SUMMARY

S.1 DESCRIPTION OF THE PROPOSED ACTION

The Western Area Power Administration (Western) proposes to establish the level of its commitment (sales) of long-term firm electrical capacity and energy from the Salt Lake City Area Integrated Projects (SLCA/IP) hydroelectric power plants. Power generated by the SLCA/IP facilities or purchased by Western from other sources is provided to Western's customers under contracts that establish the terms for how capacity (generation capacity) and energy (quantity of electrical energy) are to be sold. The contracts also specify amounts of capacity and energy that Western agrees to offer for long-term (greater than 12 months) sale to its customers. These amounts constitute Western's "commitment levels." The capacity and energy level is called "firm" when its availability is guaranteed to the customer.

Because establishment of a commitment level could be a major Federal action with potentially significant impacts to the human environment, this environmental impact statement (EIS) is being prepared in compliance with the National Environment Policy Act of 1969 (NEPA), as amended, and associated implementing regulations, particularly Council on Environmental Quality regulations (40 CFR Parts 1500-1508) and Department of Energy (DOE) regulations (10 CFR Part 1021).

S.2 WESTERN'S RESPONSIBILITIES AND MISSION

Western, a power marketing administration within the DOE, was created with the passage of the Department of Energy Organization Act of 1977 (DOE Act). The DOE Act transferred the power marketing and transmission functions from the Secretary of the Interior (Bureau of Reclamation [Reclamation]) to the Secretary of Energy, acting through Western.

Western's mission is to sell and deliver electricity that is in excess of project uses (power that is required for the operation of the project) generated from power plants that were built as part of certain Federal water projects. Most of the power plants included in this EIS are located on the Upper Colorado River and its tributaries. Western's Colorado River Storage Project Customer Service Office (CRSP-CSO; formerly known as the Salt Lake City Area [SLCA]) is responsible for marketing of power from the Colorado River Storage Project (CRSP), Collbran Project, Rio Grande Project, and Provo River Project. On October 1, 1987, the Colorado River, Collbran, and Rio Grande projects were integrated for marketing and rate-making purposes and are collectively known as the SLCA/IP.

Western's power marketing responsibility begins at the switchyard of Federal hydroelectric power facilities and includes the Federal transmission system to interconnected utility systems. The hydroelectric projects of the SLCA/IP are operated by Reclamation. Reclamation manages and releases water in accordance with the various acts authorizing specific projects and with other enabling legislation. Western's capacity and energy sales must be in conformance with the laws that govern its sale of electrical power. Further, Western's hydropower operations at each facility must comply with minimum and maximum flows and other constraints set by Reclamation or other operating agencies, acting in accord with law or policy.

The Reclamation Project Act of 1939 defined the responsibility of Reclamation in irrigation development and permitted revenues from the sale of electricity generated at the Federal facilities to be used to repay some of the irrigation investment, as well as all costs incurred in developing the hydroelectric facilities. The principal purposes of these projects include irrigation, flood control, and navigation. About 90% of all revenues received from these projects

are from power sales.

An important provision of the Reclamation Project Act was to give preference in the sale of Federally generated electricity to municipalities, other public corporations or agencies, cooperatives, and other nonprofit organizations financed under the Rural Electrification Act of 1936. Western sells firm power to nonpreference customers only if the available supply exceeds the demands of interested and eligible preference customers. Preference is an important issue because the price of Western's firm power (the long-term firm capacity and energy rate) is limited to cost recovery at a rate that currently places it below market levels.

S.3 PUBLIC INVOLVEMENT

Public comments and opinions from interested groups, Federal and state agencies, customers, and the general public are an integral part of the decision-making process. Through a series of workshops, hearings, and mailings, Western has received comments on the scope of this EIS, on the purpose and need statement (which was finalized after the scoping process), on the alternatives, on the hydropower operational scenarios, and on the draft EIS (see Appendix E, Comments and Responses). In addition, this EIS reflects comments by cooperating and coordinating agencies. The cooperating agencies are the Bureau of Reclamation, the National Park Service, and the U.S. Fish and Wildlife Service. The coordinating agencies are the states of Utah, Wyoming, New Mexico, Colorado, and Arizona.

Government agencies and members of the public raised several specific issues during the public review period for the draft EIS. Those issues were related primarily to selection of a preferred commitment-level alternative for the power-marketing program and to preference for specific hydropower operational scenarios at the generating facilities evaluated in the EIS, particularly at Flaming Gorge Dam. Environmental groups commented that if Western made a high commitment of electrical power, the bulk electrical purchases that would be required would exceed Western's legal authority. Western has determined that all the alternatives included in the EIS are lawful.

Most Western customers that commented on the draft EIS recommended that Western select commitment-level alternative 1, a high-capacity, high-energy alternative, as the preferred alternative. Since publication of the draft EIS, Western has chosen this commitment-level alternative as the preferred alternative. Western has also identified this alternative as the environmentally preferred alternative because it minimizes impacts to socioeconomic resources and lacks consequential natural resource impacts. These customers also wrote that they agreed with the major findings of the draft EIS but were concerned that Western had relied on studies that are incomplete. The analyses included in Western's final EIS are based on currently available information.

Concerns raised by Federal natural resource agencies (specifically, the U.S. Fish and Wildlife Service and the National Park Service) that the preferred alternative would result in operations at hydropower facilities that were more damaging to natural resources are not supported by the analyses summarized in the EIS. The weak relationship between hydropower operations and commitment levels allows a decoupling of selections of commitment level and operational restrictions. Selection of a commitment level in no way forecloses future changes in hydropower operations. These same natural resource agencies expressed concern that fluctuations at hydropower facilities would cause detrimental impacts on downstream ecological resources. These impacts have been fully considered and presented in the EIS. Western's eventual decision regarding a commitment level will not present an obstacle to a future decision to change the operation of a hydropower facility by either Reclamation or by Western. Federal natural resource agencies also expressed concern that protection of natural resources would require occasional releases that are above power plant capacity. Such releases would be under the jurisdiction of the Bureau of Reclamation and would not be affected or limited by Western's control of these facilities for power generation.

Environmental groups commented that the analyses summarized in the EIS were methodologically accurate, but they would have preferred a process that included interested publics in the analysis process. Finally, environmental groups were concerned about Western's treatment of air resource impacts and commented that Western should consider the absolute value of decreases in air emissions that results from changed dam operation and not just the percentage change in these emissions. The EIS was modified to include presentation of these emission values.

S.4 ALTERNATIVES

Western could market the electricity produced at the SLCA/IP in a variety of ways. The hydroelectric resource is highly variable among seasons and years because of variation in natural hydrology. To firm up the hydroelectric resource and enhance its value as a reliable source of electricity, and to fulfill Western's mission and statutory responsibilities, Western markets hydroelectricity supplemented with energy purchased from and exchanged with other utilities. By purchasing and exchanging power with other utilities, Western is able to increase its level of long-term firm sales, enhance the value of the hydrogeneration resources, and optimize the efficiency of integrating hydroelectric and other electric power resources.

Western's principal marketing program is the sale of long-term firm capacity and energy at long-term firm power rates. The amount of capacity and energy sold under long-term contract is called the level of commitment. The alternatives examined in this EIS are based upon different levels of long-term firm commitments and are called commitment-level alternatives.

The commitment-level alternatives evaluated in this EIS are defined on the basis of a specified level of both capacity (which is equivalent to the instantaneous output of a generator, usually stated in megawatts [MW]) and energy (the amount of power generated over a period of time, usually stated in megawatt-hours [MWh] and limited by generator capacity). The combination of capacity and energy commitment, plus other elements of the power marketing contracts, is used to define a resource that is used to meet all or part of a customer's load requirements. Normally, this allows for higher energy use during daytime (on-peak) hours and a lower use during nighttime (off-peak) hours. Within constraints, Western schedules and releases water on an hourly and daily basis from the SLCA/IP in coordination with Reclamation and makes purchases and exchanges to optimize the integration of hydroelectric with other power resources and to meet its contractual commitments defined by the alternatives. Together these factors affect hydropower operations at SLCA/IP facilities.

The commitment-level alternatives considered in this EIS span the range of commitments necessary for Western to fulfill its statutory obligations. These alternatives were presented in draft to the general public for comment and were discussed with specific environmental and customer groups. Seven combinations of capacity and energy commitments are considered as representative of the entire range of commitments that could be offered by Western. Capacity commitments range from a low of 550 MW (less than 40% of the historical commitment) to a high of 1,450 MW. Energy commitments range from a low of 3,300 MWh (less than 60% of the historical commitment) to a high of 6,200 MWh.

The major characteristics of the commitment-level alternatives considered in this EIS are described in Table S.1. These alternatives were selected on the basis that, as a group, the combinations of capacity and energy incorporated into these alternatives represent the reasonable bounds of capacity and energy available to Western given currently available resources. In addition to two moderate capacity-moderate energy alternatives (3 and 6), the alternatives include high capacity and energy (alternative 1, the preferred alternative), low capacity and energy (alternative 4), high capacity and low energy (alternative 2), and low capacity and high energy (alternative 5) combinations.

S.5 WESTERN'S PREFERRED ALTERNATIVE AND THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

Commitment-level alternative 1 — the Post-1989 commitment level, was developed and chosen as Western's preferred alternative during an extended public process involving SLCA/IP customers and other interested parties. This alternative was also identified as the environmentally preferred alternative on the basis of the results of the analyses in this EIS (see Section S.8, Table S.5). These analyses indicate that most impacts to natural and cultural resources would result from hydropower operations rather than from commitment levels. This situation is due to the fact that

commitment levels are only weakly linked to hydropower operations. Furthermore, under this alternative, socioeconomic impacts, including impacts to financial viability, retail rates, and regional and agricultural economies, would be minimized.

TABLE S.1 Electric Power Marketing EIS Commitment-Level Alternatives

Alternative	Capacity Commitment (MW)	Energy Commitment (GWh)	Load Factor (%)	Minimum Schedule Requirement (%)	Description
No action	1,291	5,700	50	35	Moderate capacity and high energy (the 1978 marketing program commitment level)
1 (preferred alternative)	1,449	6,156	48.5[a]	35	High capacity and high energy (the Post-1989 commitment level)
2	1,450	3,300	26	10	High capacity and low energy
3	1,225	4,000	37	15	Moderate capacity and moderate energy
4	550	3,300	68	52	Low capacity and low energy
5	625	5,475	100	100	Low capacity and high energy
6	1,000	4,750	54	33	Moderate capacity and moderate energy

[a] This load factor differs slightly from that published in the Post-1989 Marketing Criteria (50.2%) because of a difference between calculating this number annually versus seasonally.

S.6 HYDROPOWER OPERATIONAL SCENARIOS

In addition to analyzing the commitment-level alternatives, this EIS evaluates the impacts of hydropower operations at Glen Canyon Dam, Flaming Gorge Dam, and the Aspinall Unit, which are the three SLCA/IP facilities that provide most of the hydropower marketed by Western, and over which Western exercises some measure of hourly or daily control. The array of potential hydropower operations — referred to as operational scenarios — ranges from historical[1] high hourly fluctuations to no hourly fluctuation (baseload or steady flows) at each facility. Operational scenarios considered here are presented in Tables S.2, S.3, and S.4. These hydropower operational scenarios were submitted in draft to the public and to specific interest groups for review.

This EIS addresses a set of actions that could be considered in separate NEPA documents. By considering both commitment-level alternatives and operational scenarios together, examination of a full range of operations and commitment levels and their combined impacts is possible. Actual hydropower operations within the range of scenarios examined may come about as a result of management decisions by Western or Reclamation. Reclamation determines operational constraints (including minimum and maximum release rates and monthly release volumes) for Federal hydropower facilities, and Western makes operational decisions within these constraints at Glen Canyon, Flaming Gorge, and the Aspinall Unit. Western has no control over water releases at the rest of the facilities, which are operated for other purposes with incidental power generation.

S.7 AFFECTED ENVIRONMENT

The environment potentially affected by the commitment-level alternatives and the hydropower operational scenarios

varies among resources (Figures S.1 and S.2). For socioeconomics and air resources, the area served by the SLCA/IP is described because commitment-level alternatives would affect this broad geographic region. For other resources, including water resources, ecology, cultural resources, land use, recreation, and visual resources, the affected environment is the area associated with specific SLCA/IP hydroelectric facilities that provide most of the power supplied by Western and over which Western has some degree of control of operations, namely Glen Canyon Dam, Flaming Gorge Dam, and the Aspinall Unit. Socioeconomics are treated first in this EIS because commitment-level alternatives vary considerably in their impact on socioeconomics but differ little in their effects on the natural environment.

Figure S.1. Affected Environment for Socioeconomics

Figure S.2. Affected Environment for Natural and Cultural Resources

S.7.1 Socioeconomics

Western's SLCA/IP serve about 183 customers, including municipalities, Federal installations, state universities, irrigation districts, and others. In turn, Western's utility customers serve end-users in 192 counties in 12 states. Part of the socioeconomic analysis of the commitment-level alternatives assessed the impacts that a change in Western's long-term firm commitments could have on its utility customers. Specific attention was focused on the financial viability of these customers and the retail rates charged to their end-users.

TABLE S.2 Hydropower Operational Scenarios for Glen Canyon Dam

			Restricted Fluctuating Flows			Steady Flows		
Parameter	Continuation of Historical Flows	Maximum Power Plant Capacity	Moderate	Modified Low[a]	Interim Low	Existing Monthly Volume	Seasonally Adjusted	Year-Round
Minimum releases[b] (cfs)	1,000 Labor Day-Easter 3,000 Easter-Labor Day[c]	1,000 Labor Day-Easter 3,000 Easter-Labor Day[c]	5,000	8,000 between 7 a.m. and 7 p.m. 5,000 at night	8,000 between 7 a.m. and 7 p.m. 5,000 at night	8,000	8,000 Oct-Nov[d] 8,500 Dec 11,000 Jan-Mar 12,500 Apr 18,000 May-Jun 12,500 Jul 9,000 Aug-Sep	Yearly volume prorated[e]
Maximum releases[f] (cfs)	31,500	33,200	31,500[g]	25,000[g]	20,000	Monthly volumes prorated	18,000g	Yearly volume prorated[e]
Allowable daily change in flow (cfs/24 hours)	30,500 Labor Day-Easter 28,500 Easter-Labor Day	32,200 Labor Day-Easter 30,200 Easter-Labor Day	"45% of mean flow for the month not to exceed "6,000	5,000,[h] 6,000, or 8,000	5,000,[h] 6,000, or 8,000	"1,000[i]	"1,000[i]	"1,000[i]

Allowable scheduled ramping (cfs/h)	Unrestricted	Unrestricted	4,000 up 2,500 down	4,000 up 1,500 down	2,500 up 1,500 down	2,000 cfs/d between months	2,000 cfs/d between months	2,000 cfs/d between months
Elements common to restricted fluctuating and steady flow alternatives	None	None	Adaptive management, including long-term monitoring and protection of cultural resources, flood frequency reduction measures, beach/habitat-building flows, new population of humpback chub, further study of selective withdrawl, emergency exeption criteria					

[a] Identified by Reclamation as their preferred alternative (Reclamation 1995).

[b] In high volume release months, the allowable daily change would require higher minimum flows.

[c] Releases each weekday during recreation season (Easter to Labor Day) would average not less than 8,000 cfs for the period from 8 a.m. to midnight.

[d] Based on an 8.23-million acre-feet year; in higher release years, additional water would be added equally to each month, subject to an 18,000 cfs maximum.

[e] For an 8.23-million acre-feet year, steady flow would be about 11,400 cfs.

[f] Maximums represent normal or routine limits and may necessarily be exceeded during high water years.

[g] May be exceeded during habitat-maintenance flows.

[h] Daily fluctuation limit of 5,000 cfs for monthly release volumes less than 600,000 acre-feet; 6,000 cfs for monthly release volumes of 600,000 to 800,000 acre-feet and 8,000-cfs for monthly volumes over 800,000 acre-feet.

[i] Adjustments would allow for small power system load changes.

Source: Adapted from Reclamation (1995).

TABLE S.3 Hydropower Operational Scenarios for Flaming Gorge Dam a

Parameter	Year-Round High Fluctuating Flows	Seasonally Adjusted Flows[b]		
		High Fluctuating	Moderate Fluctuating	Steady
Minimum releases (cfs)	800	800 Oct-Jan 2,380 Feb-Mar 800 Apr-May 4,700 Jun 1-21 800 Jun 22-Jul 9 890 Jul 10-31 990 Aug 1,070 Sep	800 Oct 2,220 Nov-Jan 2,380 Feb-Mar 2,440 Apr 2,740 May 4,700 Jun 1-21 2,770 Jun 22-30 1,860 Jul 1-Jul 9 976 Jul 10-31 1,080 Aug 1,160 Sep	800 Oct 2,380 Nov-Mar 2,600 Apr 3,390 May 4,700 Jun 1-21 3,740 Jun 22-30 2,020 Jul 1-9 1,060 Jul 10-31 1,160 Aug 1,240 Sep
Maximum releases (cfs)	4,700	800 Oct 4,700 Nov-	800 Oct 4,170 Nov-Jan	Same as minimum releases

		Jan 2,380 Feb-Mar 4,700 Apr-Jul 9 2,900 Jul 10-31 3,000 Aug 3,100 Sep	2,380 Feb-Mar 4,390 Apr 4,700 May-Jun 3,810 Jul 1-9 1,980 Jul 10-31 2,080 Aug 2,160 Sep	
Allowable daily change in flow (cfs/24 hours)	3,900	0 Oct 3,900 Nov-Jan 0 Feb-Mar 3,900 Apr-May 0 Jun 1-21 3,900 Jun 22-Jul 9 2,010 Jul 10-Aug 2,030 Sep	0 Oct 1,950 Nov-Jan 0 Feb-Mar 1,950 Apr-May 0 Jun 1-21 1,950 Jun 22-Jul 9 1,000 Jul 10-Sep	0
Allowable scheduled ramping (cfs/h)	3,900	3,900	1,950	0

[a] For a moderate hydrological year.

[b] All seasonally adjusted hydropower operational scenarios were developed to comply with the USFWS Biological Opinion for Operation of Flaming Gorge Dam.

TABLE S.4 Hydropower Operational Scenarios for the Aspinall Unit a

Parameter	Seasonally Adjusted High Fluctuating Flows			Seasonally Adjusted Steady Flows		
	Blue Mesa	Morrow Point	Crystal	Blue Mesa	Morrow Point	Crystal
Minimum release (cfs)	1,750 Jun 0 Others	0 Oct-Mar 557 Apr 1,830 May 2,440 Jun 1,070 Jul 0 Aug-Sep	1,920 Oct 1,430 Nov 1,280 Dec 680 Jan-Mar 2,250 Apr 3,580 May 3,830 Jun 2,640 Jul 1,920 Aug-Sep	1,570 Oct 1,200 Nov 1,050 Dec 500 Jan-Mar 1,600 Apr 2,370 May 3,050 Jun 2,350 Jul 1,750 Aug-Sep	1,700 Oct 1,280 Nov 1,100 Dec 570 Jan-Mar 1,970 Apr 2,890 May 3,320 Jun 2,480 Jul 1,770 Aug 1,820 Sep	1,920 Oct 1,430 Nov 1,280 Dec 680 Jan-Mar 2,250 Apr 3,580 May 3,830 Jun 2,640 Jul 1,920 Aug-Sep
Maximum release (cfs)	3,700	5,300 Oct-	Same as minimum	Same as minimum	Same as minimum	Same as minimum

		Mar 2,680 Apr 3,420 May 3,770 Jun 3,190 Jul 5,300 Aug-Sep	releases	releases	releases	releases
Allowable daily change in flow (cfs/24 hours)	3,700 Oct-May 1,950 Jun 3,700 Jul-Sep	5,300 Oct-Mar 2,120 Apr 1,590 May 1,330 Jun 2,120 Jul 5,300 Aug-Sep	0	0	0	0
Allowable scheduled ramping (cfs/h)	3,700	5,300	0	0	0	0

[a] For a moderate hydrological year.

Figure S.1

For analytical purposes, utilities were classified according to whether they are municipally or cooperatively owned and the degree to which they rely on Western for the power they sell.

Utilities that receive less than 25% of their total energy from Western were classified as low reliance; 55% of Western's customers fall into this category. The remaining 45% of Western's customers were classified as high reliance. On this basis, high-reliance municipals are most dependent on Western — an average of 47% of the load served by utilities in this category is provided by Western. At the other extreme, an average of 6% of the load served by low-reliance municipals is provided by Western.

In addition, the impact of commitment-level alternatives on conservation and renewable energy programs was evaluated by examining the impacts on consumption efficiency and load management activities by long-term firm power customers.

To facilitate the analysis of regional economic impacts, the combined service territory of these utilities was subdivided into six metropolitan subregions and three rural subregions. Within the metropolitan subregions, economic activity, as measured by employment, is concentrated in the wholesale, retail, business, and public service sectors. In the three rural subregions, economic activity is more dispersed, with no one sector accounting for more than 25% of the total employment in each subregion. Population, employment, and output are most heavily concentrated in the metropolitan subregions.

Figure S.2

The impacts on agricultural production were analyzed on a state-by-state basis. The six-state region that includes Arizona, Colorado, New Mexico, Nevada, Wyoming, and Utah produces a variety of crops, such as alfalfa, cotton, and wheat. About 24% of the total acreage in this region that is used in agriculture is irrigated with use of electric pumps.

S.7.2 Air Resources

The affected environment for air resources was defined as the area encompassing the states of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming. This region is semiarid to arid and enjoys generally good air quality, with a large number of Class I areas where air quality degradation is stringently limited under the Prevention of Significant Deterioration regulations (Appendix B, Figure B.11). Many major population centers are located in the region, including Phoenix and Tucson, Arizona; Denver and Colorado Springs, Colorado; Albuquerque, New Mexico; Las Vegas, Nevada; and Salt Lake City, Utah. These population centers and some of their suburbs are designated as *nonattainment areas*[2] with respect to one or more of the National Ambient Air Quality Standards. All remaining areas of the region are designated as either in attainment or unclassified with respect to all criteria pollutants. The electric utility industry is a major contributor to the overall air emissions within the region, particularly with regard to sulfur dioxide, nitrogen oxides, and carbon dioxide. Despite this situation, ambient air quality in the region as a whole is generally considered good, and visibility is currently the best in the contiguous United States.

S.7.3 Water Resources

The affected environment for water resources and other natural resources evaluated in this EIS was defined as the areas associated with the hydroelectric facilities that are influenced on an hourly and daily basis by Western to produce power (Glen Canyon Dam, Flaming Gorge Dam, and the Aspinall Unit). Other facilities where operations are dictated by irrigation demands, municipal and industrial uses, flood control, or other nonpower purposes were not considered because, although Western markets power produced at these facilities, Western does not affect power production at them.

The area affected by hydropower operations at Glen Canyon Dam was the area along the Colorado River between the dam and Lake Mead. The affected area for Flaming Gorge Dam was the area along the Green River between the dam and Jensen, Utah; and the affected area for the Aspinall Unit was the reservoirs of the unit (Blue Mesa, Morrow Point, and Crystal reservoirs).

Water resources in the affected environment of these three facilities have been affected by the dams and their operations since the facilities were built in the early 1960s. Compared with pre-dam conditions, the Colorado River below Glen Canyon Dam and the Green River below Flaming Gorge Dam generally exhibit larger daily fluctuations in flow and less seasonal fluctuations in flow, are much clearer (carry less sediment), are more erosive of existing sediment deposits, and are colder. Flow, stage, water temperature, and sediment transport are considered the most important characteristics of water resources downstream of these facilities.

The affected environment of the Aspinall Unit was limited to the reservoirs themselves because the lowermost dam of the unit (Crystal Dam) is a reregulation dam operated by Reclamation that eliminates hydropower-induced fluctuations in flow in the Gunnison River below the unit. The water resources of the affected environment of the Aspinall Unit are characteristic of western reservoirs (cold, clear, minimal flow). Sediment is not an important resource of the Aspinall Unit because the shores of the reservoirs are mostly bare rock. The largest of the reservoirs, Blue Mesa, experiences relatively minor hydropower-induced daily fluctuations, while the elevations of Morrow Point and Crystal reservoirs can exhibit larger fluctuations within a day because of steep canyon walls and limited storage volume.

S.7.4 Ecological Resources

As for water resources, the current conditions of ecological resources in and along the Colorado and Green rivers below Glen Canyon Dam and Flaming Gorge Dam, respectively, and the reservoirs of the Aspinall Unit reflect the effects of the dams and their operations over about the past 30 years.

Certain ecological resources below Glen Canyon and Flaming Gorge dams are similar. Both rivers support high-quality trout fisheries in the areas immediately below the dams where waters are clearest and coldest. Farther downstream, native fish that rely on warm water are more common, and each river supports several fish species that are Federally listed as endangered. The humpback chub and the razorback sucker occur in the Colorado River between Glen Canyon Dam and Lake Mead. No reproduction of the razorback sucker is known to occur in the area, while the humpback chub population is maintained almost exclusively by reproduction in the Little Colorado River. This population is the largest known remaining population of humpback chub in the Colorado River system. The Green River below Flaming Gorge Dam supports populations of razorback sucker, humpback chub, and Colorado squawfish. Little or no successful reproduction by the razorback sucker has been observed in the Green River, and this population is declining. The Colorado squawfish and humpback chub successfully reproduce in the Green River, and populations may be stable. The bonytail chub may be extirpated from the Green River above Jensen, Utah. No verified specimens of this species have been collected from this portion of the Green River Basin since 1979.

Riparian vegetation and some wildlife species have increased substantially along the rivers downstream of Glen Canyon and Flaming Gorge dams. The endangered peregrine falcon commonly breeds along both the Colorado and Green rivers below the dams, and the threatened bald eagle winters in the downstream corridors. Other Federally listed terrestrial species that are either known to occur or could occur in the affected environment of these two facilities include Ute ladies'-tresses (Flaming Gorge), Mexican spotted owl (Glen Canyon and Flaming Gorge), and the whooping crane (Flaming Gorge).

The ecological resources of the Aspinall Unit reservoirs are very different from those below Glen Canyon and Flaming Gorge dams. The cold, nutrient-poor waters of the reservoirs support few aquatic resources, with the exception of an important introduced kokanee salmon population. Little riparian vegetation occurs in the vicinity of any of the reservoirs, and most shoreline areas consist of bare rock. Federally listed threatened or endangered species that could occur in the vicinity of the reservoirs include the peregrine falcon, bald eagle, and the whooping crane. Only the bald eagle is relatively common in the area.

S.7.5 Cultural Resources

The affected environment for cultural resources, including archaeological, historical, and Native American resources, includes the area along the Colorado River below Glen Canyon Dam, the Green River below Flaming Gorge Dam, and the area around the Aspinall Unit reservoirs. The regional prehistory and ethnohistory for the three sites is relatively similar. Numerous archaeological sites, but fewer historical structures, are present in the river corridors below Glen Canyon and Flaming Gorge dams. The paucity of historical remains reflects the relatively minor degree of Euro-American settlement and activity that has occurred in the area. Most sites in the area of the Aspinall Unit are located along Blue Mesa Reservoir and consist of archaeological sites, although some historic sites also occur. Native American tribes that have ties to the affected areas include the Havasupai, Hopi, Hualapai, Navajo, San Juan Southern Paiute, Kaibab Paiute, Shivwits Paiute, and Zuni for the Glen Canyon Dam area; and the San Juan Southern Paiute, Southern Ute Tribe, Ute Mountain Tribe, and Ute Indian Tribe for the Flaming Gorge Dam and the Aspinall Unit areas.

S.7.6 Land Use

Most of the land in areas along the Colorado River below Glen Canyon Dam, along the Green River below Flaming Gorge Dam, and in the vicinity of the Aspinall Unit reservoirs is publicly owned and consists primarily of national parks, monuments, forests, and reservation lands. Recreation is a key component in the management of the region s public lands.

S.7.7 Recreation

The affected areas of the Glen Canyon, Flaming Gorge, and Aspinall Unit facilities support important water-based recreational activities. These activities include white-water boating, angling, and riverside camping downstream of both the Glen Canyon and Flaming Gorge dams and boating and angling in the Aspinall Unit reservoirs.

S.7.8 Visual Resources

Visual resources in the affected areas are of high quality and are dominated by the prominent geological features characteristic of each area. Dam operations in these areas, through their effects on stream flow and shoreline vegetation, have relatively minor influence on visual resources.

S.8 ENVIRONMENTAL CONSEQUENCES OF COMMITMENT- LEVEL ALTERNATIVES

Commitment-level alternatives were analyzed for their potential impacts on the financial viability of Western's utility customers, the retail rates charged to the end-users of electricity marketed by Western, regional economic variables (including population, employment, disposable income, and gross regional product), agricultural production, and the use value of recreational activities. In addition, the analysis considered the potential effects that a change in Western's commitment levels could have on the need for additional capacity and energy and on the mix of generation options used to supply electricity to the affected region and the resulting impacts on local and regional air quality. Any additional capacity needed as a result of alternatives would be purchased to augment the hydropower capacity produced as a result of operations selected by Western or Reclamation. Impacts on natural and cultural resources were assessed in the context of changes in operational scenarios at each of the affected sites. With this approach, it was possible to identify the range of impacts that could result from implementation of any one of the commitment-level alternatives.

Hydropower operational scenarios could affect socioeconomics through their effects on purchases and exchanges and the resultant cost of electricity. Thus, it was necessary to specify both an operational scenario and a commitment-level alternative to assess socioeconomic and air resource impacts. Commitment-level alternatives were paired with specific supply options, which consisted of combinations of operational scenarios at each of the three facilities considered in this EIS, combined with power purchases. These supply options were defined as follows:

- *Supply Option A:* Continuation of historical operations at Glen Canyon, year-round high fluctuations at Flaming Gorge, and seasonally adjusted high fluctuations at the Aspinall Unit, combined with all necessary power purchases;
- *Supply Option B:* Low fluctuations at Glen Canyon, year-round high fluctuations at Flaming Gorge, and seasonally adjusted high fluctuations at the Aspinall Unit, combined with all necessary power purchases; and
- *Supply Option C:* Seasonally adjusted steady flows at Glen Canyon, Flaming Gorge, and the Aspinall Unit, combined with all necessary power purchases.

The socioeconomic impacts determined for these supply options represent the maximum, median, and minimum impacts, respectively, and thus capture the full range of impacts that could occur given any possible combination of operational scenarios. Combinations of operational scenarios whose impacts approximate those of supply option A include any combination that incorporates a continuation of historical operations, maximum power plant capacity, or restricted high fluctuations at Glen Canyon Dam; any of the four operational scenarios at Flaming Gorge Dam; and either of the operational scenarios at the Aspinall Unit. Combinations whose impacts approximate those of supply option B include any combination that incorporates moderate fluctuations or low fluctuations at Glen Canyon Dam; any of the four operational scenarios at Flaming Gorge Dam; and either of the operational scenarios at the Aspinall Unit. Finally, combinations whose impacts approximate those of supply option C include any combination consisting of seasonally adjusted steady flows, existing monthly steady flows, or year-round steady flows at Glen Canyon Dam; any of the four operational scenarios at Flaming Gorge; and either of the operational scenarios at the Aspinall Unit.

The predicted impacts attributable to the combinations of commitment-level alternatives and supply options considered in this EIS are summarized in Table S.5. The analyses indicated that none of the combinations of commitment-level alternatives and supply options would have a statistically significant effect in any of the nine subregions on any of the four regional socioeconomic variables (i.e., the estimated impacts are not statistically different from zero), and would have slight impacts in the two high-reliance communities. Only slight impacts are likely on conservation and renewable energy programs as measured in terms of consumption efficiency and load management. This result is partly a reflection of the fact that the power marketed by Western accounts for only about 10% of the total electricity consumed in the affected region. In addition, much of the affected region has an excess supply of generating capacity. This excess capacity would serve to offset the adverse price effects of a reduction in the amount of Western's long-term firm commitment of capacity and energy and thus blunt the regional economic impacts of any increase in electricity prices.

The analysis also indicates that a change in Western's long-term firm commitments would have through their effect on electrical rates and the cost of pump irrigation, at most, a very small effect on agricultural production, as measured by net income to the agricultural sector at the state level. At the state level, most of the impacts would consist of shifts from irrigated to dryland farming methods for individual crops and some substitution among crops. However, the largest impact indicated by the analysis was a decrease in net agricultural income by about 1.2% in Utah in the final year of the forecast period. Furthermore, this impact would occur under the commitment-level alternative representing the lowest long-term firm commitment of capacity and energy and, therefore, the lowest supply risk.

TABLE S.5 Relative Impacts of the Commitment-Level Alternatives a

Commitment-Level Alternative	Financial Viability and Retail Rates	Regional Economic Activity	Agricultural Production	Air Resources	Water, Ecological, Cultural, Recreation, Land Use, and Visual Resources
No action (1978 Marketing Criteria)	Slight impacts on financial viability of Western's customers and the retail rates charged to end-users.	No impacts in any of the nine subregions or in the two high-reliance counties.	No impacts on agricultural production.	No impacts on local or regional air quality or noise.	Impacts dependent on hydropower operations (see Tables S.6, S.7, and S.8).
Commitment-level alternative 1 (preferred alternative)	No impact on financial viability; slight impact on retail rates.	No impacts in any of the nine subregions; slight impacts in the two high-reliance counties.	Slight impact on agricultural production.	Slight impact on local or regional air quality or	Same as above.

				noise.	
Commitment-level alternative 2	Slight impact on financial viability; moderate impact on retail rates.	Same as above.	Same as above.	Same as above.	Same as above.
Commitment-level alternative 3	Slight impact on financial viability; moderate impact on retail rates.	Same as above.	Same as above.	Same as above.	Same as above.
Commitment-level alternative 4	No impact on financial viability; moderate or large impact on retail rates.	Same as above.	Same as above.	Same as above.	Same as above.
Commitment-level alternative 5	Slight impact on financial viability; moderate to large impact on retail rates.	Same as above.	Same as above.	Same as above.	Same as above.
Commitment-level alternative 6	Slight impact on financial viability; moderate impact on retail rates.	Same as above.	Same as above.	Same as above.	Same as above.

[a] The terms *slight, moderate,* and *large* are used to convey the importance of the impact. These relative terms were determined after the analysis of the impacts was completed and are based on professional judgment. For further descriptions, see Section 4.1.

Results of the analysis suggest that the different combinations of commitment-level alternatives and supply options could affect the financial viability of Western's utility customers and the retail rates charged to end-users. The combination of commitment-level alternative 2 and unrestricted dam operations at the three affected sites . Glen Canyon Dam, Flaming Gorge Dam, and the Aspinall Unit . would leave the financial viability of affected utilities unchanged. In addition, many of Western's utility customers would experience a decline in their retail rates. However, the remaining combinations of commitment-level alternatives and operational scenarios could result in adverse impacts. Maximum adverse impacts to financial viability would result from the combination of commitment-level alternative 4 and steady flows at each of the hydropower facilities. However, this impact is considered moderate. Less than 12% of the utilities included in the financial analysis would experience a decrease in financial viability under this combination of commitment-level alternative and supply option. All of the other alternatives and operational scenarios would result in smaller impacts on financial viability.

With the exception of alternative 2, retail rates would generally increase as a result of a change in Western's commitment levels. Changes in rates would vary by alternative, state, and the characteristics of the affected utilities. Commitment-level alternatives 4 and 5 combined with steady flows at each dam would result in the largest weighted average increase in rates (15%) across affected utilities. The combination of alternative 4 and steady flows would also result in the largest rate increase. Under these conditions, it is estimated that the retail rates charged by municipal utilities in Utah that rely on Western for more than 25% of their supply (high reliance) would increase by 41%.

Overall, municipal utilities (municipals) in Utah and New Mexico, which have high reliance on Western power, would experience the largest retail rate impacts under any of the commitment-level alternatives. Utility customers in Arizona, Colorado, and Nevada (which have low reliance levels) would experience slight to moderate impacts on retail rates under most alternatives. Utility customers in Wyoming, which have very low reliance levels, would be largely unaffected.

The analysis of regional impacts showed that none of the commitment-level alternatives would have a statistically significant impact on population, gross regional product (GRP), disposable income, or employment in any of the

subregions used in the analysis. In addition, analysis of impacts in two counties with high reliance on Western electricity showed that impacts would be small under each of the alternatives and supply options.

The analysis of impacts to air resources indicated that local and regional air quality and noise levels would be affected only slightly by any of the commitment-level alternatives.

The impacts of commitment-level alternatives on water resources, ecological resources, cultural resources, and recreation would depend on the operational scenarios implemented at the hydropower facilities under consideration. In addition to the direct impacts of hydropower operations, indirect impacts could result from fulfilling the need for additional generating capacity under each commitment-level alternative. This need for additional capacity could be met through conservation at existing facilities, by building new power plants, by expanding or retrofitting existing ones, or by purchases and exchanges. Construction and operation of power plants to meet additional capacity needs could result in additional impacts to natural and cultural resources in the vicinities of any new or expanded facilities. A detailed assessment of specific impacts is not presented here because the significance and nature of any such impacts would depend on the specific plans and locations for the new expanded facilities . information that is not available at this time.

S.9 ENVIRONMENTAL CONSEQUENCES OF HYDROPOWER OPERATIONAL SCENARIOS

Most of the hydropower marketed by Western from the SLCA/IP is generated at Glen Canyon Dam, Flaming Gorge Dam, and the Aspinall Unit. Impacts are described below for each of these facilities and are summarized in Tables S.6, S.7, and S.8.

S.9.1 Glen Canyon Dam

Continuation of historical operations and maximum power plant capacity operational scenarios would have impacts on most resources similar to those that have occurred since the dam was completed in 1963.[3] The dam and its operations have affected most resources dependent on the river and have produced the existing conditions for these resources. The increase in fluctuations under maximum power plant capacity operations would result in some additional adverse impacts to water resources, riparian vegetation, humpback chub, the Kanab ambersnail, southwestern willow flycatcher, and recreation.

Restricted high fluctuations would result in slight benefits to water resources, most ecological resources, and recreation. For this scenario, adverse impacts were identified for the humpback chub and the Kanab ambersnail.

Moderate and low fluctuating flow operational scenarios would produce moderate benefits for water resources (moderate increases in the probability of a net gain in riverbed sand), cultural resources, and white-water boating. These operational scenarios could result in slight or moderate benefits to trout, native fish, peregrine falcon, bald eagle, southwestern willow flycatcher, and angling. Slight adverse impacts could occur to the humpback chub; and adverse impact could occur to the Kanab ambersnail.

TABLE S.6 Summary of Potential Impacts of Hydropower Operational Scenarios on Natural and Cultural Resources below Glen Canyon Dam a

Operational	Water	Ecological Resources[c]	Cultural Resources[d]	Recreation[e]

Scenario	Resources[b]			
Continuation of historical flows	No change from current conditions.	Slight adverse impact to humpback chub; adverse impact to Kanab ambersnail; no change from current conditions for other resources.	No change from current conditions; some sites continue to be affected by fluctuation-induced erosion.	No change from current conditions.
Maximum power plant capacity	Slight adverse impact from increase in daily flow fluctuations.	Slight adverse impact to humpback chub and southwestern willow flycatcher; adverse impact to Kanab ambersnail; no impact to other resources.	Same as above.	Slight adverse impact to angling and white-water boating.
Restricted high fluctuating flows	Slight benefit; slight increase in probability of net gain in riverbed sand.	Slight adverse impact to humpback chub; adverse impact to Kanab ambersnail; slight benefit to aquatic and terrestrial resources.	Same as above.	Slight benefit to angling and white-water boating.
Moderate fluctuating flows	Moderate benefit; moderate increase in probability of net gain in riverbed sand.	Slight adverse impact to humpback chub; adverse impact to Kanab ambersnail; slight benefit to bald eagle, peregrine falcon, and southwestern willow flycatcher; slight benefit to aquatic resources; no impact to terrestrial resources.	Benefit because of reduced erosion rates.	Same as above.
Modified low fluctuating flows	Same as above.	Slight benefit to humpback chub, bald eagle, peregrine falcon, and southwestern willow flycatcher; adverse impact to Kanab ambersnail; slight to moderate benefit to aquatic resources; no impact to terrestrial resources.	Same as above.	Moderate benefit to white-water boating; slight benefit to angling.
Interim low fluctuating flows	Same as above.	Same as above, except moderate benefit to terrestrial resources.	Same as above.	Same as above.
Existing monthly steady flows	Same as above.	Slight benefit to humpback chub, bald eagle, peregrine falcon, and southwestern willow flycatcher; adverse impact to Kanab ambersnail; moderate benefit to aquatic resources; large benefit to terrestrial resources.	Same as above.	Large benefit to angling and white-water boating.
Seasonally adjusted steady flows	Same as above.	Slight to moderate benefit to humpback chub; no impact to terrestrial resources; same as above for other resources.	Same as above.	Large benefit to white-water boating; moderate benefit to angling.

Year-round steady flows	Same as above.	Slight benefit to humpback chub, bald eagle, and peregrine falcon; moderate benefit to southwestern willow flycatcher; adverse impact to Kanab ambersnail; moderate benefit to aquatic resources; large benefit to terrestrial resources.	Same as above.	Large benefit to angling and white-water boating.

[a] The impacts presented are relative to a baseline of existing conditions that have formed since placement and operation of the dam. No impacts to air resources, land use, or visual resources were identified. The terms *slight*, *moderate*, and *large* benefits and *adverse* impacts are used to convey the importance of the impact. These relative terms were not included in the Glen Canyon Dam EIS but have been added on the basis of a review of the findings presented in that EIS to provide consistency in treatment among facilities. For further descriptions of impacts, see Section 4.2.

[b] Effects of hydropower operational scenarios on water resources were considered benefits if they resulted in a more natural flow regime or sediment balance

[c] Expected benefits of reduced flow fluctuations to native and endangered fishes may not occur if competing or predaceous non-native fish increase in response to more stable flows.

[d] Archaeological, historical, and Native American resources.

[e] Angling and white-water boating.

Source: Adapted from Reclamation (1995).

TABLE S.7 Summary of Potential Impacts of Hydropower Operational Scenarios on Natural and Cultural Resources below Flaming Gorge Dam a

Operational Scenario	Water Resources[b]	Ecological Resources[c]	Cultural Resources[d]	Recreation[e]
Year-round high fluctuating flows	Slight adverse impact; increase in erosion rate.	Slight to moderate adverse impact to aquatic resources; slight adverse impacts to terrestrial resources.	Slight adverse impact because of increase in erosion rate.	Slight adverse impact to angling; conditions for white-water boating unchanged; no impact on day floating.
Seasonally adjusted high fluctuating flows	Same as above.	Slight to moderate benefit to native fish and endangered fish; no impact or slight benefit to trout; slight adverse impact to terrestrial resources; slight adverse impact to bald eagle; slight adverse impact to existing Ute ladies'-tresses but slight potential for establishment of new individuals.	Same as above.	Slight adverse impact to angling; moderate benefit to white-water boating; no impact on day floating.
Seasonally adjusted moderate	Slight benefit; decrease in	Slight to moderate benefit to native fish and endangered fish; slight benefit to trout; slight adverse impact to bald eagle; slight adverse impact to existing Ute ladies'-	Slight benefit because of	Slight adverse impact to angling;

fluctuating flows	erosion rate.	tresses but greater potential for establishment of new individuals; slight adverse impact to terrestrial resources.	reduced erosion rate.	moderate benefit to white-water boating; no impact on day floating.
Seasonally adjusted steady flows	Same as above.	Moderate to large benefit to native fish and endangered fish; moderate benefit to trout; slight benefit to terrestrial resources; slight adverse impact to bald eagle; moderate adverse impact to existing Ute ladies'-tresses but greatest potential for establishment of new individuals; slight benefit to peregrine falcon.	Same as above.	Slight benefit to angling; moderate benefit to white-water boating; no impact on day floating.

[a] The impacts presented are relative to a baseline of existing conditions that have formed since placement and operation of the dam. No impacts to air resources, land use, or visual resources were identified. The terms *slight*, *moderate*, and *large* are used to convey the importance of the impact. These relative terms were determined after the analysis of the impacts was completed and are based on professional judgment. For further descriptions of impacts, see Section 4.2.

[b] Effects of hydropower operational scenarios on water resources were considered benefits if they resulted in a more natural flow regime or sediment balance.

[c] Expected benefits of reduced flow fluctuations to native and endangered fishes may not occur if competing or predaceous non-native fish increase in response to more stable flows.

[d] Archaeological, historical, and Native American resources.

[e] Angling and white-water boating.

TABLE S.8 Summary of Potential Impacts of Hydropower Operational Scenarios on Natural and Cultural Resources Associated with the Aspinall Unit a

Operational Scenario	Water Resources[b]	Ecological Resources	Cultural Resources[c]	Recreation[d]
Seasonally adjusted high fluctuating flows				
Blue Mesa Reservoir	Slight benefit; daily fluctuations same as historical but monthly release volumes change.	No impact to any resources.	No impact.	No impact.
Morrow Point Reservoir	Same as above.	Same as above.	Same as above.	Slight adverse impact to boaters.
Crystal Dam Reservoir	Same as above.	No impacts to aquatic resources; slight benefit to terrestrial resources.	Same as above.	Same as above.
Seasonally adjusted steady flow				
Blue Mesa Reservoir	Slight benefit; daily fluctuations eliminated and monthly release	No impact to aquatic or terrestrial resources; slight adverse impact to bald	No impact.	No impact.

	volumes change.	eagle.		
Morrow Point Reservoir	Moderate benefit; daily fluctuations eliminated and monthly release volumes change.	Same as above.	Same as above.	Same as above.
Crystal Reservoir	Large benefit; daily fluctuations eliminated and monthly release volumes change.	No impact to aquatic resources; slight benefit to terrestrial resources; slight adverse impact to bald eagle.	Same as above.	Same as above.

[a] The impacts presented are relative to a baseline of existing conditions that have formed since placement and operation of the dams. No impacts to air resources, land use, or visual resources were identified. The terms *slight*, *moderate*, and *large* are used to convey the importance of the impact. These relative terms were determined after the analysis of the impacts was completed and are based on professional judgment. For further descriptions of impacts, see Section 4.2.

[b] Effects of hydropower operational scenarios on water resources were considered benefits if they resulted in a more natural flow regime or sediment balance.

[c] Archaeological, historical, and Native American resources.

[d] Angling and boating.

Although steady flow scenarios could result in benefits to a number of resources, some benefits may require occasional high flows to build beaches and maintain fish habitats (Reclamation 1995). Benefits could occur for water resources (moderate increase in the probability of a net gain in riverbed sand), aquatic ecology (trout and native fish), terrestrial ecology (increase in upper riparian zone vegetation), cultural resources, and recreation (angling and white-water boating). Benefits would be expected for the humpback chub, bald eagle, peregrine falcon, and southwestern willow flycatcher. Marsh vegetation could decrease. Beach- and habitat-maintenance flows could have adverse effects on the Kanab ambersnail.

S.9.2 Flaming Gorge Dam

The year-round high fluctuating flow operational scenario for Flaming Gorge Dam features higher maximum releases and greater daily flow fluctuations than occurred under historical operations. These higher flows and daily fluctuations could result in adverse impacts to some ecological resources, including trout, native fish, endangered fish, and riparian vegetation. Since this scenario has a higher erosion rate than steady flows, adverse impacts to cultural resources would be expected.

The remaining three operational scenarios at Flaming Gorge Dam are seasonally adjusted and feature periods of restricted flow to meet requirements of the U.S. Fish and Wildlife Service Biological Opinion for operation of the facility (USFWS 1992). These scenarios exhibit a high sustained flow in May or June, reduced fluctuations and lower flows in summer and autumn, and steady flows when ice cover is present on the river (February and March). These flows are intended to be protective of endangered fish in the system and could result in benefits to these species, as well as to other resources. Some adverse impacts could result from seasonal adjustment, however. The spring peak in flows would result in large adverse impacts to anglers. The bald eagle and overwintering waterfowl could be adversely affected by steady flows in February and March. With steady flows, less open ice-free water would be available for these species.

Seasonally adjusted high fluctuations would have moderate effects on flow and stage, but would have erosion rates similar to those of year-round high fluctuations. Slight to moderate benefits are expected to native fish (including the endangered humpback chub, bonytail chub, Colorado squawfish, and razorback sucker) because of the expectation of improved nursery habitat conditions and increased overwinter survival. This scenario would result in slight benefits to angling in mid-summer through autumn (when fluctuations are reduced) and moderate benefits to white-water boating

during the spring peak in flows. Slight adverse impacts are expected to terrestrial ecology because of the inundation of some riparian vegetation. Slight adverse impacts are also expected to trout as under year-round high fluctuations. Because erosion rates would be higher than under steady flows, cultural resources would be adversely affected by this operational scenario.

Although seasonally adjusted moderate and steady flows are relatively similar in their impacts to most resources, seasonally adjusted steady flows generally would provide greater levels of benefits. Both scenarios would have reduced erosion rates and, thus, would benefit water resources and cultural resources. Slight or moderate benefits to trout and moderate to large benefits to native and endangered fish, angling, and white-water boating are also expected under these scenarios because of reduced daily fluctuations.

Seasonally adjusted moderate fluctuations are expected to have slight adverse impacts on terrestrial resources because some existing riparian vegetation would be inundated and lost. The steady flow scenario would result in slight benefits to terrestrial resources by allowing an increase in riparian vegetation. Slight to moderate adverse impacts to the threatened plant Ute ladies'-tresses could occur if these scenarios resulted in lower soil moisture levels in the alluvial meadows where the species occurs. The more natural flow patterns of these scenarios, however, could result in the establishment of new populations of this species.

S.9.3 Aspinall Unit

Because Crystal Dam reregulates flows from the Aspinall Unit, flows in the Gunnison River below the Unit and the resources that depend on those flows would not be affected by changes in hydropower operations. Slight to moderate impacts to flow and stage in Blue Mesa and Morrow Point reservoirs would occur because of seasonal adjustments in releases and daily fluctuations. Despite these changes in flow and stage, neither operational scenario is expected to result in impacts to sediment, most ecological resources (aquatic ecology, threatened and endangered species), cultural resources, land use, or visual resources. Both scenarios would result in slight benefits to terrestrial resources in the headwaters of Crystal Reservoir in the form of an increase in riparian vegetation. Slight adverse impacts to the bald eagle are expected under the seasonally adjusted steady flow scenario because, with reduced fluctuations, the reservoirs would freeze earlier in the winter. Slight adverse impacts to boaters on Morrow Point and Crystal reservoirs could occur at low water under the seasonally adjusted high fluctuation scenario.

S.10 CUMULATIVE ENVIRONMENTAL CONSEQUENCES

Past actions relevant to the cumulative impacts of commitment-level alternatives and hydropower operational scenarios include the construction and operation of existing hydropower facilities and thermal power plants, as well as other development activities. These past impacts and the impacts of ongoing activities were incorporated into the baseline conditions described under *Affected Environment* and, consequently, are considered in the assessment of impacts discussed under *Environmental Consequences*. Similarly, reasonably foreseeable future actions have been considered in the impact assessment wherever possible. Included are actions that might be implemented in association with findings or recommendations of the EIS for continued operation of Glen Canyon Dam (Reclamation 1995), the Biological Opinion for operation of Flaming Gorge Dam (USFWS 1992), and any NEPA documentation for operations of the Aspinall Unit. These actions were incorporated into the impact assessment in the formulation of the hydropower operational scenarios considered.

The location of Glen Canyon Dam, Flaming Gorge Dam, and the Aspinall Unit within the Colorado River Basin, together with other hydroelectric facilities within the basin, increases the potential for cumulative impacts on the hydrology of the basin. However, because of the distance between facilities and the number of intervening tributaries that ameliorate the impacts of individual facilities on flow, sediment load, and water temperature, no cumulative impacts to resources are expected that have not already been considered in the individual assessments for each facility.

REFERENCES FOR SUMMARY

Reclamation (U.S. Bureau of Reclamation), 1995, *Operation of Glen Canyon Dam Colorado River Storage Project, Arizona, Final Environmental Impact Statement*, U.S. Bureau of Reclamation, Salt Lake City, Utah.

USFWS (U.S. Fish and Wildlife Service), 1992, *Final Biological Opinion on the Operation of Flaming Gorge Dam*, Fish and Wildlife Service, Mountain-Prairie Region, Denver, Colo., Nov. 25.

[1] When used to describe flows or operational scenarios, the term *historical* refers to the period in time from construction of the dam to that time when operations recently were modified to protect downstream natural resources.

[2]This designation means that the air in the area exceeds the concentration limits established for one or more pollutants.

[3]The assessment presented here for Glen Canyon Dam was based on the analysis presented in a separate EIS for that facility (Reclamation 1995). Relative levels of benefits or adverse impacts were added to provide consistency of treatment among facilities.