuit 230-kV line from Boundary Substation to the border (instead of the double-circuit line described above) would be needed (Figure 4.1-6).

2003: Boundary Substation to Border: One new single-circuit 230-kV line

3 to 8 km (2 to 5 mi) long

New right-of-way: 38 m (125 ft) wide

New access roads: 2.5 km/km of line

Two phase shifters in the United States or at Nelway, BC

Assumes use of the existing 230-kV Boundary-Nelway lines.

Assumes cross-Cascades lines are constructed on current schedule; need currently unrelated to Entitlement.

Comparable facilities would be required from the border to the Selkirk Substation in BC. Cross-BC lines would be

required as described in section 4.2.1.3.

Environmental Consequences

This component would have environmental consequences similar to those for the previous Selkirk component. The same corridors would be used; the only differences would be in the size of the towers and the number of conductors. A single-circuit line would have slightly less visual impact because the lines would be shorter and less massive, with fewer conductors. Other differences would be negligible. This alternative would provide no additional north-to-south transmission capacity.

Another alternative for delivery of some of the Entitlement amount may be (as described in section 2.2.1.1) a new 163-km (102-mile) double-circuit 230-kV transmission line that WWP proposes to build from its Beacon Substation in the Spokane area to the Selkirk Substation. The line is proposed primarily to increase northtosouth transmission capacity and has received a Presidential Permit from the Department of Energy (DOE). According to WWP, the line could be energized as early as 2000. The decision to construct the line now rests with WWP and BC Hydro.

If built, the line would have a south-to-north transmission capacity of 600 to 800 MW, and might be available to deliver that amount of Entitlement energy and/or capacity to Canada. It is unlikely that this line would be built primarily to deliver Entitlement power, as it is much more costly and would create significantly greater environmental impacts than other Selkirk delivery alternatives. However, if the line were to be constructed for reasons unrelated to the Entitlement delivery, it would require no modifications to transmit Entitlement power north. Therefore, no environmental impacts would be associated with using this line to deliver Entitlement power. Transmission needs in Canada likely would be similar to other Selkirk delivery components.

The environmental consequences of the WWP/BC Hydro Transmission Interconnection Project are summarized in the final EIS (WWP/BC Hydro, 1992). For the preferred alternative (which is the alternative for which DOE has granted a Presidential Permit), the EIS identified unavoidable adverse construction as the removal of 3 ha (8.5 acres) of forested wetlands and the removal of 7 residences. The EIS identified no unavoidable adverse impacts for the 3- to 8-km (2- to 5-mi) segments between Boundary Dam and the border, which is the alternative BPA is considering for Entitlement delivery at Selkirk.

To transmit Entitlement power north, the only modifications needed in the United States could be the reinforcement of the lines between WWP's Beacon Substation and BPA's Bell Substation. This would result in few environmental impacts in addition to those identified in the WWP/BC Hydro EIS, because the preferred route passes within 1 km (1.6 mi) of the Bell Substation. Facilities in addition to those already planned may be required to deliver up to 1400 MW at Selkirk.

Figure 4.1-6, page 1

Figure 4.1-6, page 2

C. Delivery of up to 300 MW

Delivery of Entitlement amounts up to 300 MW at Selkirk would require no new transmission facilities in the United States and would create no new environmental consequences.

In Canada, facilities as described for the other Selkirk delivery components would be required but on different schedules; specifically, the Selkirk-to-Nicola 500-kV line would be required by the second half of the second decade of the 21st century. This line combines the Selkirk-Oliver and the Oliver-Nicola segments, delaying the Oliver to Nicola segment by about 11 years. The timing of the Selkirk to Oliver segment remains the same as if the Entitlement is delivered at Oliver.

4.1.2 Intertie Use

Entitlement delivery options that involve delivering power to the Canadian border or to the PSW (e.g., sales or seasonal or environmental exchanges) would require the use of the Northern or PNW-PSW Intertie (Figure 4.1-7). Use of these transmission facilities could limit their use for other purposes and affect BPA wheeling and marketing revenues, and could change the way other utilities use economy energy purchased from BPA.

Delivering power across the United States-Canadian border would require use of the existing Northern Intertie. These facilities consist of two 500-kV transmission lines north of Custer Substation near Blaine and two 230-kV transmission lines north of Boundary Substation, with a total north-to-south transfer capability of 2,300 MW and a total south-to-north transfer capability of 2,000 MW. With the completion of the BPA/Puget Power Northwest Washington Transmission Project, north-to-south transfer capability will increase to 3,150 MW; south-to-north transfer capability will not change.

A sale to the PSW or an exchange agreement involving the PSW would require access over the PNW-PSW Intertie, the high-voltage alternating current (AC) and direct current (DC) transmission lines that link the PNW with California. The combined AC and DC Intertie system has a total capacity of 7,900 MW. In California, Intertie facilities are owned by over a dozen public and private utilities and utility groups. In the PNW, BPA owns 5,825 MW, Portland General Electric owns 950 MW, PacifiCorp (d.b.a. Pacific Power and Light Company) owns 400 MW, and (under the provisions of the Non-Federal Participation Memorandum of Understanding) non-Federal participants own 725 MW.

If PSW parties were to purchase part or all of the Entitlement or were to participate in exchange transactions involving Entitlement power, access across the PNW-PSW Intertie would probably be provided over BPA's share of the facilities. In providing such service, BPA's nonfirm sales or other transactions with the PSW over the Intertie may be negatively affected.

BPA could use exchange power in storage agreements and/or environmental exchanges with Canada to offset the displacement of Intertie transactions. In a storage agreement, BPA would deliver energy to the BC Hydro system during one period (for example, the spring months), and accept return of that energy during another period (for example, during the fall months). When such exchanges allowed flow augmentation on the Columbia and Snake Rivers during spring run-off, they would support juvenile anadromous fish migration and would function as environmental exchanges. In recent years, BPA has signed several such short-term agreements for storage and environmental exchanges with BC Hydro. Agreements for storage or environmental exchanges could be a component of an agreement for the delivery of the Entitlement. Such agreements could involve fixed amounts of energy for specified periods, or could be structured to allow BPA to store energy on the BC Hydro system at times when granting BC Hydro access to the BPA Intertie or main grid transmission system would displace BPA transactions due to constrained transmission. Storage agreements and environmental exchanges could reduce some of the potential adverse revenue impacts to BPA that would occur if BPA granted BC Hydro access over the PNW-PSW Intertie, the Northern Intertie, or the main grid transmission system and if that access displaced BPA transactions.

Figure 4.1-7 (one page only)

Environmental Consequences

Northern Intertie Use. In the past, BPA has stored energy in the BC Hydro hydroelectric system in accordance with a series of short-term agreements and the 1991 Non-Treaty Storage Agreement. When BPA does so (for example, when BPA's system is operated to produce high spring flows for fish migration), BPA delivers energy north over the Northern Intertie, and receives the stored energy later in the year.

If the Entitlement were delivered to Canada over existing Northern Intertie facilities, some opportunities for sending power north for storage on the BC Hydro system might be precluded because of transmission capacity and/or operating constraints. If BPA could not store energy on the BC Hydro system, it would have to either sell the energy on the spot

market during a period (usually the spring) when spot market prices are generally lower because nonfirm energy is available from BPA and other utilities with hydroelectric generation; or, if no market were available, spill. Energy purchased from BPA on the spot market would probably be used by utilities in the PNW or PSW to displace more expensive thermal generation resources (such as coal or older CTs), with a consequent reduction in thermal plant emissions in the PNW.

PNW-PSW Intertie Use. During some spring and summer months, when the PNW-PSW Intertie typically would be loaded, delivery of the Entitlement to the PSW or exchanges with the PSW could displace PNW economy energy sales. The PNW economy energy could displace PNW thermal resources if the economy energy were sold at less than the thermal resources' marginal costs. If no other market were available, over-generation spill at PNW hydroelectric projects might occur. In other months, when sufficient PNW-PSW Intertie capacity would be available to deliver both the Entitlement and all of the PNW economy energy to the PSW, the Entitlement might displace the higher-priced markets, and the PNW economy energy would be sold at lower prices. BPA used its System Analysis Model II (SAM II) to evaluate the impacts from granting access over the PNW-PSW Intertie for sales to the PSW of up to 1,400 MW capacity and 550 aMW energy (in addition to existing firm contracts and the 725 MW of Intertie capacity that may be available for non-Federal participants under the proposed non-Federal participation in the AC Intertie). Assuming random water conditions and delivery each month starting in September 2002, the analysis showed that, in general, for every 50 aMW of Intertie access provided to other parties, BPA lost approximately 10 aMW of Intertie transactions with the PSW. As a result, instead of selling that economy energy to the PSW, BPA would have to sell it on the PNW spot market to displace higher-priced coal and CT resources. In the SAM II analysis, thermal displace-ment increased about 95 aMW (about a 2 percent change) and overgeneration spill increased about 25 aMW. BPA would receive less revenue on the PNW spot market than from sales to the PSW, but, all other things being equal, some air emissions from coal and older, more expensive CT resources in the PNW might decrease slightly. Changes in sales over the PNW-PSW Intertie could affect the operations of thermal resources in the PSW, as described in section 4.1.3.1.

4.1.3 Resource Development and Operation

4.1.3.1 Resource Development and Operation in the PNW

Although the Entitlement would be delivered as a system transfer (that is, it would be supported by the entire PNW system), delivering it to Canada would require new conservation and/or generation in the United States to replace the Entitlement capacity and energy that would no longer be available in the United States (Figure 4.1-8). In its resource planning process, BPA assumed that the Entitlement would be delivered to Canada begin-ning in 1998; therefore, the loss of a resource equivalent to the Entitlement is already planned. The *Resource Programs Final EIS* (DOE, February 1993) analyzed the environmental impacts of alternative combinations of conservation and generation resources to serve projected PNW loads based on the assumption that the Entitle-ment would be returned to Canada.

The preferred alternative in the *Resource Programs Final EIS* includes a mix of conservation, efficiency improvements, renewable energy resources, cogeneration, and combustion turbines (CTs). This mix of resources would serve all BPA loads (including the delivery of the Entitlement) through 2010. Based on their cost, flexibility in size, construction lead times, and plant factors, the marginal energy resource in the PNW that would replace the Entitlement probably would be combined cycle combustion turbines (CCTs).

Environmental Consequences

CTs typically use natural gas (or, less often in the PNW, oil) to produce a high-temperature, high-pressure exhaust gas,

which is expanded through a turbine to power a generator. They are easily started and stopped (i.e., they are easily *dispatchable*) and therefore are often used to firm nonfirm hydropower, which reduces their cost of operation. For example, BPA used its Integrated System for Analysis of Acquisitions (ISAAC) resource analysis model to evaluate CT operations to serve regional loads (including the Entitlement) over the period 1997 through 2010, under a range of water and load conditions. In the modeled case, CTs were displaced 18 to 30 percent of the time (24 percent on average). Therefore, if 550 aMW of CT resources were acquired to serve energy loads, the CTs would generate on average only 418 aMW, and the remaining 132 aMW would be served by other lower-cost resources (presumably, nonfirm energy from the hydroelectric system).

Land Use. Moderate impact. In most cases, CT projects create few land use conflicts. CTs typically occupy rather small sites (usually less than .06 ha (0.15 acre) per megawatt, or a total of less than 85 ha (210 acres) for 1,400 MW). Often they are within or adjacent to existing industrial sites. Depending on the site, noise impacts may need mitigation by means of silencing packages.

Water and Fish. Little or no impact. CTs often use water for cooling. Although cooling water typically is recirculated, some make-up water is required to replace water losses. A typical CT project might use 4,194 cubic meters (m3) (3.4 acre-feet) per average megawatt generated per year, or 1.75 million m3 (1,421 acre-feet) per year for 418 aMW of generation (550 aMW displaced 24 percent of the time). In most places, if projects are able to pass regulatory reviews and receive necessary water permits, the amounts of water consumed are likely to have minor impacts on local water bodies and other uses of the water.

Water discharged from cooling systems may be warmer than receiving waters, and may contain small amounts of suspended and dissolved solids. Normally, wastewater discharge permits limit thermal and other waste discharges to cause minimal or no impact on the ecology of the receiving water body.

Air Quality. Moderate impact. The major impact of CTs is the air quality impact of fossil fuel combustion emissions. Generation projects that use natural gas are relatively clean-burning. NOx emissions are the main pollutant of concern, although NOx can be controlled by water or steam injection into the combustor, eliminating up to 80 percent of the NOx. For a combined cycle CT, approximately 0.42 tons of oxides of nitrogen are emitted per aMW per year, or 176 metric tons per year for 418 aMW generation (Business Plan Final EIS, DOE, June 1995).

*Figure 4.1-8 (one page only)*Oil used as a fuel (which is not generally the case in the PNW), creates some sulfur dioxide pollution, which can generally be mitigated with scrubbers. Other potential air pollutants include CO and particulates; both are closely regulated and can be mitigated through air pollution controls. As in all combustion technologies, significant amounts of CO2, a "greenhouse gas," are produced (3,313 metric tons per aMW per year, or 1.38 million tons per year for 418 aMW). Greenhouse gases have been implicated as a source of long-term atmospheric heating.

The effects of air pollutant emissions on human health and the environment would depend not only on the quantity and types of emissions, but also on the location of the project. Air pollutant emissions in a nonattainment area would be more likely to contribute to significant air-quality related health hazards and property damage; however, emissions in non-attainment areas are highly regulated, and the major generation projects are therefore less likely to receive air quality permits to operate in such areas. In attainment areas, particularly those distant from major population centers, human health impacts would be less likely, although NOx emissions could still adversely affect vegetation and water bodies (i.e., through acid precipitation). In addition, the contribution of CO2 emissions to the "greenhouse effect"-a global concern-would occur wherever the emission is located.

Visual Resources. Moderate impact. The visual impacts of CTs are highly variable, depending primarily on the project site. In urban environments, while most elements of the facility may be compatible with industrial districts, the exhaust stack may be visible in residential or commercial areas.

Socioeconomics. Moderate Impact. The primary socioeconomic impacts of most CT projects would stem from their capital and operating costs. BPA currently estimates CTs' levelized costs to be approximately 26 mills/kWh (1996 dollars). To the extent that CTs are displaced by nonfirm hydropower, the cost of using CTs to firm nonfirm power would be lower than that range.

Many environmental impacts of CTs, such as visual impacts or water quality impacts, vary in importance according to the location of the project, and would be evaluated in site-specific NEPA reviews of the decision to acquire their output. More information about the environmental impacts of CTs may be found in the *Resource Programs Final EIS.*

Delivering the Entitlement may lead to different operations by the hydroelectric system in the PNW in order to shape deliveries as specified by Canada. However, any changes in hydroelectric system operations (for example, changes in flows or spill) would occur within the operations regime that is being developed by the Columbia River SOR. The SOR seeks to define a range of hydroelectric operations that balances multiple uses of the Columbia River system and that supports the recovery of anadromous and other fish species in the Columbia River. Deliveries of the Entitlement will occur within the range developed by the SOR, and therefore, delivering the Entitlement should have no significant impacts on fish.

Figure 4-1.9

4.1.3.2 Funding Development of Resources in BC

As an alternative to using resources in the United States to support delivery of the Entitlement, the United States could pay for the development of conservation and/or generation resources in BC (Figure 4.1-9).

If the United States were to pay for development of resources in BC, the BC government and/or BC Hydro would actually select, site, permit, and develop the resource with U.S. funding. BC Hydro's most recent resource plan states that, in the absence of the Entitlement, new resources would consist of new generation units at existing hydroelectric dams to provide capacity and displaceable CTs to provide energy (BC Hydro, *1992 Electric Plan*, December 1992).

The amount of U.S.-funded resources would be determined in negotiations between the United States and Canada. The maximum amount would be equivalent to the full Entitlement amount (that is, up to approximately 1,400 MW capacity and 550 aMW energy). Adding new resources in BC has a potential advantage: some could be sited closer to BC load centers in the Lower Mainland, reducing or eliminating the need for the new transmission required in the United States and Canada if the Entitlement is delivered at Oliver or Selkirk. In recognition of these savings (which might not be equal on both sides of the border), the actual amount of resources that the United States would fund might be adjusted in negotiation to provide a value equivalent to the Base Case (that is, delivery of the full Entitlement at Oliver).

Environmental Consequences

In the United States, the primary consequences of this alternative would be economic, from the costs to United States ratepayers of funding the development of resources in Canada. Costs of this alternative would probably be approximately the same as if the generation projects were constructed in the United States. For purposes of analysis, the levelized costs of CTs (26 mills/kWh in 1996 dollars) are assumed. The environmental impacts in Canada are summarized in section 4.2.2.

4.1.4 Purchases

Since the signing of the Canadian Entitlement Purchase Agreement in 1964, the Entitlement has been sold to the Columbia Storage Power Exchange, a group of utilities in the PNW, for use in the PNW and PSW. When that

Agreement expires, Canada and the United States could again agree for PNW or PSW utilities to purchase all or part of the Entitlement.

There are a number of elements that could make up an agreement to purchase the Entitlement-capacity, energy, and transmission access. A purchase agreement could involve these components separately or in various combinations. The utilities that might purchase the Entitlement could be located in the PNW or PSW.

4.1.4.1 Purchase of Capacity and/or Energy by the PNW

Capacity is the amount of power that can be produced by a generation system (or carried by a transmission facility) at any instant or over a defined short period of time, such as an hour. A "pure" capacity sale typically involves the delivery of a defined amount of power (the contracted capacity amount, measured in megawatts) during heavy load hours (for example, during eight daylight hours every day). Later, the purchaser returns the amount of energy received (measured in megawatt-hours) during offpeak hours (for example, at night or on weekends), and pays for the benefit of having received power during peak hours.

Capacity purchases are valuable because utilities typically must build or acquire resources to serve their peak-hour loads, which are higher than their average loads. When a utility can purchase capacity on a firm basis, it can make its existing resources "stretch" further, and can defer building or acquiring new generation resources to serve peak loads.

In the Entitlement agreements, capacity is defined as "dependable hydroelectric capacity" apportioned over the entire load shape. In other words, the Entitlement does not include a pure capacity component, but instead increases the energy producing capabilities of utilities with downstream hydroelectric facilities over the entire load shape, including peak hours. PNW parties to the Allocation Agreements could purchase the capacity component of the Entitlement as a way of "buying down" or reducing the capacity obligation of the Entitlement, at amounts up to approximately 750 MW (Figure 4.1-10). Purchases of pure capacity in amounts greater than 750 MW are unlikely because it would be difficult for the BC Hydro system to accept higher amounts of the return energy associated with the capacity. The actual shaping of deliveries and returns would be specified in the contract between the parties. Utilities that are not parties to the Allocation Agreements (that is, utilities that are not beneficiaries of the downstream benefits) could not purchase pure capacity, but could, as described below, purchase energy with capacity, i.e., power.

A power sale is a sale that combines capacity and energy components. It is likely that any energy delivery would be shaped to some degree to meet the loads of the purchaser, and therefore would include a capacity component. For example, 1,400 MW capacity shaped into 13 hours per day five days per week equals almost 550 aMW energy. A purchase by PNW utilities of 1,400 MW (Figure 4.1-11) and associated energy over daylight hours could help the PNW meet daylight peak loads. A delivery of that amount of energy and capacity would involve a resale by Canada of the entire Entitlement amount. Alternatively, Canada and the United States could agree to a sale of some other combination of the estimated Entitlement amount (up to 550 aMW energy and 1,400 MW capacity).

Environmental Consequences

An agreement to purchase a portion of the Entitlement as capacity would increase the PNW's surplus capacity and allow PNW utilities to defer acquiring new resources to serve peak loads.

As noted in section 4.1.3.1 (Resource Development and Operation in the PNW), BPA's Resource Programs have included the delivery of the Entitlement to Canada as an element of the regional load projections. If the PNW were to purchase all or part of the Entitlement, regional loads (and the resources required to serve those loads) would be reduced correspondingly. CTs probably would be the marginal resource avoided if the region purchased the Entitlement. Section 4.1.3.1 describes the typical environmental impacts of CTs--in particular, **air quality**, **land use**, and **water** impacts. These impacts would be avoided in the PNW depending on the amount of the Entitlement

purchased from Canada. There would be a **socioeconomic** impact in the PNW from a decision to purchase the Entitlement, in the form of the purchase costs of acquiring that block of power from Canada. These costs would be determined in negotiations between the United States and Canada.

Figure 4.1-10 - one page only

Figure 4.1-11 page 1

Figure 4.1-11 page 2

4.1.4.2 Purchase of Capacity and Energy by the PSW

Canada could negotiate a long-term sale of part or all of the Entitlement to PSW utilities to serve their summer peak loads or could participate with BPA in seasonal or environmental exchanges with the PSW (Figure 4.1-12). For example, Canada could sell Entitlement capacity and energy to California to serve peak loads from June or July through September, and use the remainder of the Entitlement to serve loads in BC. Alternatively, BPA could allow Canada to use the PNW-PSW Intertie for sales of Entitlement power to the PSW during summer months; in exchange, Canada could agree to store energy for PNW use.

However, in the last few years, the PSW capacity market has declined as that region has developed a surplus of generating resources. California, once the primary market for BPA surplus electricity, now has a significant energy surplus, and has sold large amounts of power to the Northwest during the last few years. The primary causes of this surplus have been recession, steep reductions in the defense industry, large amounts of high-cost Public Utilities Regulatory Policy Act (PURPA) resources, and strong incentives from demand-side management. The low cost and apparently long-term availability of gas supplies along with open access to transmission, have accelerated competition for power sales beyond all initial predictions. The availability of this surplus and the highly competitive market for surplus capacity and energy have reduced the ability of BPA to sell its own surplus energy and capacity and have kept prices for these products low on the wholesale market.

Environmental Consequences

Entitlement power sold to the PSW could be used to defer the acquisition of new generating resources in that region or to displace the operations of existing resources. If the Entitlement were sold to the PSW, replacement resources would have to be developed and operated in Canada and resources to support the Entitlement delivery would have to be developed and operated in the PNW (section 4.1.3.1).

The following information about the resulting environmental impacts in the PSW is summarized from the *Draft EIS on Non-Federal Participation in AC Intertie* (DOE, August 1993).

According to the most recent Electricity Report (ER) by the California Energy Commission (CEC), ER 92, California's loads in the year 2003 will be met by existing or committed resources (78 percent), pending resources and PNW "spot-market" purchases (6 percent), demand-side management (13 percent), and new resource acquisitions by investor-owned and municipal utilities (4 percent). New resource acquisitions are projected to include repowering of older fossil fuel steam plants (that is, replacement of existing boilers with more efficient combustion turbines and heat-recovery steam generators), new efficient gas resources, Public Utilities Regulatory Policy Act (PURPA)-qualifying renewable resources, and purchases from the ISW and the PNW.

If the PSW were to acquire capacity and energy from the PNW instead of acquiring new energy resources in the PSW, the resources deferred would tend to be gas-fired CTs from new independent power producers or PURPA-qualifying facilities, repowering of existing facilities, and imports from the ISW (a mix of coal, gas, or nuclear) or Mexico (probably gas-fired).

Air quality was the key environmental externality of concern to the CEC in its ER process. While electric generation projects have broader effects on **land use, water use, visual impacts,** etc. (described above for the PNW), in the PSW, air quality is the environmental impact of primary concern, given the very poor existing air quality in a number of major population centers.

Because regulators and the public are concerned about air quality in the PSW, it is likely that long-term purchases by the PSW of Entitlement energy and capacity would be used to displace the output of existing thermal plants (which are often older, less efficient, and more polluting than the new CT and cogeneration projects being developed in the PNW), or to defer development of new gas-fired CTs. Alternatively, utilities could defer the repowering of existing older thermal plants; in this case, imports from the PNW might allow the utility to close the existing plant. In either case, the major environmental impact would be the elimination of air pollution from thermal generation. The types of air pollutants that would be eliminated would be similar to those described for the PNW in section 4.1.3.1. NOx, CO, and CO2 are of particular concern; however, the amounts of pollutants involved and the effects on human health and the environment would depend on the particular plant displaced or deferred and its location.

Figure 4.1-12, page 1

Figure 4.1-12, page 2

4.2 Connected Actions in Canada

Each of the alternatives for delivering the Entitlement to Canada would require connected actions in Canada in addition to the actions in the United States described above. While the actions that are the subject of this EIS are the actions that BPA may take in the United States to implement the decision of the United States Entity, for a complete picture of the likely environmental impacts of each alternative, the connected actions to be taken by BC Hydro and/or the BC provincial government are described below. The following is summarized from material provided by the Crown Corporations Secretariat of the BC provincial government, from maps of the area, and from site visits.

4.2.1 Transmission Line Construction

Delivery at Oliver and delivery of more than 300 MW at Selkirk would require the construction of new transmission facilities in BC. In addition, alternatives for the delivery of the Entitlement could affect the timing of transmission lines linking the interior of BC with the Lower Mainland. Specific transmission facilities that could be required are described below. The impacts of transmission lines in Canada have been examined in less detail than those that may be built in the United States. Information on their potential routes is limited. In general, impacts would be similar; however, construction and mitigation practices may be very different in the two countries. In particular, the First Nations Traditional Territories issue and unresolved land claims being handled by the Treaty Commission could significantly affect transmission siting in BC.

4.2.1.1 Oliver Transmission Line and Substation

2003: Border to Oliver: One new single-circuit or double-circuit 230- or 500-kV line and substation.

Length: 13 to 46 km (8 - 29 mi)

Right-of-way (new or expansion of existing): 49 to 64 m (161 - 210 ft) wide

New or upgraded access roads: probably required

New 500-kV (or 230-kV) switching station where new line intersects existing 500-kV line

New substation near Oliver (if line is 500-kV): approx. 9 ha (22 acres)

Environmental Consequences

The new line would probably cross the border east of Highway 97 and travel due north, 13 km (8 mi) east of Osoyoos. The line would cross mostly rolling hills with open grassland or pasture and scattered ranches. A few stands of pine and larch forest cover some hills. Aesthetic values to residents of nearby ranches may be adversely affected. If the route continues due north, the intensely farmed and developed valley, with its irrigated orchards and populated recreation areas, would not be affected.

The new substation would be located at a site somewhere near Oliver. Farm and orchard land in the valley might be affected by the line or the substation. An existing major line crosses Highway 3A 3.2 km (2 mi) south of a tiny provincial park on the south end of Vaseaux Lake, at a point north of Oliver where the valley narrows down into granite mountains. The existing line itself is not visible from the park or from the road by the lake. Numerous motels, campgrounds, and RV parks line the road. Wildlife is abundant.

4.2.1.2 Selkirk Transmission Line

If Entitlement power in amounts above 300 MW is delivered to the United States border near Selkirk, the following line would be needed to tie to the United States system.

2003: Border to Selkirk: One new single-circuit or double-circuit 230-kV line.

Length: 8 to 15 km (5 to 9 mi)

Right-of-way (new or expansion of existing): up to 34 m (112 ft) wide

New or upgraded access roads: probably required

One or two phase shifters at Selkirk

Environmental Consequences

This line would cross mostly forested lands, which would have to be cleared for new right-of-way for most of the line's length, with consequent impacts to timber and wildlife. The line would cross areas of moderate to steep slopes, but with proper construction and maintenance practices, erosion and sedimentation potential could be minimized. The line would cross the Pend Oreille River. Although the floodplain could probably be spanned, the new line could increase collision potential for bald eagles. The line might be visible to recreational users of the area or residents.

4.2.1.3 Cross-Province Transmission Lines

The amount of the Entitlement delivered at various points would affect the timing of the following transmission additions planned by BC Hydro. Each section briefly describes impacts that are likely to occur regardless of the Entitlement decisions, as these lines may be needed in the period between 2008 and 2024 regardless of the location of the return of the Entitlement to Canada. The location of the Entitlement return may affect the timing of these facilities.

Different delivery points may accelerate construction of some segments and delay others. If construction schedules are accelerated, impacts are accelerated and costs are incurred sooner than otherwise planned. In general, near-term costs are valued higher than long-range costs. In addition, the use of resources is lost sooner, and the perception may exist that impacts occurring sooner are more significant than those predicted to happen years later.

A. Selkirk to Oliver

This line would connect BC Hydro's Selkirk Substation to the proposed substation near Oliver in south-central BC. It could parallel an existing transmission line along that corridor, but additional right-of-way would have to be acquired.

Selkirk to Oliver: One new single-circuit 500-kV line.

164 km (102 mi) long

Right-of-way (new or expansion of existing): 39 to 54 m (128 to 177 ft) wide

New or upgraded access roads: possibly required

Environmental Consequences

Potentially affected land uses are varied in this segment. At the eastern end, impacts associated with forest clearing, including removal of commercial timber and increased hunting pressure on wildlife (but also increased forage) would be the most noticeable. It is possible the line could create aesthetic effects on recreational users or scattered residents. A small amount of cultivated land could be affected near Grand Forks. Effects on pasture land in the western portions would be minor. There may be aboriginal land holdings and claims in the area through which the line likely would be routed.

B. Oliver to Nicola

This line would connect BC Hydro's proposed substation near Oliver to the Nicola Substation in south-central BC. It could parallel an existing transmission line along that corridor, but additional right-of-way would have to be acquired.

Oliver to Nicola: One new single-circuit 500-kV line.

138 km (86 mi) long

Parallel right-of-way:): 39 to 54 m (128 to 177 ft) wide

New or upgraded access roads: possibly required

The likely corridor crosses several provincial forests, with probable commercial forestry and wildlife impacts. The existing line crosses creeks, skirts lakes, and reaches elevations of 1,500 to 1,800 meters (5,000 to 6,000 feet). Some erosion or sedimentation impacts could occur. Recreational areas northwest of Oliver may be affected, although careful location could screen most views. Much of the area is remote, accessible only by unpaved roads. There appear to be

few residents in the immediate vicinity of the existing line. Aboriginal land holdings and claims may exist in the area through which the line likely would be routed.

C. Nicola to Lower Mainland (Meridian)

This line would be an additional 500-kV line connecting BC Hydro's Nicola Substation in south-central BC to a load center in the Lower Mainland (the Meridian Substation northeast of Vancouver might be one possible terminus). Although no new corridor has been identified, a possible routing might be adjacent to an existing 500-kV line; in that case, BC Hydro has rights to much of the required additional right-of-way. For purposes of analysis, BPA has assumed the second line would cross terrain similar to that crossed by the existing line.

Nicola to Meridian (Lower Mainland): One new single-circuit 500-kV line.

248 km (154 mi) long

New right-of-way: 39 to 54 m (128 to 177 ft) wide

New or upgraded access roads: probably required

Environmental Consequences

The line begins in a valley near the town of Nicola, but by the time it reaches a possible terminus at Meridian Substation north of Vancouver, it has passed through or near several provincial forests and near parks, and has reached elevations of about 1,500 meters (5,000 feet). The line could pass near several lakes, cross Highway 5 near a camping area, cross a scenic portion of trans-Canada Highway 1 and the Fraser River near Yale, and pass by Sasquatch Provincial Park, Harrison Hot Springs, and Harrison Lake, as well as several other large lakes and associated large wetlands northeast of the Vancouver metropolitan area. Depending on its exact location, the line could reduce the aesthetic quality of some of these areas for residents, travelers, and recreational users. Also depending on final location, fish and wildlife habitat and other resources associated with wetlands could be adversely affected by a transmission line.

Other special status areas near the potential line include Indian reserves near the Highway 1 crossing and aboriginal land holdings or claims in other portions; and a research forest reserve near Pitt Lake, northeast of Vancouver.

Much of the area is forested. Clearing for right-of-way could remove commercially valuable timber from production. However, it is likely that the cleared trees could be sold profitably. Clearing could open up new browse areas for some wildlife but could also increase hunter pressure in areas of new right-of-way.

4.2.2 Resource Development and Operation

If Canada were to decide to resell all or part of the Entitlement (i.e., if it is repurchased in the United States), BC would have a resource requirement equivalent to the Entitlement (up to 1,400 MW capacity and 550 aMW energy). If BC sold the entire Entitlement, BC Hydro's *1992 Resource Plan* indicates that it would likely replace the Entitlement by accelerating the construction date of new peaking units at existing hydroelectric facilities at Revelstoke and Mica in order to replace the capacity component of the Entitlement. To replace the Entitlement's energy component, BC would probably add combined cycle combustion units.

The operations of existing hydroelectric facilities might change in order to support the sale of Entitlement power to the PNW or PSW.

Environmental Consequences

The principal environmental impacts of CT projects are described in section 4.1.3.1 for the PNW. Impacts to **land use, water and fish, air quality,** and **visual resources** would be largely comparable for projects located in BC (Figure 4.1-9). The level of impacts to air and water quality would depend in part on the degree to which CTs are displaced by nonfirm energy; for analysis purposes, it is assumed here that CTs in BC would be displaced about as frequently as CTs in the PNW (assumed here to be displaced 24 percent of the time on average).

The impacts of installing new turbines at existing hydroelectric facilities would stem primarily from construction. Operations impacts should be relatively small, given that the storage capacity of the reservoirs would not be changed and because the Canadian Columbia River does not have anadromous fish habitat (anadromous fish are blocked from the upper Columbia River by Grand Coulee Dam).

There is some potential that additional generation at existing facilities or changes in the operations of existing facilities (e.g., resulting from storage agreements with the PNW) could change downstream **water temperatures** or concentrations of dissolved gasses; however, the impacts on aquatic environments and resident fish could be determined only through site-specific studies.

Construction impacts could affect **water quality** by causing turbidity and sedimentation at the construction site. Sedimentation can destroy aquatic habitats; however, in-water construction can be managed to minimize sedimentation. Other construction impacts (such as boom-town effects of large construction crews on small communities, traffic disruption, noise, and air emissions from construction vehicles) would be relatively short-term and mitigable through careful construction scheduling and management.

Chapter 5: Consultation, Review, and Permit Requirements

5.1 National Environmental Policy

This EIS was prepared pursuant to regulations implementing the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et seq.), which requires Federal agencies to assess the impacts that their actions may have on the environment. Decisions will be based on understanding of the environmental consequences and actions will be taken to protect, restore, and enhance the environment.

5.2 Endangered and Threatened Species and Critical Habitat

The Endangered Species Act (ESA) of 1973 (16 U.S.C. 1536), as amended requires Federal agencies to ensure that their actions are not likely to jeopardize endangered or threatened species or result in the destruction or adverse modification of their critical habitats. BPA, COE, and BOR have consulted with NMFS regarding the effects of operation of the FCRPS in 1995 and future years upon listed, threatened, and endangered species and NMFS and USFWS issued biological opinions. BPA's actions to implement power-related activities, including the alternatives considered in this EIS, will not conflict with the outcomes of such ESA consultations. Therefore, no specific consultation is planned on these alternatives. If a site-specific action affects listed species in a manner or to an extent not considered in the biological opinions, additional consultations may become necessary.

If a site-specific NEPA document tiered to this EIS is needed, the appropriate offices of the United States Fish and Wildlife Service (USFWS) will be contacted for a species list. As necessary, Biological Assessment(s) analyzing the effects of the actions on any listed species will be prepared. These Biological Assessments will be forwarded to the USFWS for concurrence and included in the site-specific NEPA document. Consultations regarding the effects of Federal hydropower operations on endangered or threatened Columbia River salmon species are done for the annual operating plans prepared by BPA, the U.S. Army Corps of Engineers (Corps), and the U.S. Bureau of Reclamation. BPA's actions to implement power-related activities (e.g., Intertie transmission access) will not conflict with the outcomes of such ESA consultations.

5.3 Fish and Wildlife Conservation

The Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901 et seq.) encourages Federal agencies to conserve and to promote conservation of nongame fish and wildlife species and their habitats. The Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) requires Federal agencies undertaking projects affecting water resources to consult with the USFWS in order to conserve or improve wildlife resources. BPA will consult with the USFWS to conserve, improve, and protect fish and wildlife resources if a site-specific action is taken.

The Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act) (16 U.S.C. 839 et seq.) contains provisions intended to protect, mitigate, and enhance the fish and wildlife (including their spawning grounds and habitat) of the Columbia River and its tributaries. The Pacific Northwest Electric Power and Conservation Planning Council (Council) established under the Northwest Power Act developed a Regional Electric Power and Conservation Plan (Plan). In implementing its mandate to assure an adequate, efficient, economical, and reliable power supply, BPA must give due consideration to the protection, mitigation, and enhancement of the region's fish and wildlife resources. Any actions BPA takes must be consistent with the Plan, including its fish and wildlife components, unless an exemption is granted by Act of Congress.

5.4 Heritage Conservation

A number of Federal laws and regulations have been promulgated to protect the Nation's historical, cultural, and prehistoric resources. BPA must consider whether its actions may have an effect on a property listed or eligible for listing on the National Register of Historic Places, a property listed on the National Registry of Natural Landmarks, a property listed as a National Historic Landmark, a property listed on the World Heritage List, a property listed on a state-wide or local list, or the ceremonial rites or access to religious sites of Native Americans. Consistent with Section 106 of the National Historic Preservation Act (16 U.S.C. 470), BPA will consult with the appropriate State Historic Preservation officers before undertaking any site-specific actions.

In addition, BPA has executed a Programmatic Agreement with the Bureau of Reclamation; the Corps; USFS; the Advisory Council on Historic Preservation; the Idaho, Montana, and Washington State Historic Preservation Officers; the Colville Confederated Tribes; and the Spokane Tribe of Indians. This Programmatic Agreement effectively mitigates for impacts to cultural resources from changes in elevation at the five major Federal storage reservoirs on the Columbia River system, satisfying BPA's responsibilities under Section 106 of the National Historic Preservation Act. The Programmatic Agreement also ensures BPA's consistency with the American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act by providing for BPA participation in the disposition of Native American burials if such sites are discovered.

5.5 State, Area-Wide, Local Plan and Program Consistency

In accordance with Executive Order 12372, this EIS will be circulated to the appropriate state clearinghouses to satisfy review and consultation requirements.

5.6 Coastal Zone Management Consistency

The Coastal Zone Management Act of 1972 requires that Federal actions be consistent, to the maximum extent practicable, with approved state Coastal Zone Management programs. The alternatives examined here are not expected to have coastal zone impacts.

5.7 Floodplains Management

Executive Order 11988 (Floodplain Management) and DOE regulations implementing the Executive Order (10 CFR Part 1022) direct BPA to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Avoiding impacts to floodplains by siting structures outside such areas will be addressed during follow-on site-specific siting and environmental studies required to implement alternatives addressed in this EIS.

5.8 Wetlands Protection

Executive Order 11990 (Protection of Wetlands) and DOE regulations implementing the Executive Order (10 CFR Part 1022) direct BPA to minimize the destruction, loss, or degradation of wetlands; and to preserve and enhance the natural and beneficial values of wetlands. Avoiding impacts to wetlands will be addressed during follow-on site-specific siting and environmental studies that may be associated with the implementation of alternatives addressed in this EIS.

5.9 Farmland Protection

The Farmland Protection Policy Act (7 U.S.C. 4201 et seq.) requires Federal agencies to identify and take into account the adverse effects of their programs on the preservation of farmlands. Minimizing impacts to farmlands will be addressed during follow-on site-specific siting and environmental studies that may be associated with the implementation of alternatives addressed in this EIS.

5.10 Recreation Resources

BPA's site-specific actions will be evaluated to determine if they affect a component of the National Wild and Scenic Rivers System or the National Trails System; a USFS Wilderness Area or roadless area; a Bureau of Land Management Wilderness Area or Area of Critical Environmental Concern; a park or other area of ecological, scenic, recreational, or aesthetic importance; or convert property acquired or developed with assistance from the Land and Water Conservation Fund to other than outdoor public recreation uses. This evaluation would be included in any site-specific document tiered to this EIS.

5.11 Global Warming

A discussion of possible global warming effects from the operation of up to 1,400 MW of combustion turbines has been presented in this EIS. Greenhouse gases have been included in this analysis in terms of describing the total volume of greenhouse gases that may be emitted; dollar values have not been assigned.

5.12 Permits for Structures in Navigable Waters

If a proposed action includes a structure or work in, under, or over a navigable water of the United States; a structure or work affecting a navigable water of the United States; or the deposit of fill material or an excavation that in any manner alters or modifies the course, location, or capacity of any navigable water of the United States, a Section 10 Permit under the Rivers and Harbors Appropriations Act of 1899 will be required from the Corps.

5.13 Permits for Discharges Into Waters of the United States

A Section 404 Permit (Permit for Discharges into the Waters of the United States) under the Federal Water Pollution Control Act (Clean Water Act) of 1972 as amended will be required from the Corps of Engineers if an action includes the discharge of dredged or fill material into waters of the United States.

5.14 Permits for Rights-of-Way on Public Land

If an action involves the use of public or Indian lands not in accordance with the primary objective of the management of those lands, under the Federal Land Policy and Management Act (43 U.S.C. 1701 et seq.),
a Federal permit for a right-of-way across such lands will be required. The issue will be addressed during any site-specific environmental studies required to implement alternatives addressed in this EIS.

5.15 Energy Conservation at Federal Facilities

Energy conservation at Federal facilities need not be addressed since no alternative studied here includes the operation, maintenance, or retrofit of an existing Federal building; the construction or lease of a new Federal building; or the procurement of insulation products.

5.16 Pollution Control at Federal Facilities

In addition to their responsibilities under NEPA, Federal agencies are required to carry out the provisions of other Federal environmental laws. The alternatives discussed in this EIS do not require any particular response with regard to these other Federal laws, which are more concerned with site-specific proposals and alternatives, rather than the broad decisions analyzed in this EIS. They will be addressed as appropriate in any site-specific document tiered to this EIS.

To the extent applicable to an alternative presented in this EIS, compliance with the standards contained in the following legislation is mandatory:

Title 42 U.S.C. 7401, et seq., The Clean Air Act, as amended.

Title 33 U.S.C. 1251 et seq., The Clean Water Act, as amended.

Title 42 U.S.C. 300 F, et seq., The Safe Drinking Water Act, as amended.

Title 42 U.S.C. 9601 [9615] et seq., The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended.

Title 7 U.S.C. 136, et seq., The Federal Insecticide, Fungicide, and Rodenticide Act, as amended.

Title 42 U.S.C. 6901, et seq., The Resource Conservation and Recovery Act of 1976, as amended.

Title 15 U.S.C., et seq., The Toxic Substances Control Act, as amended; Title 40 CFR Part 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions."

Title 42 U.S.C. 4901, et seq., The Noise Control Act of 1972, as amended.

5.17 Other

Title 16 U.S.C. 1131, et seq., The Wilderness Act, as amended; Title 43 CFR Part 19, "Wilderness Preservation."

Chapter 6: List of Preparers

List of Preparers

Name	EIS Responsibility	Qualifications
Charles Alton	Office Environmental Coordinator	M.S., Public Administration; B.S., Sociology. BPA - 5 years, Environmental Specialist for Energy Conservation and Renewable Energy; 8 years, Environmental Coordinator for Office of Energy Resources.
Carol Brodsky	Editor	B.A., Journalism. BPA 8 years (contractor). Writer/editor, PNW Loads & Resources Studies; PNW Long-Term Forecasts; Resource Programs EIS; other projects.
Linda Cordilia	Informational Graphics	B.A., Sociology. Graphic design and illustration, 18 years. CH2M Hill.
David Gilman	Transmission System Planning	B.S., Electrical Engineering. BPA - 27 years, transmission system planning.
Cindy Horvath	Modeling	M.P.H., Biostatistics, BPA - 13 years, Power System Branch.
Pamela Kingsbury	Hydro System Studies	M.S., Chemical Oceanography. Private - 3 years Environmental Consulting. BPA - 4 years, Power Scheduler; 4 years work for Environmental Coordinator; 5 years, Canadian Treaty and Hydro System Analysis.
Andy Linehan	Project Management	M.A., Public Affairs and Urban and Regional Planning; B.A., International Studies. BPA - 4 years; Private environmental consulting, 8 years, CH2M Hill.
Kathy Pierce	Project Management; NEPA Coordinator	M.F., Forest Ecology; B.S., Forestry and Wildlife Ecology. BPA - 16 years, Environmental Analysis.
Colleen Spiering	Health and Safety	M.Ph. Health Education and Planning; B.S., Health Education. BPA - 5 years, Environmental Specialist; prior years, health education and planning, public involvement, environmental analysis.
Nancy Weintraub	Transmission Facility Environmental Analysis	M.S., Aquatic Ecology; B.S., Ecosystems Analysis. BPA and WAPA - 15 years, Environmental Specialist, environmental analysis, transmission facility planning, coordination, and project management.
Douglas Wittren	GIS Specialist	Graduate study in Geography and GIS; B.S., Earth Sciences. BPA - 3 years (consultant).
Judith Woodward	Writer/Editor	B.A., Geography and Arts and Letters. BPA - 15 years, Environmental

Analysis and Public Involvement; 4 years - communications consultant.

   

Chapter 7: List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

CANADA

BC Hydro and Power Authority, Burnaby, BC

BC Hydro and Power Authority, Vancouver, BC

Ministry of Energy, Mines, & Petroleum, Victoria, BC

Powerex, Vancouver, BC

Greg Mallette, Vancouver, BC

Marvin Shaffer, White Rock, BC

UNITED STATES

FEDERAL GOVERNMENT

U.S. Army Corps of Engineers, Portland, OR

U.S. Environmental Protection Agency, Seattle, WA

U.S.D.A. Forest Service, Portland, OR

U.S.D.O.C. NOAA National Marine Fisheries Service, Seattle, WA

U.S.D.O.C. NOAA National Marine Fisheries Service, Portland, OR

U.S.D.O.E. Office of Energy Assessments, Washington, DC

U.S.D.O.I. Bureau of Land Management, Portland, OR

U.S.D.O.I. Bureau of Reclamation, Boise, ID

U.S.D.O.I. Fish & Wildlife Service, Portland, OR

U.S.D.O.I. Fish & Wildlife Service, Olympia, WA

U.S.D.O.I. Office of Environmental Affairs, Washington, DC

U.S. Department of State, Washington, DC

TRIBAL GOVERNMENT

Coeur D'Alene Tribe of Idaho, Plummer, ID

Confederated Salish & Kootenai Tribal Council, Pablo, MT

Confederated Tribes of the Colville Reservation, Nespelem, WA

Kalispel Indian Community of Kalispell Reservation, Usk, WA

Kootenai Tribal Council, Bonners Ferry, ID

Muckleshoot Tribal Council, Auburn, WA

Nez Perce Tribe of Idaho, Lapwai, ID

Nooksack Indian Tribal Council, Deming, WA

Puyallup Tribal Council, Tacoma, WA

Spokane Tribes, Wellpinit, WA

Stillaguamish Tribe, Arlington, WA

Swinomish Indian Tribal Community, La Conner, WA

Tulalip Tribes of Washington, Marysville, WA

Upper Skagit Tribal Council, Sedro Woolley, WA

Yakima Tribal Council, Toppenish, WA

NORTHWEST POWER PLANNING COUNCIL

Northwest Power Planning Council, Portland, OR

Northwest Power Planning Council, Boise, ID

Northwest Power Planning Council, Helena, MT

Northwest Power Planning Council, Olympia, WA

Northwest Power Planning Council, Pullman, WA

STATE NEPA POINTS OF CONTACT

Department of Health and Welfare, Boise, ID

INEL Oversight Program, Boise, ID

Office of Budget and Program Planning, Helena, MT

Washington State Department of Ecology, Olympia, WA

STATE HISTORIC PRESERVATION OFFICER

State of Washington, Olympia, WA

STATE GOVERNMENT

California Public Utilities Commission, San Francisco, CA

California Energy Commission, Sacramento, CA

Idaho Public Utilities Commission, Boise, ID

Montana Public Service Commission, Helena, MT

Oregon Department of Energy, Salem, OR

Oregon Public Utilities Commission, Salem, OR

Washington Department of Community, Trade, and Economic Development, Olympia, WA

Washington Department of Fisheries, Olympia, WA

Washington Department of Wildlife, Olympia, WA

Washington State Energy Facility Site Evaluation Council, Olympia, WA

Washington State Energy Office, Olympia, WA

Washington Utilities & Transportation Commission, Olympia, WA

COUNTY GOVERNMENT

County of Chelan, Wenatchee, WA

County of Douglas, East Wenatchee, WA

County of Grant, Ephrata, WA

County of King, Seattle, WA

County of Kittitas, Ellensburg WA

County of Okanogan, Okanogan, WA

County of Pend Oreille, Newport, WA

County of Skagit, Mount Vernon, WA

County of Snohomish, Everett, WA

County of Spokane, Spokane, WA

County of Stevens, Colville, WA

County of Whatcom, Bellingham, WA

REGIONAL LIBRARIES

California State Library, Sacramento, CA

Portland State University, Portland, OR

University of Idaho.Library, Moscow, ID

University of Montana, Missoula, MT

Washington State Library, Olympia, WA

UTILITIES/UTILITY ASSOCIATIONS

Association of Northwest Gas Utilities, Portland, OR

Chelan County PUD No. 1, Wenatchee, WA

Cowlitz County PUD No. 1, Longview, WA

Douglas County PUD No. 1, East Wenatchee, WA

Grant County PUD No. 2, Ephrata, WA

Lincoln Electric Co-op, Eureka, MT

Mid-Columbia Participants, Ephrata, WA

Non-Generating Public Utilities, Portland, OR

Northwest Natural Gas Company, Portland, OR

Northwest Power Pool Coordinating Group, Portland, OR

Pacific Gas & Electric, San Francisco, CA

Pacific Northwest Utilities Conference Committee, Portland, OR

Portland General Electric, Portland, OR

Public Power Council, Portland, OR

Southern California Edison, Rosemead, CA

Washington Water Power, Spokane, WA

BUSINESS/INDUSTRY

American Rivers, Seattle, WA

Anderson & Wook, Meridian, ID

Ater Wynne Hewitt Dodson & Skerrit, Portland, OR

Basin American, San Francisco, CA

Brown and Caldwell Consultants, Seattle, WA

Clearing Up, Seattle, WA

Culp Dwyer Guterson & Grader, Seattle, WA

Davis Arneil Dorsey Knight & Parlette, Wenatchee, WA

Direct Service Industries, Portland, OR

Foianini Law Office, Ephrata, WA

Heller Ehrman White & McAuliffe, Portland, OR

D. Hittle & Associates, Richland, OR

Industrial Customers of Northwest Utilities, Portland, OR

Merrill Schultz & Associates, Seattle, WA

Packwood Hydro Plant, Richland, WA

Perkins Coie, Bellevue, WA

Resource Management International, Inc., Portland, OR

Southern Electric International, Atlanta, GA

Tenaska, Inc., Portland, OR

INTEREST GROUPS

Columbia Basin Fish & Wildlife Authority, Portland, OR

Columbia River Intertribal Fish Commission, Portland, OR

Convergence Research, Seattle, WA

Environmental Defense Fund, Oakland, CA

Friends of the Earth, Seattle, WA

Greenhouse Action, Clinton, WA

Idaho Conservation League, Boise, Id

Lake Roosevelt Forum, Coulee Dam, WA

Natural Resources Defense Council, San Francicsco, CA

Northwest Environmental Defense Center, Portland, OR

Northwest Resource Information Center, Eagle, ID

Oregon natural Resources Council, Portland, OR

Sierra Club, Seattle, WA

The Nature Conservancy, Seattle, WA

INDIVIDUALS

Kurt J. Breithaupt

Austin Collins, Portland, OR

Ray Foleen, Portland, OR

Carl Halvorson, Portland, OR

Gordon Kindken, Seattle, WA

Marvin Klinger, Everett, WA

Will Miller, Portland, OR

Mike and Diane Persky, Montesano, WA

Jay Picco, Salem, OR

Don Reading, Boise, ID

Gordon Rogers, Pasco, WA

Terry Simmons, Reno, NV

Jim Waldo, Tacoma, WA

Darren Wertz, Ridgefield, WA

Robert Witzl, Montesano, WA

Jay Yelton, Portland, OR

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Chapter 9: Glossary

The words below are defined for the reader as they are used in this EIS. A list of acronyms and abbreviations follows.

AC
(see Alternating current)

aMW
(see Average megawatts)

Acquisition
The gain of a power resource, including demand-side and supply-side categories, in the form of energy or capacity. The term is commonly used by BPA to distinguish acquisition from ownership of a project and its facilities, from which BPA is prohibited by law.

Air basins
Defined areas which generally confine the air-borne pollutants produced within them. Air pollutants tend to circulate and mix together within a basin.

Alternating current (AC)
Term applied to an electric current or voltage that reverses its direction of flow at regular intervals and has alternately positive and negative values, the average value of which (over a period of time) is zero.

Availability factor
Ratio of the amount of time a resource is capable of providing service to the amount of time the resource is actually in service over a given period.

Average megawatts (aMW)
The average amount of energy (number of megawatts) supplied or demanded over a specified period of time.

Baseload
In a demand sense, a load that varies only slightly in level over a specified time period. In a supply sense, a plant that operates most efficiently at a relatively constant level of generation.

BC Hydro
The British Columbia Hydro and Power Authority. This Crown corporation was formed in 1962 following the merger of an expropriated private utility and the BC Power Commission.

Canadian Entitlement
The Canadian Entitlement is Canada's 50-percent share of the downstream power benefits of Canada's three large storage dams, Duncan, Keenleyside, and Mica. These dams were built as part of the Columbia River Treaty. Canada offered the rights to this Entitlement for sale in the United States for an agreed upon period of 30 years, beginning with the operational dates of the storage project dams.

Capacity
The amount of power that can be produced by a generator or carried by a transmission facility at any instant. Also, the service whereby one utility delivers firm energy during another utility's period of peak usage with return made during the second utility's offpeak periods; compensation for this service may be with money, energy, or other services.

Capacity/energy exchange
A transaction in which one utility provides another with capacity service in exchange for additional amounts of firm energy (exchange energy) usually during offpeak hours or money under specified conditions.

Capacity factor
Ratio of the average generation of a resource to its rated capacity over a given period of time.

Capital costs
The costs to construct a power plant, including the costs of materials, permits, and interest on borrowing.

Cogeneration
The generation of power in conjunction with (usually) an industrial process, using waste heat from one process

to fuel the other.

Columbia River Treaty

A treaty signed by the United States and Canada on September 16, 1964, for joint development of the Columbia River. Under the Treaty, Canada built three large storage dams on the upper reaches of the Columbia River, which originates in Canada: Duncan, Keenleyside, and Mica. The portion of the historical stream flow of record for the Columbia River system during which the least amount of electrical energy can be generated by drafting the reservoirs according to seasonal power demands.

Critical Period

Critical period is a fundamental planning concept used to determine annual firm energy load carrying capability for the hydro system.

Cultural resources

The nonrenewable evidence of human occupation or activity as seen in any district, site, building, structure, artifact, ruin, object, work of art, architecture, or natural feature that was important in human history at the national, state, or local level.

Demand

The level of electric energy, in kilowatts or megawatts, that is needed at any given time.

Direct current (DC)

Term applied to an electric current or voltage which may have pulsating characteristics, but which does not reverse direction at regular intervals.

Direct-service industries (DSIs)

Industrial customers, primarily aluminum smelters, that buy power directly from BPA at relatively high voltages.

Dispatch

The monitoring and regulation of an electrical system to provide coordination; or the sequence by which electrical generating resources are called upon to generate power to serve changing amounts of load.

Displacement

The substitution of less-expensive energy (usually hydroelectric energy transmitted from the Pacific Northwest or Canada) for more expensive thermal energy produced in California. Such displacement means that the thermal plants may reduce or shut down their production, saving money and often reducing air pollution as well.

Dissolved gas concentrations

The amount of chemicals normally occurring as gases, such as nitrogen and oxygen, which are held in solution in water, expressed in units such as milligrams of the gas per liter of liquid.

Double-circuit

The placing of two separate electrical circuits on the same row of towers. For alternating current, each circuit consists of three separate conductors or bundles of conductors.

Economy energy

Nonfirm energy that can be generated on a partially loaded generating unit, or purchases of energy, at a price less than decremental cost. Economy energy is unconditionally interruptible.

Endangered

A plant or animal species which is in danger of extinction throughout all or a significant portion of its range because its habitat is threatened with destruction, drastic modification, or severe curtailment, or because of overexploitation, disease, predation, or other factors; Federally endangered species are officially designated by the U.S. Fish and Wildlife Service and published in the *Federal Register*.

Energy

The ability to produce electrical power over a period of time--expressed in kilowatt-hours.

Energy surplus

A condition in which a utility system can supply more energy than is demanded; the energy may be nonfirm, due to water conditions, or firm, due to excess generating capability.

Hydroelectric

With reference to a power system, the production of electric power through use of the gravitational force of falling water.

IOU

(see Investor-owned utility)

ISW

(see Inland Southwest)

Independent power producers
Non-utility producers of electricity who operate generation plants under the 1978 Public Utilities Regulatory Policy Act of 1978 (PURPA). Many independent power producers are cogenerators who produce power as well as steam or heat for their own use and sell the extra power to their local utilities.

Inland Southwest (ISW)
For the purposes of this EIS, the States of Nevada Arizona, Utah, and New Mexico.

Integrated System for Analysis of Acquisitions (ISAAC)
A computer model used by BPA and the Pacific Northwest Power Planning Council for analysis of resource acquisitions.

Interruptibility
The extent to which the flow of power can be stopped for a given period of time. By agreement, the supply of interruptible power can be shut off to a customer on relatively short (hours or a few days') notice.

Intertie
A transmission line or system of lines permitting a flow of energy between major power systems. BPA has several interties, both AC and DC, connecting the Pacific Northwest to the Southwest.

Intertie access
The assigned right to send a defined amount of electric power at a certain time over the high-voltage line system called the Pacific Northwest-Pacific Southwest Intertie.

Investor-owned utility
A privately owned utility whose programs are financed by (IOU) private (nongovernment) investors in the utility's stocks and bonds. (In contrast to publicly owned utilities.)

Juvenile
The stage in the life cycle of anadromous fish when they migrate downstream to the ocean.

Kilowatt-hour (kWh)
The common unit of electric energy equal to 1 kilowatt of power supplied to or taken from an electric circuit for 1 hour. A kilowatt equals 1,000 watts.

Least-cost mix of resources
The combination of generating (including conservation resources that would meet a given amount of load at a given time or for a given period most economically.

Levelized
Of costs, a method of calculating equal, periodic payments or receipts from unequal cost data for the same time period, considering the time value of money.

Load
The amount of electric power or energy delivered or required at any specified point or points on a system. Load originates primarily at the energy-consuming equipment of the customers.

Load growth
Increase in demand for electricity.

Load management
Methods or programs used by utilities or building and facility managers to reduce, reshape, or redistribute electrical loads.

Load/resource balance
The point at which the demand for electricity matches or balances the amount and type of resources available to serve that demand.

Long-Term Intertie Access Policy (LTIAP)
The policy developed by BPA to allocate use of the Federal portion of the Intertie for the long-term, an indefinite period that would at least encompass long-term power sales (up to 20 years) and long-term transmission contracts.

Long-term transmission contracts
Contracts between BPA and other entities for the use of the Federal transmission system, including the Intertie, for 20 years.

Low water years
Years in which less water than usual is received in a river system producing power from water flow. This is usually a consequence of reduced rain/snowfall over the fall and winter months.

MW

(see Megawatt)

Marginal energy costs

For a generating resource, the cost to produce one more kilowatt-hour of electricity.

Megawatt (MW)

A megawatt is one million watts, an electrical unit of power.

Mill

A tenth of one cent. A thousand mills equals one dollar. The cost of electricity is often expressed in mills per kilowatt-hour.

Nitrogen supersaturation

A condition of water in which the concentration of dissolved nitrogen exceeds the saturation level of the water. Excess nitrogen can lead to bubbles of nitrogen in the circulatory systems of fish.

Nominal dollars

For economic analysis, dollars in the year specified, not adjusted for the effects of inflation or the time value of money.

Nonfirm energy sales

Sales of electricity that are not guaranteed, but areinterruptible under specified conditions.

Nonfirm access

Use of the Intertie to transport sales of nonfirm energy.

Nonfirm energy

Energy produced by the hydropower system that is available when water conditions are better than critical period water flows and after reservoir refill is assured. Nonfirm energy is available in varying amounts depending upon season and weather conditions. Nonfirm energy is made available or supplied by BPA to a purchaser under an arrangement that does not have the guaranteed continuous availability of firm power. (See "Critical Period.")

Non-Treaty Storage Agreement (NTSA)

Three storage dams were built under the Canadian Treaty--Mica, Duncan, and Arrow (Keenleyside). These dams together provide more storage than is required under the Columbia River Treaty. This extra storage space was not covered by the Treaty. In 1983, a short-term (10-year) agreement was worked out on this issue; recently (November 1990) a new agreement was reached on how to share the extra several million acre-feet.

Offpeak hours

Period of relatively low system demand for electrical energy, as specified by the supplier (such as the middle of the night).

PF rate

(see Priority Firm rate)

PNW

(see Pacific Northwest)

Pacific Northwest (PNW)

According to the 1980 Northwest Power Act, the Pacific Northwest comprises Oregon, Washington, Idaho, and Montana west of the Continental Divide, as well as portions of Nevada, Utah, and Wyoming that are within the Columbia-Snake River Basin. The Pacific Northwest also includes any contiguous areas not more than 75 miles from the region defined above that are part of the service area of rural electric cooperative customers served by BPA on the effective date of the Act whose distribution system serves both within and without the region.

Pacific Northwest Coordination Agreement (PNCA)

An agreement between Federal and non-Federal owners of hydropower generation on the Columbia River system. This agreement governs the seasonal release of stored water to obtain the maximum usable energy, subject to other uses.

Pacific Northwest Electric Power Planning and Conservation Act

In December, 1980, Congress passed this Act, Public Law 96-501 (referred to as the Northwest Power Act). This Act authorized the four Pacific Northwest States--Idaho, Montana, Oregon, and Washington-- to enter into an interstate compact for the purpose of long-range planning and protection of shared resources. As a result of the Act, each of the four States passed enabling legislation to create the Pacific Northwest Electric Power Planning and Conservation Council in April 1981.

Pacific Northwest Electric Power Planning and Conservation Council (Council)

A council established by the Pacific Northwest Electric Power Planning and Conservation Act in 1981 made up of two voting representatives from each Northwest State--Washington, Oregon, Idaho, and Montana. The

Council is charged with planning for power resources and enhancement of fish and wildlife resources in the region.

Pacific Northwest Power Act

(see Pacific Northwest Electric Power Planning and Conservation Act)

Pacific Southwest (PSW)

In this EIS, PSW refers to California and the states of the Inland Southwest (Nevada, Arizona, Utah, and New Mexico).

Peak energy

The amount of energy (in megawatt-hours) used during a peak load period.

Peak loads

The maximum electrical demand for power in a stated period of time. It may be the maximum instantaneous load or the maximum average load within a designated interval of the stated period of time.

Phase shifters

Equipment used to control power flow on AC transmission systems.

Plume

The discharge of gas and other pollutants into ambient air, or the discharge of polluted or heated water into a body of water from its source to the point where the discharge is no longer identifiable since it has mixed with the ambient air or the water.

Point of delivery (POD)

The point where power is transferred from one system to another.

Power Plan

A 20-year power plan developed by the Pacific Northwest Electric Power Planning and Conservation Council. In the Plan, the Council proposed a comprehensive set of actions and projects to be undertaken to assure the region of adequate power resources, giving due consideration to conservation and fish and wildlife needs.

Priority Firm (PF) rate

The priority firm (PF) rate schedule is for sale of firm power to be used within the Pacific Northwest by public bodies, cooperatives, Federal agencies, and IOUs participating in the residential and small farm exchange under Section 5(C) of the Pacific Northwest Power Act.

Record of Decision

The document notifying the public of a decision taken on a power project, together with the reasons for the choices entering into that decision. The Record of Decision is published in the *Federal Register*.

Reliability level

For a power system, a measure of the degree of certainty that the system will continue operation for a specified period of time.

Renewable resource

A resource that uses solar, wind, water (hydro), geothermal, biomass, or similar sources of energy, and is used either for electric power generation or for reducing the electric power requirements of a customer.

Reservoir elevations

The various levels reached by water stored behind a dam.

Resident fish

Fish species that reside in fresh water during their entire life cycle.

Resource mix

The different types of resources used to generate power (e.g., hydroelectric, thermal, etc.) within a given area or for a given utility.

Return energy

The energy that is returned to a utility, equaling the amount of energy previously transmitted, under the terms of capacity sales and capacity energy contracts.

Rivers Study Data Base

Classification of the Pacific Northwest river resources. Stream resource categories evaluated include anadromous fish, resident fish, wildlife, natural features, recreation, cultural features (Indian, historic, and archaeological resources, etc.) and institutional constraints. Now maintained as part of the Northwest Environmental Data Base (NED).

Salmonids

Fish belonging to the family of salmonidae, including salmon, trout char, whitefish, and allied freshwater and

anadromous fish.

SAM

(See System Analysis Model)

Scoping

The definition of the range of issues requiring examination in studying the environmental effects of a proposed action. Scoping generally takes place through public consultation with interested individuals and groups, as well as with agencies with jurisdictions over parts of the project area or resources in that area. Scoping is mandated by Council on Environmental Quality regulations.

Secondary power

The excess above firm power to be furnished to a customer when, as, and if available.

Secondary revenues

Revenues received from sales of secondary energy, which is the energy produced in excess of firm power due to favorable water conditions.

Secondary sales

Surplus power, both firm and nonfirm, in the Pacific Northwest that is available for sale to the Pacific Southwest.

Shaping

The scheduling and operation of generating resources to meet load of changing levels. Load shaping on a hydro system usually involves the adjustment of storage releases so that generation and load are continuously in balance.

Simulation

The representation of an actual system by analogous characteristics of some device easier to construct, modify, or understand, or by mathematical equations.

Smolt

A juvenile salmon or steelhead that is migrating to the ocean and is in a physiological state to transition from fresh to salt water.

Spill (forced)

Water for which there is not storage capability in the system reservoirs and which could not be used for power production because the resulting flows would exceed turbine capacity.

Spill (inadvertent/overgeneration)

An amount of water which could have been used to generate electricity but was not because of lack of available market and inability to store for later use.

Spill (programmed or planned)

Water intentionally passed through a hydroelectric project without producing electricity. This is usually done for fisheries mitigation proposes.

Surplus capacity

Amount of electrical capacity above the amount needed to meet the current load requirements of BPA customers.

Surplus energy

Generally energy generated that is beyond the immediate needs of the producing system. Specifically for BPA, firm or nonfirm electric energy generated at Federal hydroelectric projects that would otherwise be wasted if there was not a market for the energy.

Surplus firm energy

Energy that can be generated and guaranteed to be provided, but is excess to demand.

Surplus firm power

Power that can be provided on a guaranteed basis, that is excess to system demand, and that can be provided in an agreed upon shape.

Surplus nonfirm energy

An excess of interruptible energy that is available due to water conditions better than critical.

Surplus peaking capacity

Electric peaking capacity for which there is no demand in the Pacific Northwest at the rate established for the disposition of such capacity.

System Analysis Model (SAM)

A computer model that simulates the full operation of the existing Pacific Northwest hydro system under various specified conditions.

System Operation (SOR)
A public involvement process conducted by three Federal Review agencies--BPA, the Bureau of Reclamation, and the Corps of Engineers--who are concerned with the operation and use of the Federal Columbia River Power System (FCRPS). Key events affecting the outcome of the SOR are the pending expiration in 2003 of the Coordination Agreement among U.S. parties who operate the U.S. dams in the FCRPS, and the end of the sale period of the Canadian Entitlement, which is part of the Columbia River Treaty that allocated Canada's firm power benefits from the Treaty to the U.S.

TSP
(see Total suspended particulates)

Thermal resources
Generating plants that convert heat energy into electric energy. Coal-, oil-, and gas-fired power plants and nuclear power plants are common thermal resources.

Total suspended particulates (TSP)
An air pollution term referring to all matter contained in a sample of air which is in solid or liquid form regardless of its particle size or chemical composition.

Transmission grid
An interconnected system of electrical transmission lines and associated equipment for the transfer of electric energy in bulk between points of supply and points of demand.

Turbidity
A measure of the optical clarity of water, which depends on the light scattering and absorption characteristics of both suspended and dissolved material in the water.

Wheeling
The use of the transmission and distribution facilities of one system to transmit power of and for another system.

Acronyms and Abbreviations

AC	Alternating current
aMW	Average megawatts
BC	British Columbia
BC Hydro	British Columbia Hydro and Power Authority
BPA	Bonneville Power Administration
CCCT	Combined cycle combustion turbine
CEC	California Energy Commission
cfs	Cubic feet per second
CO2	Carbon dioxide
Corps	U.S. Army Corps of Engineers
Council	Pacific Northwest Power Planning Council
CT	Combustion turbine
DC	Direct current
DOE	Department of Energy
EIS	Environmental Impact Statement
EMF	Electric and magnetic fields
Entitlement	Canadian Entitlement
EPA	Environmental Protection Agency
ER	Electricity Report

ESA	Endangered Species Act
FCRPS	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FY	Fiscal year
IOU	Investor-owned utilities
ISAAC	Integrated System for Analysis of Acquisitions
ISW	Inland Southwest
kcfs	Thousand cubic feet-per-second
kV	Kilovolts (thousands of volts)
MAF	Million acre feet
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NMFS	National Marine Fisheries Service
Northwest Power Act	Pacific Northwest Electric Power Planning and Conservation Act
NOx	Nitrogen oxide
NTSA	Non-Treaty Storage Agreement
PF	Priority Firm
Plan	Regional Electric Power and Conservation Plan
PNW	Pacific Northwest
POD	Point of delivery
PSW	Pacific Southwest
PURPA	Public Utilities Regulatory Policy Act
SAM	System Analysis Model
SCE	Southern California Edison
SOR	System Operation Review
SOx	Sulfur dioxide
Treaty	Columbia River Treaty
TSP	Total suspended particulates
U.S.	United States of America
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WWP	Washington Water Power

APPENDIX A

DELIVERY OF THE CANADIAN ENTITLEMENT EIS

RESPONSES TO COMMENTS ASSIGNED

TO NANCY WEINTRAUB

Response to Comment 1-1

Thank you for your recommendation. If and when new transmission lines are proposed for construction to facilitate the delivery of the Canadian entitlement, site-specific environmental documentation would be prepared for them. This documentation will include consultation with the State Historic Preservation Office regarding survey needs and the evaluation and protection of historic properties under the National Historic Preservation Act.

Response to Comment 3-6

The EIS describes technical factors which affect delivery capability for three possible points of delivery - Oliver, Blaine, and Selkirk - in section 2.2.1.1. The EIS describes the facilities necessary for each of the points of delivery, as well as when and whyadditional facilities would need to be constructed.

The U.S. Entity does not agree that standby service to Blaine is required for delivery of the entitlement at Oliver. Therefore, we did not include those consequences in our analysis of the environmental impacts of delivery at Oliver.

Comments by Austin Collins at the 4/26/94 Public Meeting:

Provided comments regarding the history of the Columbia River Treaty and in support of its continuation. He supported efforts to make arrangements among power producers and users that benefit the public, and spoke in support of public, as opposed to investor-owned, power.

Stated that BPA originally took a risk by assuming the responsibility for payingfor the Canadian entitlement, and hopes BPA is positioning itself better in the current negotiations.

Advocated BPA making better [power system] connections with BC Hydro and divorcing itself from investor-owned utilities. Expressed concern about repayment of the Treasury debt.

Response to all three comments: Thank you for your comments. **[should we address the responsibility for repayment of Canadian Entitlement?]**

Table A-1

Comments and Response Letters