

3.4.7.3 Fuel Usage and Land Use

The IDU Final EIS also contained a method by which coal consumption by specific coal-fired power plants serving the PNW can be estimated. Further, amounts of land that would be disturbed by mining to produce the coal can be estimated. These methods are described in Appendix F, Part 2 of the IDU Final EIS. This methodology was used to determine potential effects of the proposed NTSA on coal consumption and land disturbance.

Table 3.4.11 shows the total amounts of coal consumed by each PNW coal-fired power plant, and Table 3.4.12 shows the total amounts of land that would be disturbed by mining over the course of the SAM study, 1989 through 2008. The No-Action alternative is compared with the proposed NTSA used for opportunity storage and as a firm resource. The impacts on coal consumption and land disturbance for mining are small on a percentage basis, and there is not a significant difference whether the proposed NTSA is used for opportunity storage or as a firm resource. Also, it is likely that the total surface area ultimately disturbed for coal mining will be unchanged, because mining will tend to continue until all economically recoverable coal is mined.

The only CT expected to be affected the proposed NTSA is Beaver. Natural gas consumption in total over the period 1989 through 2008 for the Beaver CT facility is projected to increase relative to the No-Action alternative when the proposed NTSA is used as a firm resource. The increase would be about 8,580 million cubic feet (MCF), an increase of about 7.1 percent, assuming combined cycle operation. When the proposed NTSA is used for opportunity storage, natural gas consumption at Beaver in total for 1989 through 2008 is reduced relative to the No-Action alternative by about 22,900 MCF, a reduction of about 19 percent. Differences in fuel consumption were not determined for the other CT facilities addressed in the SAM analysis because differences in generation between the alternatives are so small.

3.4.7.4 Water Use Impacts

Water quality impacts of thermal power plants are typically well regulated and, therefore, are not likely to be altered by the proposed NTSA. Since the operation of coal-fired power plants may be changed if the proposed NTSA is implemented and these plants utilize large amounts of water for cooling and other purposes, impacts on water supplies become a concern. The methodology used for the IDU Final EIS (See IDU Final EIS, Vol. 1, Section 4.3.3, and Vol 4, Appendix F, Part 2) was used to conservatively assess these impacts for all but the Corette plant, for which generation differences between No Action and the proposal are consistently very small. Table 3.4.13 shows impacts of changes in surface water use, and Table 3.4.14 shows impacts of changes in groundwater use. (Valmy is the only plant in the analysis that uses groundwater.)

The water consumption analysis is based on the positive and negative differences in generation between operation under the proposed NTSA for

TABLE 3.4.11

COAL CONSUMPTION
1989 - 2008

Plant	No-Action 10 ³ tons	Proposed NTSA as Opportunity Storage		Proposed NTSA as Firm Resource	
		Change from No-Action 10 ³ tons	Percent Change from No-Action	Change from No-Action 10 ³ tons	Percent Change from No-Action
Colstrip	121,300	1,300	1.1	870	0.7
Boardman	23,600	92	0.4	1,220	5.2
Centralia	91,900	1,940	2.1	1,950	2.1
Bridger	118,200	2,110	1.8	1,250	1.1
Valmy	9,620	220	2.3	520	5.4
Corette	3,390	65	1.9	44	1.3
Total	368,010	5,727	1.6	5,854	1.6

TABLE 3.4.12
LAND DISTURBED FOR MINING
1989 - 2008

Plant <u>a/</u>	No-Action acres	Proposed NTSA as Opportunity Storage		Proposed NTSA as Firm Resource	
		Change from No-Action acres	Percent Change from No-Action	Change from No-Action acres	Percent Change from No-Action
Colstrip <u>b/</u>	2,320	25.5	1.1	17.1	0.7
Boardman	403	1.6	0.4	20.7	5.1
Centralia	5,400	114	2.1	115	2.1
Bridger	7,840	140	1.8	82.9	1.1
Total	15,963	281.1	1.8	235.7	1.5

a/ Valmy uses coal from an underground mine. Land use impacts at the mine are not substantially affected by Valmy's coal consumption.

b/ Includes Corette which also uses coal from the Colstrip mine.

Table 3.4.13

MAXIMUM IMPACT ON SURFACE WATERS

A	B	C	D	E	F	G	H	I	J	K	L
STATE	PLANT	WATER BODY	MEAN ANNUAL DISCHARGE (AC-FT)	YEARS OF RECORD	RECENT YEAR DISCHARGE (AC-FT)	MINIMUM DISCHARGE (AC-FT/DAY)	YEAR	LARGEST POSITIVE AND NEGATIVE ANNUAL CHANGES IN GENERATION (aMW)	LARGEST POSITIVE AND NEGATIVE ANNUAL CHANGES IN WATER USE (AC-FT)	PERCENT OF MINIMUM DISCHARGE	RECORD RATING
PROPOSED NTSA USED FOR OPPORTUNITY STORAGE											
OR	Boardman	Columbia River	140100000	104 yrs	165700000	24000	1968	16.1 -40.0	393 -976	0.0045 -0.011	Excellent
WA	Centralia	Skookumchuck River	183300	1930-82	238600	167	1982	42.9 -21.7	926 -469	1.5 -0.77	Good
WY	Bridger	Green River	1277000	33 yrs	1677000	337	1955	37.3 2/	806	0.66	Good-Poor
MT	Colstrip	Yellowstone River	8620000	1978-84	8780000	12246	1984	21.1 2/	456	0.010	--
PROPOSED NTSA USED AS A FIRM RESOURCE											
OR	Boardman	Columbia River	140100000	104 yrs	165700000	24000	1968	29.9 -3.9	730 -95	0.0083 -0.0011	Excellent
WA	Centralia	Skookumchuck River	183300	1930-82	238600	167	1982	44.7 2/	966	1.6	Good
WY	Bridger	Green River	1277000	33 yrs	1677000	337	1955	23.4 -19.3	505 -417	0.41 -0.34	Good-Poor
MT	Colstrip	Yellowstone River	8620000	1978-84	8780000	12246	1984	12.9 -3.1	279 -67	0.0062 -0.0015	--

1/ Percent of Minimum Discharge computed assuming minimum discharge occurs over the course of an entire year. This method tends to overstate the actual expected impacts.

2/ No decreases or zero changes occurred.

Table 3.4.14

MAXIMUM IMPACT ON GROUNDWATER

<u>STATE</u>	<u>PLANT</u>	<u>WELL LOCATION</u>	<u>AQUIFER RECHARGE OR YIELD (AC-FT/YR)</u>	<u>LARGEST POSITIVE AND NEGATIVE CHANGES IN GENERATION (aMW)</u>	<u>LARGEST POSITIVE AND NEGATIVE ANNUAL CHANGES IN WATER USE (AC-FT)</u>	<u>PERCENT OF RECHARGE OR YIELD</u>
PROPOSED NTSA USED FOR OPPORTUNITY STORAGE						
NV	Valmy	Valmy aquifer near Valmy	9000	7.8 -11.2	112 -16.1	1.2 -1.8
PROPOSED NTSA USED AS A FIRM RESOURCE						
NV	Valmy	Valmy aquifer near Valmy	9000	13.1 */	188	2.1

*/ No decreases or zero changes occurred.

opportunity storage and firm resource use and the No-Action alternative of the largest magnitude throughout the 20 years of the SAM analysis. Therefore, the results shown in Tables 3.4.13 and 3.4.14 are only for two particular years, which are not necessarily the same for each plant. Differences in water use for all other years of the SAM analysis are of smaller magnitude than those shown on the Tables. Water use impacts for the Boardman and Colstrip plants tend to be very small because they draw their water from relatively large rivers, the Columbia and the Yellowstone. Also, the minimum discharges upon which the percentages in Column K of Table 3.4.13 are based, are artificial values for annual minimum streamflow computed by multiplying the minimum discharge from Column G by the number of days in a year (i.e., 365), making the analysis very conservative.

The impacts on both ground and surface waters of the proposed NTSA relative to the No-Action alternative are very small. The largest changes in water use by any plant relative to a conservatively estimated minimum annual flow in the stream acting as the source of water (or, for the Valmy plant, aquifer recharge) are less than 3 percent.

3.4.7.5 Sensitivity Analyses for Existing Thermal Resources

PNW High Loads

The differences in results of the analysis with high PNW loads from those using the Base Case assumptions are not sufficient to draw significantly different conclusions regarding impacts of the proposed NTSA on air quality, fuel consumption, land disturbance, or water related to thermal resource operations use than those described in Sections 3.4.7.2 through 3.4.7.4.

Southwest High Loads and Gas Prices

The impacts on air quality, fuel consumption, land disturbance, and water use of the proposed NTSA are expected to be similar with high Southwest load and gas prices to what are projected for the Base Case.

Alternative Dispatch Criteria

Operation of existing coal-fired plants with alternative dispatch criteria is quite similar to the Base Case operation for the proposed NTSA used as opportunity storage.

Spill Agreement

Including the negotiated Spill Agreement in the SAM analysis results in only very small differences from the Base Case assumptions in the results for operation of existing coal-fired generation and CT's including Beaver. There would be negligible differences in the impacts of these plants relative to the Base Case.

Expire in 2003

For both the existing coal-fired plants and Beaver, the differences in results between the Base Case and assuming expiration of the NTSA in 2003 are not sufficient to produce any substantial difference in conclusions about environmental impacts.

3.4.8 New Resources

The Least Cost Mix Model (LCMM) was used to determine future resource acquisitions to maintain load/resource balance. The LCMM projects resource acquisitions in order to exactly maintain load/resource balance. Thus, the LCMM projects building generating plants in hypothetical increments, 45 MW nuclear plants, for example. The LCMM data were adjusted to expected plant sizes and input to the SAM for system operation studies. For purposes of system operation comparisons between alternatives, resources used in the SAM were the same for the No-Action alternative and the proposal. Additional studies were conducted using the LCMM to determine potential changes in new resource acquisitions resulting from the proposed NTSA. A description of the LCMM is provided in Appendix B.

Operation of non-Treaty storage as opportunity storage does not provide firm energy and, therefore, does not affect the need for new resources. Through the end of the study period, 2008, new resource acquisitions for both the No-Action and proposed alternatives include 864 MW of conservation, 656 MW of renewable resources, 1621 MW of nuclear generation, and 605 MW of coal generation.

Under the proposed agreement, operation of non-Treaty storage as a firm resource could allow deferral of up to approximately 150 MW of new resources. Because the proposed agreement expires in 2003, the need for new resources in 2004 is approximately the same as in the No-Action alternative, however.

Under the PNW medium loads scenario, the marginal resources acquired by the LCMM are conservation in the early years and nuclear generation in later years. Approximately the same amount of conservation is brought on by 2004 with non-Treaty storage used as a firm resource as in the No-Action alternative. Conservation acquisition is lower by only about 10 MW each year with the proposed NTSA. The LCMM projects that an 800 MW nuclear plant will come on line around the year 2000. The use of non-Treaty storage as a firm resource would not affect acquisition of the nuclear plant because non-Treaty storage does not provide enough firm energy to defer this resource. Thus, use of non-Treaty storage as a firm resource in a PNW medium load growth scenario, would have little effect on new resource acquisitions.

Under the PNW high load growth scenario, the marginal resources projected by the LCMM to be acquired are short-term purchases and coal generation. If non-Treaty storage under the proposal is used as a firm resource, a portion of these acquisitions (up to about 150 aMW) could be deferred until 2004.

A description of potential environmental effects of conservation and coal plant acquisition is contained in Appendix N.

3.4.9 Effects on Direct Service Industries

The DSI's are a group of industrial firms that purchase much of their power directly from BPA. These firms generally use electroprocesses, and the largest part of their load is represented by the region's 10 primary aluminum smelters. BPA has contractual rights to interrupt, or restrict, service to their loads under certain conditions.

Prior BPA studies indicate that restrictions, in total, to the DSI's averaging less than 50 MW per year would not impair the DSI's production efficiency or their economic viability. When restrictions average between 50 and 200 MW per year, it is uncertain whether serious effects may occur. Restrictions averaging above 200 MW per year are likely to result in lower expected operating levels and may induce permanent plant closures.

The SAM studies project amounts of restrictions to DSI load. These results are summarized in Table 3.4.15. When the Base Case assumptions are used, on average, restrictions to DSI load are projected to be below 50 aMW in all years of the analysis. Use of the proposed NTSA as opportunity storage is projected to reduce DSI restrictions in all years. Use of the proposed NTSA as a firm resource reduces the projected amounts, relative to No-Action, of DSI restrictions in 13 of the 20 years, and increases them in 6 years. No matter what the assumption about use of the proposed NTSA, restriction of the DSI load exceeds 50 aMW in only one circumstance, 2008, when the proposed NTSA is assumed to be used as a firm resource.

With high PNW loads, amounts of DSI load restriction are higher than for the Base Case assumptions for the No-Action alternative. The proposed NTSA generally leads to lower projected amounts of DSI restriction in most years when used either as opportunity storage or as a firm resource. The same generally can be said for the other sensitivity cases.

Because changes in projected DSI restrictions are less than 50 aMW in all but one year, it does not appear that the DSI's would be adversely affected by the proposed NTSA.

Each of the DSI plants impacts the environment in its own unique way, a consequence of the plant's location and characteristics. These impacts will continue substantially unchanged if the proposed NTSA is implemented.

Table 3.4.15

DSI FIRST QUARTILE CURTAILMENT
20-YEAR aMW

	No Action	Opportunity	Firm Use
Base	24.0	16.0	22.1
PNW High Loads	46.3	32.8	42.0
PSW High Loads	23.4	16.8	22.6
Spill Agreement	24.2	16.0	22.2
Alternative Dispatch Criteria	24.2	21.2	--
Expire in 2003	24.0	19.2	23.2

3.5 CANADA

Triton Environmental Consultants, Ltd prepared an environmental report on the proposed NTSA for BC Hydro dated February 1990. Their Summary Report is included as Appendix O and results are described briefly in this Section. The air quality analysis in Section 3.5.8 was provided by BPA rather than Triton.

3.5.1 Analytical Methods

Triton Environmental Consultants Ltd. performed analyses using physical data provided by BC Hydro and BPA on alternative reservoir operating regimes with and without the proposed NTSA. The data, from SAM, consisted of monthly reservoir elevations and outflows from Mica and Arrow. For each study case, a 20-year (1989-2008) simulation was run as described in Section 3.1.2. The result was 200 data points for each month of the study (20 years) for each parameter of interest (e.g., Mica and Arrow elevations and outflows). The data distributions cover the range of expected variation in each parameter for the assumed operating regime. The impact assessment is based mainly on projected median reservoir levels and outflows averaged over the 20-year study period, although extreme values have also been considered.

3.5.2 Environmental Resources and Resource Uses

Mica Reservoir

Mica is licensed to be operated between 2,320 feet and 2,475 feet and is currently operated between about 2,411 feet and full pool. Rainbow trout, kokanee, Dolly Varden char, and mountain whitefish are the most important and abundant sport fish. Due to steep slopes, Mica does not provide good spawning or rearing habitat for fish or habitat for most species of wildlife. Waterfowl use occurs in a few areas of flat or gently sloping shoreline. Forestry is the dominant resource industry in the region. None of the communities in the area utilize the reservoir for water supply. Agricultural activity in the area is severely limited. Recreation on and around the reservoir is light and confined mainly to the local population, although use is slowly increasing.

Arrow Lakes Reservoir (Keenleyside Dam)

Arrow presently varies from 1,378 feet to 1,444 feet. Rainbow trout, Dolly Varden char, and kokanee are the principal sport fish. Arrow Lakes Valley is a natural migration route for many birds during spring and fall, primarily waterfowl. Forestry (logging and sawmills) sustains most of the labor force in the area. A pulp and paper company operates a water intake just upstream of Keenleyside Dam, which supplies process and drinking water to its pulp mill near Castlegar and to a sawmill, and drinking water to the City of Castlegar. There is limited agriculture in the Arrow Lakes area. The reservoir is large, scenic, and more accessible than Mica; recreational use by both residents and tourists is increasing.

Downstream Area

Flows from Keenleyside Dam are greatest during winter and lowest in March-April. The river provides resident fish with year-around, mostly open-water habitat with high rearing potential. Rainbow trout, kokanee, Dolly Varden char, whitefish, and burbot are the principal sportfish species. Flows are controlled and the spring freshet reduced, providing relatively stable habitat for aquatic/riparian wildlife, although riparian habitats are of limited extent. A smelter uses water from the river; a village and a subdivision of Trail also obtain their water from this intake. Effluent from industrial complexes and Castlegar's sewage treatment facility is discharged to the river. A timber company stores logs on the river prior to transporting them by water to its sawmill. There is little agriculture in the vicinity of the Columbia River. The river has moderately significant recreation capability, but there are few developed recreational facilities; use is mainly by regional residents.

3.5.3 Fish and Fish Habitat

Mica Reservoir

The proposed NTSA would result in an overall reduction of the annual elevation of Mica Reservoir compared with the No-Action alternative. It is expected that the upper 20 to 30 feet of the wetted drawdown zone that is currently being flooded is likely to be flooded less frequently. Outflows from the reservoir are expected to increase during the months of August through November and decrease during December through July.

Minor changes in plankton production may occur as a result of reservoir elevation changes. Increased outflows during the July through October period could result in increased fish entrainment which is known to be a problem. Losses to Mica fisheries due to increased entrainment of fish and plankton would likely be offset by positive effects on fish stocks immediately below the dam.

Lower reservoir levels resulting from the proposal could affect access to three tributaries by migratory fish. These three tributaries, Beaver and Wood Rivers and Foster Creek, have natural barriers to fish which are currently inundated and, therefore made passible to fish. Lower elevations could impede migration and spawning of rainbow trout socks, which usually spawn in April through June. Since rainbow trout spawning coincides with spring runoff, hence reservoir filling, it is probable that rainbow trout spawning would be delayed rather than halted. It is likely that these streams contribute little to the overall production of the reservoir's rainbow trout population given the low water temperatures and turbulent conditions prevalent in all three. In very dry years, exposure of migration barriers could encompass all or part of the spawning season for rainbow trout, Dolly Varden char, kokanee, and mountain whitefish. Kokanee are not known to spawn in these cold, glacial streams and would, therefore, not be affected. Although production by Dolly Varden char and

mountain whitefish could be affected, these three streams are estimated to contribute only 5 to 10 percent of the overall reservoir production of the two species, which would be impacted only in very dry years.

The current drawdown zone does not provide productive fish habitat. Therefore, it is unlikely that reduced reservoir levels resulting from the proposal, will have any effect on the amount of available rearing habitat in the reservoir or its tributaries.

Arrow Reservoir

Arrow reservoir elevations would be essentially unchanged by the proposed NTSA. Arrow outflows are expected to increase during August through December and decrease January through July with the proposed in NTSA compared to the No-Action alternative.

Overall, there are no anticipated impacts on fish utilizing the Arrow Reservoir as a result of the proposal. Changes in Arrow outflows could affect downstream fish stocks. Present high levels of total dissolved gas (TDG) downstream of Arrow do not appear to adversely affect fish and it is not expected that flow changes associated with the proposed NTSA would have an incremental effect. Decreased flow levels during the January through July period would result in small decreases in discharge in the Columbia River downstream of Arrow. Eggs deposited during the high water period may become exposed when late winter-early spring downward fluctuations in water depth occur. The maximum monthly average reduction in flow is expected to be less than 4 kcfs however, and minimum project outflows would not be altered.

3.5.4 Wildlife Resources

Mica

Variation in reservoir level, combined with other factors such as steepness of terrain, severely limit production of aquatic/wetland wildlife at Mica Reservoir. Increased annual elevation ranges resulting from the proposed NTSA would have little incremental effect compared to the No-Action alternative. Waterfowl, shorebirds, and other migrating species would not be adversely affected because those birds rest primarily on sandbars and mudflats and such habitats will still be available.

A potential reduction in aquatic productivity due to loss of plankton during periods of increased discharge could adversely affect wildlife species dependent on aquatic food chains. Populations of potentially-affected species are small and few individuals would be affected. As few fish will be affected, reduced access to three tributary streams is not expected to have impacts on species such as bears and bald eagles which feed on spawners.

Lower water levels should have no adverse impact on any cross-reservoir big game movements. Seasonal timing of open water and ice over should not

change. Lower reservoir levels will mean that crossing distance, on average, is slightly less with the proposal than with the No-Action alternative.

Arrow

Arrow elevations are not expected to change as a result of the proposed NTSA. Slight, if any, incremental impacts on wildlife or on waterfowl are expected.

Changes in reservoir levels and discharge rates projected as a result of the proposed NTSA should not cause measurable changes in productivity or fish abundance, therefore, no impacts on wildlife species which feed on plankton, aquatic invertebrates, or fish should occur.

Differences in average monthly outflows from Arrow between the proposed NTSA and the No-Action alternative are slight. Therefore, no measurable impact on wildlife habitat or populations along the river downstream of Arrow is expected to occur as a result of the proposal.

3.5.5 Recreation

Mica Reservoir

Recreation use occurs mainly from June through September when the reservoir is filling. Decreases in reservoir levels during this period resulting from the proposal would cause access problems and an unattractive exposed drawdown area which would detract from the recreational appeal of the reservoir. Potential changes in reservoir operation will need to be taken into account during development of new recreation sites.

Arrow Reservoir

The very slight differences in projected Arrow elevations between the proposal and the No-Action alternative are not expected to have an incremental impact on recreation. Likewise, changes in Arrow outflow are not expected to affect recreation facilities, which have been constructed to accommodate changes in flows.

3.5.6 Cultural Resources

Mica Reservoir

With the proposed NTSA, the two documented heritage sites at Mica Reservoir will remain inundated even with the projected increase in reservoir drawdown, thus will not be affected.

Arrow Reservoir

Differences in Arrow Reservoir levels resulting from the proposed NTSA are very small. Most known heritage sites have already received impacts from present reservoir operation. Therefore, no further impacts on heritage sites are expected from implementation of the proposal. Changes in outflows from Arrow resulting from the proposed NTSA as compared to the No-Action alternative will not have incremental impacts on known downstream heritage sites.

3.5.7 Water Quality

The only area where water quality is a present concern is in the Columbia River downstream of Arrow, due mainly to the Celgar pulp mill effluent. Recent legislation requires all mills to have secondary effluent treatment and reduced emissions of other pollutants by 1991. Accordingly, future water quality in the vicinity of the Celgar pulp mill near Castlegar will be improved compared to what it is today. In general, water quality will be improved by the required work on the pulp mill effluent system both with and without the proposed NTSA.

3.5.8 Air Quality

The Burrard Thermal generating plant is located on the north shore of Burrard Inlet 16 kilometers east of downtown Vancouver, British Columbia. The plant consists of six gas-fired, steam-cycle generating units with a total nameplate capacity of 912 MW. The plant uses water from Lake Buntzen for boiler makeup and other miscellaneous purposes, and water from Burrard Inlet for cooling. Cooling water is discharged back to the inlet resulting in a slight increase in temperature (less than 1°C when four units are operated) of the water in the vicinity of the plant.

It is expected that the proposed NTSA would result in additional displacement of the Burrard plant (40-65 aMW). This could result in some slight improvement in air quality in the Vancouver, B.C. vicinity.

3.6 CALIFORNIA

3.6.1 California's Resource Mix

About half of California's generating capacity consists of oil- and gas-fired power plants. About 20 percent is hydroelectric capacity. Other sources of power are nuclear, coal, geothermal, and cogeneration. In recent years California has purchased about 25 percent of its energy requirement from utilities in the Inland Southwest (ISW) and Pacific Northwest. California also imports energy from Canada when transmission access is available. Imports of economy energy and firm power allow California utilities to displace their oil and gas generation when economical or when required for air pollution control reasons.

3.6.2 Resource Operation

Changes in amounts and timing of PNW sales of surplus power and energy to California affect the amount and type of California generation required. They also can affect the level of imports to California from the ISW.

California utilities operate their own resources based on economic dispatch and considerations of minimum generation constraints, system reliability, and required purchases from PURPA qualifying facilities (QFs), and environmental quality.

Most of California's hydro capacity is run-of-river, with little storage capacity. Therefore, it operates whenever there is sufficient water. Hydro generation in California would not be affected by the proposed NTSA.

Nuclear power, with high capital costs and low operating costs, also would not be affected by the proposed NTSA. Similarly, other generation such as geothermal, cogeneration, solar, and QFs would not change with the proposal.

Most oil/gas generators can switch relatively quickly between the two fuels. Utilities choose between fuels based on the relative costs of each fuel and state policies on fuel use. In recent years most oil and gas units in California have used gas. Oil and gas units can operate within a wide range of capacity and have high fuel costs, so California utilities typically use imported economy energy to displace generation by oil and gas units. Thus, virtually all the impacts expected from changes in imports to California from the PNW and ISW occur to oil/gas generation levels.

3.6.3 Resource Impacts

The IDU Final EIS explains that natural variations in water conditions on a seasonal and yearly basis result in large swings in the availability of nonfirm energy in the PNW and Canada. The level of unplanned and planned outages by thermal and hydro plants also will affect the amount of available surplus energy. The effect on sales and generation of the availability of surplus energy is far greater than the effects of the proposed NTSA.

3.6.4 Air and Water Impacts

The IDU Final EIS contains an analysis of impacts of sales of PNW power to California utilities. Changes in amounts of California sales of much greater magnitude than those projected for the proposed NTSA are discussed in that Final EIS. (IDU Final EIS, Chapters 4.3.2 and 4.3.3 and Appendices F and G.) No significant impacts on air or water quality or impacts from impingement or entrainment of organisms by water withdrawals were found to occur as a consequence of changes in generation at California power plants resulting from sales of Northwest power. From the IDU analysis, it can be concluded that no significant environmental impacts of these types would occur from implementing the proposed NTSA, either for opportunity storage or for use as a firm resource. Results of sensitivity analyses support the Base Case conclusions.

3.7 GLOBAL WARMING

Carbon dioxide (CO₂) emissions from fossil fuel-fired power plants may be one of the major factors leading to global warming. With the proposed NTSA CO₂ production by operation of fossil fuel-fired power plants in the Northwest, Canada, and California may be affected. This global warming analysis evaluates changes in coal and gas-fired generation in the PNW, British Columbia, and California. It is assumed that energy sales from the PNW and BC Hydro to California reduce generation by California's gas-fired plants.

Opportunity Storage

When the proposed NTSA is used for opportunity storage, generation by PNW coal-fired plants generally increases, while generation at PNW CT plants generally decreases relative to the No-Action alternative. (See Table 3.3.1.) Because the CT unit primarily affected in the SAM analysis, Beaver, is an efficient, combined-cycle unit and burns gas (or possibly oil when it is more economical) which produces less CO₂ per unit of energy produced than coal, a net increase in the PNW CO₂ production would be expected. On the other hand, generation from Burrard, a gas-fired steamplant owned by BC Hydro, is expected to be reduced by about 65 aMW. This would result in reduced CO₂ production in British Columbia.

PNW plus BC Hydro sales to California displace operation of California resources fired with gas (or oil when it is economical). Most of these resources are steam cycle plants. When the proposed NTSA is used for opportunity storage, resource displacement in California is reduced by about 10 aMW over the 20-year study period, compared to the No-Action alternative. This is a very slight change representing about 0.4 percent of the total displacement by PNW and BC Hydro sales. (See Table 3.3.2.)

Emissions of CO₂ from Beaver and from steam cycle gas fired plants such as are displaced in California and British Columbia are about 60 percent of those from a coal-fired plant on a per unit of electric energy output basis. On average, for the 20-year study period, coal generation is expected to increase by about 56 aMW while gas-fired generation is expected to decrease by about 75 aMW. After adjusting for differences in CO₂ production between coal and gas-fired plants, the net result is an increase in CO₂ production equivalent to that produced by about 10 aMW of coal-fired generation. This is a minor change when compared to the total coal and gas-fired generation on the West coast.

Firm Resource Use

When the proposed NTSA is used as a firm resource, both PNW coal plant and CT generation increase on average for the study period. Coal generation increases by 50-60 aMW (1-2 percent) while CT generation averages a 4 aMW increase. (See Table 3.3.1.) In the study, this additional energy is not used to displace California generating plants; the study assumes an

additional 165 aMW load in the Northwest. Sales to California to displace gas (or oil) resources there decrease by about 4 percent. (See Table 3.3.2.) In British Columbia, an average of about 40 aMW of Burrard generation is displaced and some new resources are deferred.

Whether this increase in PNW coal and California resource generation is deleterious or not depends partially on what other resource would have been developed to serve the 165 aMW load. In effect, with use of the proposed NTSA as a firm resource, 165 aMW of firm energy is produced by operating about 50 to 60 aMW, on average, of additional coal-fired generation per year and 4 aMW, on average, of additional CT generation. If a 165 aMW coal-fired resource would have been developed, a net benefit relative to CO₂ emissions would be expected. If conservation or hydroelectric resources were developed instead, there would be more CO₂ emissions with the proposed NTSA than without. If a 165 aMW gas-fired resource in the Northwest were substituted, it may be about the same in either case from the Northwest perspective (depending on what type of gas-fired resource was developed and how efficient it was), but the reduced displacement of resources in California would lead to a small net increase in overall CO₂ emissions. The potential changes in CO₂ production resulting from the proposed NTSA are quite small relative to the total generation of fossil fuel-fired power plants.

Although the correlation between CO₂ production and global warming is not well-defined, it is assumed that increased CO₂ production could lead to an increase in global warming. This analysis of coal and gas-fired generation levels indicates that the proposed NTSA, used for opportunity storage or as a firm resource, would result in little net change in CO₂ production on the West Coast. Therefore, it is reasonable to conclude that global warming would not be affected by the proposal. Results of sensitivity studies support the same conclusions as those for the Base Case.

3.8 CUMULATIVE IMPACTS

The National Environmental Policy Act (NEPA) requires that a Federal agency consider the cumulative impact of the proposed action along with other reasonable and foreseeable actions. As of yet, future actions that may alter river operations are undefined. In judging the cumulative impacts associated with the proposed NTSA, BPA evaluated system operations and anadromous fish survival and how these changes compared with the results identified in the IDU Final EIS analyses. (The IDU Final EIS presented the last system wide cumulative impact analysis.) No potential adverse impacts associated with the proposed NTSA have been identified for PNW recreation, irrigation, or cultural resources. Therefore, no cumulative impacts would occur for these parameters.

3.8.1 Analytical Methods

The IDU Final EIS determined that changes in capacity of the Pacific Northwest-Southwest Intertie (rather than marketing or Intertie Access Policy) had the largest effect on the environment, particularly anadromous fish stocks. To determine if the NTSA had cumulative impacts on anadromous and resident fish beyond those identified in the IDU Final EIS, BPA analyzed the effect of the maximum intertie size (consistent with IDU maximum intertie size), the signed Spill Agreement, and non-Treaty storage space used as an opportunity and firm resource against a Base Case using the intertie size that existed at the time of the IDU analyses, pre-IDU spill plan (1987 spill plan) and no additional operation of non-Treaty storage space beyond the current agreement for 2 MAF of non-Treaty storage space which expires in 1993. All other assumptions remained the same. (Appendix L, contains the data used in the cumulative effects analysis.)

3.8.2 Cumulative Effects on Anadromous and Resident Fish

Reservoir levels are not substantially different from what was reported in Section 3.4.13 when non-Treaty storage is used as either an opportunity or firm resource. U.S. reservoirs remain consistently higher with non-Treaty storage available than without, regardless of intertie size. There is little change in the frequency of flows downstream of Libby below 4.0 kcfs, or in the frequency of flows at Columbia Falls greater than 4.5 kcfs and less than 3.5 kcfs.

The increased intertie capacity as analyzed for IDU Final EIS did not affect streamflows. Therefore, changes in streamflows are a result of the proposed NTSA. Flow changes are not substantially different from what is reported in Section 3.4.1.4 for operation of the proposed NTSA. Columbia River streamflows generally increase in the fall and are slightly lower throughout the spring and summer months. There is no change in the ability to meet the Columbia River water budget or in the frequency of meeting Vernita Bar requirements.

Increased intertie capacity had a notable effect on overgeneration spill, as shown in the IDU Final EIS. Overgeneration spill decreased nearly 78 percent,

April through August, as a result of the intertie upgrade and expansion. The proposed NTSA decreases overgeneration spill an additional 3.3 percent beyond that determined for increased capacity. Table 3.8.1 shows the projected changes in overgeneration spill resulting from increased intertie capacity and additional non-Treaty storage when used as an opportunity resource. Firm resource use of non-Treaty space results in less change in overgeneration spill than use for opportunity storage.

The analysis of survival changes under the maximum intertie size relative to the intertie size prior to the IDU expansion and upgrade shows projected average relative changes in survival throughout the contract for all yearling, subyearling, steelhead, and sockeye ranged respectively, from increase 0.5, a decrease 0.1, no effect, and a decrease of 0.1 percent to decreases of 1.8, 5.0, 1.5, and 2.2 percent. In the IDU Final EIS Section 4.2.3 the effects of the maximum intertie size were concluded to be minor relative to each stock's current population and productivity status, current smolt passage survival, and expected increases in passage survival due to planned improvements in fish passage facilities.

The cumulative effects of the expanded intertie with the opportunity storage alternative showed average relative changes in survival throughout the contract for all yearling, subyearling, steelhead, and sockeye ranged from increases of 2.4, 2.2, 2.7, and 0.1 percent to decreases of 1.0, 5.8, 1.0, and 0.9 percent.

The cumulative effects of the expanded intertie with the firm resource alternative the average relative change in survival throughout the contract for all yearling, subyearling, steelhead, and sockeye ranged from increases of 2.9, 2.5, 3.0, and 0.1 percent to decreases of 0.6, 5.5, 0.8, and 0.9 percent.

The relative change in mean survival and the frequency of relative survival increases and decreases greater than 1 and 5 percent for each category of fish stocks, for each pool of origin, was determined and provided in Appendix L, Part 2, for each year of analysis and for each alternative studied. The proposed Non-Treaty storage agreement used as either an opportunity resource or as a firm resource, with the signed Spill Agreement improved survival of yearling chinook and sockeye salmon, and made little change in the average relative survival of subyearling chinook and steelhead. Cumulative effects from the proposed Non-Treaty Storage agreement on the downstream migrant survival of juvenile fish are expected to be insignificant. The proposed Non-Treaty storage agreement is not expected to create additional cumulative impacts to resident or anadromous fish.

3.8.3 Cumulative Effects Relative to Thermal Resource Operations

The analysis for this EA generally relies on the IDU Final EIS analysis to determine the impacts of changes in thermal resource operation for the PNW and California. The analysis shows only minute changes in environmental conditions with the proposed NTSA. The IDU Final EIS, while dealing with

Table 3.8.1

**EFFECTS OF INTERTIE CAPACITY AND THE PROPOSED NTSA
ON OVERGENERATION SPILL**

Month	MW Spill Pre-IDU Tie Size w/o NTSA	MW Change Max Tie Size w/o NTSA	MW Change Max Tie Size w NTSA */	Change in Spill (%)	
				due to tie size	due to NTSA
September	0.0	0.0	0.0	0.0	0.0
October	0.0	0.0	0.0	0.0	0.0
November	0.0	0.0	0.0	0.0	0.0
December	0.7	-0.7	-0.7	100.0	0.0
January	29.6	-25.5	-25.7	86.1	0.7
February	93.0	-82.6	-85.2	88.8	2.8
March	179.7	-147.2	-150.5	81.9	1.8
April	282.5	-221.3	-228.4	78.3	2.5
May	804.5	-589.4	-625.8	73.3	4.5
June	1204.3	-746.7	-802.2	62.0	4.6
July	698.7	-556.7	-592.5	79.7	5.1
August	0.3	-0.3	-0.3	100.0	0.0
Annual Average	274.4	-197.5	-209.3	62.5	1.8
Average Apr-Aug	598.1	-422.9	-449.8	78.7	3.3

*/ NTSA used as an opportunity resource with the maximum tie size and signed spill agreement.

substantially larger changes in thermal resource operation than predicted for the proposed NTSA, showed only very small or negligible changes in environmental conditions related to thermal resource operations. The total effect of the NTSA in conjunction with actions taken under the IDU Final EIS with respect to thermal resource operations would continue to be very small or negligible.

CHAPTER 4.0

PUBLIC CONSULTATION

In November 1988, BPA invited over 150 individuals and groups known to be interested in fish and wildlife and power issues to a meeting on December 19, 1988, to discuss options for improving the efficiency of power operations between BC Hydro and the PNW. During the meeting, BPA staff discussed the proposed Agreement, described the analyses that were planned, answered questions, and solicited comments. Written comments were also requested during the comment period which closed January 12, 1989.

In response to public comments, BPA scheduled a second public consultation meeting on March 14, 1989, to further discuss the expected environmental effects of the proposed NTSA. Prior to this meeting, BPA distributed a Discussion Paper which explained the potential uses of non-Treaty storage, presented the analytical methods, and discussed preliminary study results for opportunity use of non-Treaty storage. Comments were invited by mail or at the meeting. At the March 14, 1989, meeting, BPA also presented new information on the preliminary results and circulated a sign-up sheet for a mailing in early April of material on firm resource use of non-Treaty storage. The comment period was extended from March 23, 1989, to May 1, 1989, in order to allow a more thorough review of the new material. BPA especially sought comments and suggestions on analytical tools and methods and questions about the effects of non-Treaty storage on river operations and fish. In order to respond to these questions and still allow sufficient time for review and comment, BPA again extended the comment period to May 22, 1989. Late comments were also accepted.

Meanwhile, based on questions and comments made by fishery agency and Tribal interest group representatives during the meetings and in comment letters, BPA sent personal letters to agency heads and Tribal leaders seeking specific information and analysis to support claims of potentially adverse impacts to fish and wildlife. These letters sought clarification of agency and Tribal positions and asked for specific facts to support these assertions. At the request of the Northwest Power Planning Council, BPA conducted a technical workshop on June 21, 1989. Several smaller group meetings were also held with interested commenters.

The 37 comment letters received were reviewed and the major issues were identified. Comments were grouped by topic and summarized; responses were prepared. The Non-Treaty Storage Agreement Issue Summary and Response to Comments was distributed in September 1989.

In early March 1990, the preliminary environmental assessment (EA) was circulated for review and comment to interested and affected parties. The public comment period originally scheduled to close on April 6, 1990, was extended by request to April 20.

A total of 29 comment letters were received on the preliminary EA. The concerns expressed by commenters have been considered and, where appropriate, have been incorporated into the EA.

GLOSSARY

The words below are defined for the reader as they are used in this technical report

aMW - (see Average megawatts)

Acre-foot - The volume of water that will cover an area of 1-acre to a depth of 1 foot.

Active Storage Space - Non-Treaty space that is available on a continuous basis.

Ambient Air - Ambient air is the air surrounding a particular spot, such as a power plant.

Anadromous Fish - Fish species that spawn and initially rear in fresh water, migrate and mature in the ocean and return to fresh water as adults.

Aquifer - Any geological formation containing water, especially one that supplies water to wells, springs, etc.

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.

Bypass System - A channel or conduit in a dam that provides a route for fish to move through or around the dam without going through the turbine units.

cfs - (see Cubic feet per second)

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.

Combustion Turbine (CT) - An electrical generator powered by an oil or gas-fired turbine. Normally characterized by low capital costs and short construction lead times, but having a high operating cost.

Critical Stock - Those stocks which are substantially below escapement goals, are not increasing on a clear trend, and for which harvest and production management actions reflect the stock's critical condition.

Cubic Feet Per Second (cfs) - A unit of measurement pertaining to flow of water. One cfs is equal to 449 gallons per minute.

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.

DSI - (see Direct-service industries)

Dam Passage - The percentage of fish which get from one side of a dam to the other alive.

Decremental Cost - The cost that a utility could avoid by not operating a power plant; a utility's decremental cost is considered by some regulators to be a "fair" rate for the utility to pay for purchased power.

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.

Downstream Migrant Survival - The survival of an individual juvenile salmon or steelhead from the time it enters the mainstem Snake or Columbia Rivers, until it gets below Bonneville Dam.

Draft - To remove water or energy from a reservoir. Also the quantity of water or energy that has been removed from a reservoir.

Drawdown - The distance that the water surface of a reservoir is lowered from a given elevation as water is released from the reservoir (drafted).

DSI First (or top) Quartile - The 25 percent of the DSI's load which is interruptible. The other 75 percent is considered firm.

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.

Emergence - Migration of hatched salmon fry up through the gravel of a redd preparatory to continuing their life cycle in open water.

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 Content Curve (ECC) - A set of end-of-month reservoir contents which assure a high probability of refilling the reservoirs.

Export Sales - The sales of electricity from one region to another.

Extraregional - Any entity or place not within the Pacific Northwest.

Federal Columbia River Power System (FCRPS) - The hydroelectric dams on the Columbia River financed by the U.S. Treasury, which operate as a coordinated generation system, and for which BPA serves as the power marketer.

FELCC - (see Firm Energy Load Carrying Capability)

Firm - In the power industry, guaranteed or assured. May refer to a guaranteed supply of power, to guaranteed access to a means to transmit power, or, with reference to loads, to guaranteed service for a defined need. Usually defined for a given period of time.

Firm Energy Load Carrying Capability - The maximum level of energy that can be produced and shaped to load during the period it would take reservoirs to be drafted from full to empty under critical streamflow conditions.

Firm Resource Use of Non-Treaty Storage - Using non-Treaty space to provide firm energy on a planning basis. In this document, BC Hydro's use of non-Treaty storage is restricted to service of firm loads. The U.S. portion of non-Treaty storage is drafted and filled along with PNW reservoirs and has a refill obligation.

Fish Guidance Efficiency (FGE) - The percentage of the total number of fish approaching a turbine intake that are deflected from a dam's units by a fish guidance device such as a turbine intake screen.

FISHPASS - Model used to evaluate the relative system survival of anadromous fish as they pass through the Columbia and Snake Rivers.

Fish Spill Plan - A plan to provide a certain percentage of the total flow of a project as spill, for Federal and non-Federal projects.

Flood Control Elevation - An elevation below which a reservoir's forebay must be maintained to provide protection from downstream flooding. The Corps of Engineers determine these elevations.

Fossil Fuel - A combustible, carbonaceous material formed from the remains of ancient plants and animals. Common fossil fuels include coal, natural gas, and derivatives of petroleum such as fuel oil and gasoline.

Game Fish - Fish which are sought by recreational fishermen.

Groundwater - The supply of fresh water under the earth's surface in an aquifer or soil.

Head - (see Hydraulic Head)

Head Losses - The loss of energy experienced due to a reduction in head. Specifically, a given volume of water released from Mica will produce less energy if non-Treaty space is not full. The amount of the reduction is the head loss.

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

Hydroregulator - A computer model simulating the operation of the PNW electric power system that incorporates the historical streamflow record, monthly loads, thermal and other non-hydro resources, hydroelectric plant data for each project, and the constraints limiting each projects operation.

IDUEIS or IDU Final EIS - The Intertie Development and Use Final Environmental Impact Statement which was released in April of 1988.

Inactive Storage - Space that is filled when the reservoir initially fills and is unavailable thereafter due to physical or operating constraints.

Incremental Cost - The additional cost that a utility would incur by operating a power plant.

Incubation - The period between fertilization of an egg and its hatching.

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

Intertie Access Policy - The policy developed by BPA to allocate use of the Federal portion of the Intertie.

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

kcfs - One thousand cubic feet per second. A measure of speed and volume of water flow. (see Cubic feet per second)

KSFD - thousand second foot days--a volume of water sufficient to provide a flow of 1 Kcfs for a 24-hour period.

Least Cost Mix Linear Program Model (LCMM) - A linear program computer model that estimates the amount of regional generation and conservation resources that should be acquired to yield a least-cost resource mix to meet a given firm load over a 20-year planning horizon.

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/Resource Balance - The point at which the demand for electricity matches or balances the amount and type of resources available to serve that demand.

MAF - (see Million Acre-Feet)

MW - (see Megawatts)

MW-mo - The amount of energy needed to supply a one MW load for one month.

Marginal Energy Costs - For a generating resource, the cost to produce one more kilowatthour of electricity.

Megawatts (MW) - A megawatt is one million watts, an electrical unit of power.

Mid-Columbia Participants - Any utility which owns a share of the generation of the five Mid-Columbia projects.

Million Acre-Feet - A volume of water equal to 504 KSFD. (See Acre-foot.)

NF Rate - The nonfirm energy (NF) rate schedule is used for the sale of nonfirm energy both inside and outside the U.S.

Nonfirm Energy - Energy available due to water conditions better than critical, sold on an interruptible (nonguaranteed) basis.

Non-Treaty Storage Agreement - An agreement between BPA and BC Hydro, which allows both parties to share in the use of existing Canadian storage space which is otherwise unusable to both parties.

Northwest Power Act - (see Pacific Northwest Electric Power Planning and Conservation Act)

NTSA - (see Non-Treaty Storage Agreement)

NTSA Discussion Paper - A paper released at a March 14, 1989, public consultation meeting, which presented preliminary results from the NTSA studies.

Operating Year - The 12-month period from September 1 through August 31.

Opportunity Storage - Using non-Treaty space to store energy when markets are poor, and release it when markets are better. Decisions to store or release are made based on economics and no restrictions are placed on how the energy may be used. There is no annual refill requirement for non-Treaty space.

Overgeneration - Energy that would be produced by the system, for which there is not market or other use. This energy must, therefore, be spilled. (Overgeneration spill.)

PNW - (see Pacific Northwest)

PSD - (see Prevention of Significant Deterioration increments)

Pacific Northwest (PNW) - For this EA, the States of Washington, Oregon, and Idaho; the portion of Montana west of the Continental Divide; and areas in Montana, Nevada, and Wyoming surrounding coal plants that serve the PNW.

Pacific Northwest Coordination Agreement (PNCA) - An agreement signed by most of the PNW utilities in 1961 which provides for coordinated system operations, resulting in greater efficiencies than if each system ran independently. Several types of energy exchanges are provided for under this agreement.

Pacific Northwest Electric Power Planning and Conservation Act - Signed into law December 5, 1980, the Act provides for coordinated planning of the Pacific Northwest's energy future, through a Regional Planning Council with representation from Oregon, Idaho, Montana, and Washington.

Passage Survival - The survival rate of migratory fish through, around, or over dams or other obstructions in a stream or river.

Prevention of Significant Deterioration (PSD) criteria - Any one of several incremental changes in ambient total suspended particulate or sulfur dioxide concentrations established by the Environmental Protection Agency to protect existing air quality from being degraded significantly through new developments, such as construction and operation of a new air pollution source.

Real Discount Rate - The factor used to compute the present value of a future amount, which adjusts solely for the time value of money and does not include price inflation.

Recallable Storage Space - Non-Treaty space that BC Hydro may, but is not obligated to, make available from time to time.

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.

Relative - Considered in relation to a base case condition; comparative; not absolute or independent (opposed to absolute).

Relative Change in Survival - The difference in survival between the two alternatives divided by the base case survival value. The change in survival in relation to the base case survival.

Relic Collecting - The seeking out and removal of artifacts or other cultural resources by private persons. The practice consequently excludes opportunities for study or preservation of the site, and often results in destruction of artifacts, the site itself, and/or nearby sites.

Renewable Resources - Resources for energy which are continually replenished. Water, for instance, is a renewable resource, while coal which is converted into carbon dioxide, water, and ash when burned is not.

Reservoir Draft Rate - The rate at which water, released from storage behind a dam, reduces the pool elevation of the reservoir.

Reservoir Elevations - The various levels reached by water stored behind a dam.

Reservoir Mortality - (see Pool Mortality)

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

Runoff - The volume of water expected to pass a point in a specified time period. Normally the January 1 through July 31 volume flowing past The Dalles.

Run-of-River Plant - A hydroelectric plant with little or no ability to regulate flow.

SAM - (see System Analysis Model)

Sensitivity Study - Studies run using SAM which examine the sensitivity of the study results to certain modeling assumptions.

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

SP Rate - The short-term surplus firm power rate is the rate applied to short-term sales of firm power that is excess to BPA's needs.

Spawning - The act of fish releasing and fertilizing eggs.

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 purposes.

Spot Market - A market for electricity characterized by negotiation almost solely on the basis of price, for relatively short-term sales.

Storage Reservoirs - Reservoirs maintained behind dams for the purpose of retaining excess water readily available during springtime flows as snow melts. Retained water is then released, as necessary, during periods of lower flow in order to maintain necessary levels of power production. (Water may also be released for other purposes, such as navigation, irrigation, and maintenance of life support for fish.)

Subyearling - A juvenile salmonid, normally a fall or summer chinook salmon, that hatches and migrates to the ocean in the same year.

System Analysis Model (SAM) - SAM simulates, monthly for 20 years, the operation of the Pacific Northwest hydro/thermal system. It provides information regarding the expected operation of the hydro system and individual thermal resources, the reliability of the system, production costs, the amount of California sales, and the revenues generated by California sales.

System Refill - The coordinated hydro system is considered full, for the purposes of the EA modeling, when the amount of water stored in reservoirs is equal to 94 percent of the total available space.

System Stock Survival - The survival of migrating juvenile salmon or steelhead of a particular fish stock from the point of entry into the hydroelectric system to a point below Bonneville Dam.

Thermal Resources - Generating plants which 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.

Treaty Storage - Treaty storage is the 15.5 MAF of storage that Canada was required to build under the Columbia River Treaty signed in 1964.

Variable Costs - The costs that are incurred or are increased when a power plant operates, as opposed to the fixed costs that are incurred whether the plant runs or not.

Vernita Bar - Gravel bar located downstream of Priest Rapids Dam. It is a prime spawning ground for fall chinook salmon.

Water Budget - A part of the Pacific Northwest Power Planning Council's Fish and Wildlife Program calling for a volume of water to be reserved on a planning basis and released when and if needed to augment stream flows in order to assist in the downstream migration of juvenile salmon and steelhead.

Water Conditions - The overall supply of water to operate the Pacific Northwest hydroelectric generating system at any given time, taking into account reservoir levels, snowpack, needs to provide water or retain water to meet various operating constraints (such as the Water Budget, flood control, flow constraints, etc.), weather conditions, and other factors.

Whitebook Studies - Also called the Pacific Northwest Loads and Resources Study. This study evaluates the loads and resources of the Federal system and the Pacific Northwest region and projects the yearly average energy consumption and resource availability for the next 20 years.

Yearlings - Juvenile salmon and steelhead that migrate to the ocean, often spending a full year rearing in fresh water.