

1 INTRODUCTION

The U.S. Department of the Interior (DOI), through the Bureau of Reclamation (Reclamation) and National Park Service (NPS) proposes to develop and implement a Long-Term Experimental and Management Plan (LTEMP) for operations of Glen Canyon Dam, the largest unit of the Colorado River Storage Project (CRSP). The LTEMP would provide a framework for adaptively managing Glen Canyon Dam operations over the next 20 years consistent with the Grand Canyon Protection Act of 1992 (GCPA) and other provisions of applicable federal law. The LTEMP would determine specific options for dam operations, non-flow actions, and appropriate experimental and management actions that will meet the GCPA's requirements and minimize impacts on resources within the area impacted by dam operations, commonly referred to as the Colorado River Ecosystem,¹ including those of importance to American Indian Tribes.

This LTEMP Environmental Impact Statement (EIS) has been prepared to identify the potential environmental effects of implementing the proposed federal action. In addition, this EIS identifies and analyzes the environmental issues and consequences associated with taking no action, as well as a reasonable range of alternatives to no action for implementing the proposed federal action. The alternatives addressed in this EIS include a broad range of operations and experimental actions that together allow for a full evaluation of possible impacts of the proposed action. DOI, through Reclamation and NPS, has determined these alternatives represent a reasonable range of options that may meet the purpose, need, and objectives (as described below) of the proposed action. This EIS has been developed in accordance with the National Environmental Policy Act of 1969, as amended (NEPA), following implementing regulations developed by the President's Council on Environmental Quality (CEQ) in Title 40 *Code of Federal Regulations* (CFR) Parts 1500 to 1508 and DOI regulations implementing NEPA in 43 CFR Part 46.

Reclamation and NPS are joint-lead agencies for the LTEMP EIS because of their roles in operating Glen Canyon Dam (Reclamation's role) and managing the resources of Glen Canyon National Recreation Area (GCNRA), Grand Canyon National Park (GCNP), and Lake Mead National Recreation Area (LMNRA) (NPS's role). As joint leads, both agencies have been equally involved in the development of all aspects of the LTEMP EIS. Major phases of LTEMP EIS development included (1) public and internal scoping, (2) identification of alternatives to be considered for evaluation and their characteristics, (3) identification of elements common to all alternatives, (4) analysis of the consequences of the alternatives, (5) government-to-government consultation with traditionally associated Tribes, (6) preparation and issuance of the Draft EIS (DEIS), (7) public review of the DEIS, and (8) issuance of this Final EIS.

¹ The Colorado River Ecosystem is defined as the Colorado River mainstream corridor and interacting resources in associated riparian and terrace zones, located primarily from the forebay of Glen Canyon Dam to the western boundary of GCNP. It includes the area where dam operations impact physical, biological, recreational, cultural, and other resources (see Appendix A).

The first EIS on the operation of Glen Canyon Dam was published in 1995 (Reclamation 1995). The 1996 Record of Decision (ROD) (Reclamation 1996) selected the Modified Low Fluctuating Flow Alternative as the preferred means of operating Glen Canyon Dam. The ROD incorporated the GCPA requirement that the Secretary of the Interior (hereafter referred to as the Secretary) undertake research and monitoring to determine if revised dam operations were achieving the resource protection objectives of the final EIS and the ROD. The ROD also led to the establishment of the Glen Canyon Dam Adaptive Management Program (GCDAMP), administered by Reclamation with technical expertise provided by the U.S. Geological Survey's (USGS's) Grand Canyon Monitoring and Research Center (GCMRC).

The following passages were included in the 1995 EIS for the purposes of providing background and context to the public. This section provides relevant content and context for this LTEMP EIS and is therefore reproduced here for public information:

The underlying project purpose(s) is defined by section 1 of the Colorado River Storage Project Act of 1956 (43 United States Code (U.S.C.) 620), which authorized the Secretary to “construct, operate, and maintain” Glen Canyon Dam:

“...for the purposes, among others, of regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, providing for the reclamation of arid and semiarid land, for the control of floods, and for the generation of hydroelectric power, as an incident of the foregoing purposes...”

In 1968, Congress enacted the Colorado River Basin Project Act (43 U.S.C. 1501 et seq.). This act provided for a program for further comprehensive development of Colorado River Basin water resources. Section 1501(a) states:

“This program is declared to be for the purposes, among others, of regulating the flow of the Colorado River; controlling flood; improving navigation; providing for the storage and delivery of waters of the Colorado River for reclamation of lands, including supplemental water supplies, and for municipal, industrial, and other beneficial purposes; improving water quality; providing for basic public outdoor recreation facilities; improving conditions for fish and wildlife, and the generation and sale of electrical power as an incident of the foregoing purposes.”

In addition, the Criteria for Coordinated Long Range Operation of Colorado River Reservoirs (including Glen Canyon Dam) were mandated by section 1552 of the Colorado River Basin Project Act. Article 1.(2) of these criteria requires that the Annual Operating Plan for Colorado River reservoirs:

“...shall reflect appropriate consideration of the uses of the reservoirs for all purposes, including flood control, river regulation, beneficial consumptive uses,

power production, water quality control, recreation, enhancement of fish and wildlife, and other environmental factors.”

The Colorado River Compact (1922) and the Upper Colorado River Basin Compact (1948) do not affect obligations to Native American interests. Article VII and Article XIX, Part A, respectively, of the 1922 and 1948 compacts provide that:

“Nothing in this compact shall be construed as affecting the obligations of the United States of America to Indian Tribes.”

The Colorado River Storage Project Act of 1956, the Colorado River Basin Project Act of 1968, and the associated Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs (Long-Range Operating Criteria) did not alter these compact provisions.

In addition to the Secretary's decision calling for a reevaluation, Congress subsequently enacted the Grand Canyon Protection Act of 1992. Section 1802 (a) of the act requires the Secretary to operate Glen Canyon Dam:

“... in accordance with the additional criteria and operating plans specified in section 1804 and exercise other authorities under existing law in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreational Area were established, including, but not limited to natural and cultural resources and visitor use.”

Section 1802(b) of the act further requires that the above mandate be implemented in a manner fully consistent with existing law^[2]. Section 1802(c) states that the purposes for which Grand Canyon National Park and Glen Canyon National Recreation Area were established are unchanged by the act. Section 1804 (a) of the act requires the Secretary to complete an EIS no later than October 30, 1994, following which, under section 1804 (c), the Secretary is to ‘exercise other authorities under existing law, so as to ensure that Glen Canyon Dam is operated in a manner consistent with section 1802.’ Section 1804 (c) also requires that the criteria and operating plans are to be ‘separate from and in addition to those specified in section 602 (b) of the Colorado River Basin Project Act of 1968.’

Glen Canyon Dam was completed by the Bureau of Reclamation (Reclamation) in 1963, prior to enactment of the National Environmental Policy Act of 1969 (NEPA). Consequently, no EIS was filed regarding the construction or operation

² The Secretary shall implement this section in a manner fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in *Arizona v. California*, and the provisions of the Colorado River Storage Project Act of 1956 (CRSPA) and the Colorado River Basin Project Act of 1968, that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin.

of Glen Canyon Dam. Since the dam has long been completed, alternatives to the dam itself have been excluded from the scope of the analysis.

The DOI has evaluated information developed through the GCDAMP to more fully inform decisions regarding operation of Glen Canyon Dam over the next 20 years and to inform other management and experimental actions within the LTEMP. Revised dam operations and other actions will be considered and analyzed under alternatives in this EIS.

The LTEMP will incorporate information gathered since the 1996 ROD, including status reports developed in coordination with the GCDAMP and Reclamation and NPS compliance documents supporting adaptive management efforts for the Glen Canyon Dam. These include, but are not limited to, the *Environmental Assessment for Non-Native Fish Control Downstream from Glen Canyon Dam* (Reclamation 2011a), *Environmental Assessment for an Experimental Protocol for High-Flow Releases from Glen Canyon Dam* (Reclamation 2011b), Colorado River Management Plan (CRMP) (NPS 2006b), *EIS for 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead* (Reclamation 2007a), and the *Comprehensive Fisheries Management Plan* (CFMP) (NPS 2013e).

A previous planning process, called the Long Term Experimental Plan (LTEP) for the operation of Glen Canyon Dam, commenced in late 2006. In February 2008, the LTEP EIS was put on hold until the completion of environmental compliance on a 5-year plan of experimental flows (2008–2012), including a high-flow test completed in March 2008 and yearly fall steady flows conducted each year in September and October from 2008 to 2012. As stated in the Notice of Intent (NOI) in the *Federal Register* on July 6, 2011 (DOI 2011b), the LTEMP EIS supersedes the LTEP EIS. This LTEMP EIS draws on the environmental documentation and updated information developed for the LTEP EIS.

1.1 DESCRIPTION OF THE PROPOSED ACTION

The proposed federal action considered in this EIS, as described in the 2011 NOI and as further refined in this EIS, is the development and implementation of a structured, long-term experimental and management plan for operations of Glen Canyon Dam. The LTEMP and the Secretary's decision would provide a framework for adaptively managing Glen Canyon Dam operations and other management and experimental actions over the next 20 years consistent with the GCPA and other provisions of applicable federal law. The LTEMP would determine specific options for dam operations (including hourly, daily, and monthly release patterns), non-flow actions, and appropriate experimental and management actions that will meet the GCPA's requirements, maintain or improve hydropower production to the greatest extent practicable, consistent with improvement of downstream resources, including those of importance to American Indian Tribes. The locations of Glen Canyon Dam, Lake Powell, the Colorado River between Lake Powell and Lake Mead, and adjacent lands are shown in Figure 1-1. Glen Canyon Dam is shown in Figure 1-2.

This LTEMP EIS analyzes alternative-specific monthly, daily, and hourly releases from Glen Canyon Dam. Under the LTEMP, water will continue to be released in a manner that is

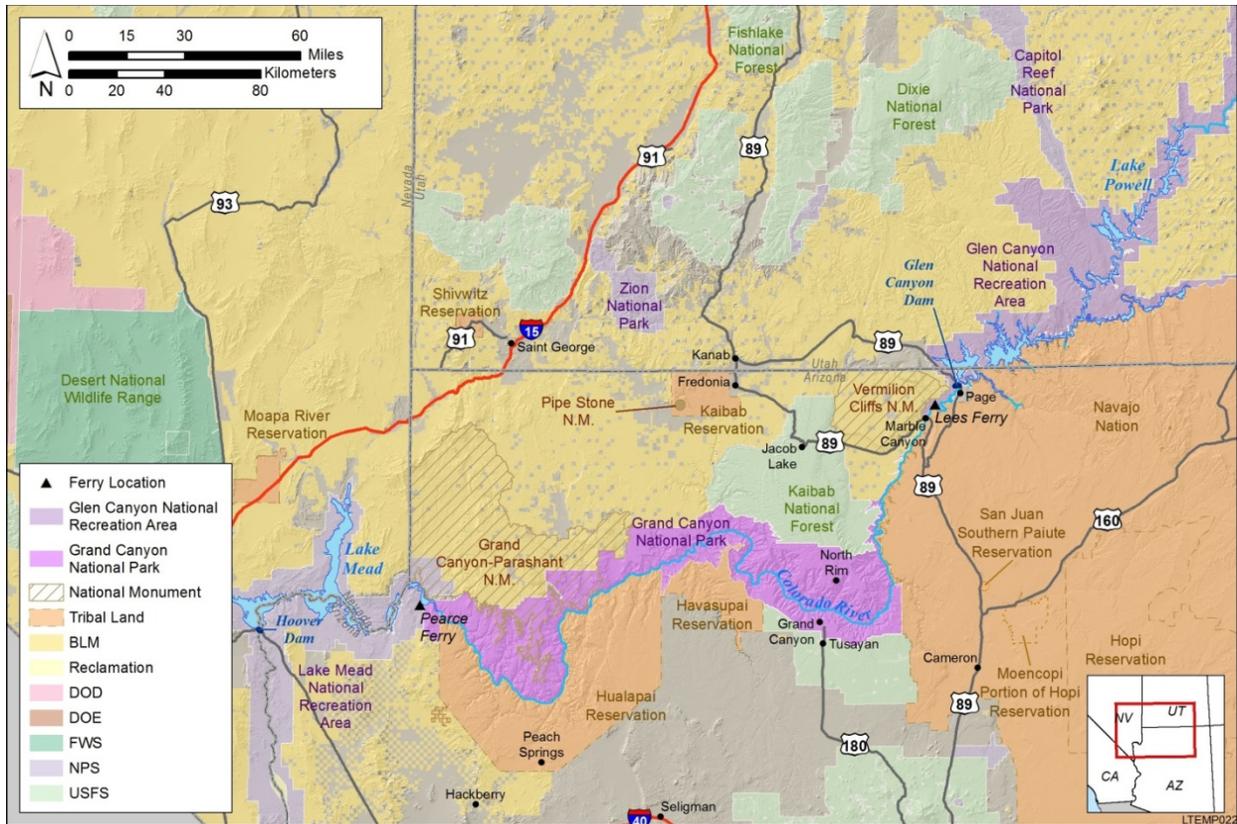


FIGURE 1-1 Generalized Locations of Glen Canyon Dam, Lake Powell, the Colorado River between Lake Powell and Lake Mead, and Adjacent Lands (This map is for illustrative purposes only, not for jurisdictional determinations; potential area of effects varies by resource and is addressed in Chapters 3 and 4.)

fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in *Arizona v. California*, and the provisions of the Colorado River Storage Project Act of 1956 (CRSPA) and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin, and consistent with applicable determinations of annual water release volumes from Glen Canyon Dam made pursuant to the Long-Range Operating Criteria for (LROC) Colorado River Basin Reservoirs, which are currently implemented through the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead.

1.2 PURPOSE OF AND NEED FOR ACTION

The purpose of the proposed action is to provide a comprehensive framework for adaptively managing Glen Canyon Dam over the next 20 years consistent with the GCPA and other provisions of applicable federal law.



FIGURE 1-2 Glen Canyon Dam

The proposed action will help determine specific dam operations and actions that could be implemented to improve conditions and continue to meet the GCPA's requirements and to minimize—consistent with law—adverse impacts on the downstream natural, recreational, and cultural resources in the two park units, including resources of importance to American Indian Tribes.

The need for the proposed action stems from the need to use scientific information developed since the 1996 ROD to better inform DOI decisions on dam operations and other management and experimental actions so that the Secretary may continue to meet statutory responsibilities for protecting downstream resources for future generations, conserving species listed under the Endangered Species Act (ESA), avoiding or mitigating impacts on *National Register of Historic Places* (NRHP)-eligible properties, and protecting the interests of American Indian Tribes, while meeting obligations for water delivery and the generation of hydroelectric power.

The purpose and need statement described above was modified from the July 6, 2011, *Federal Register* notice based on public and Cooperating Agency comments. The ESA Recovery Implementation Program was removed from the objectives in Section 1.4 and eliminated from further consideration for this EIS, as described in Section 2.2; other refinements to the purpose and need statement were not substantively different from those described in the original notice.

Several key issues related to resources downstream of Glen Canyon Dam, and new scientific information related to them, are summarized below:

- *Continued loss of sandbars.* The Colorado River downstream from Glen Canyon Dam is depleted of its natural sediment load due to the presence of the dam, and many types of ongoing dam releases further deplete sediment delivered to the main channel by causing erosion. However, high-flow releases, between approximately 30,000 and 45,000 cubic feet per second (cfs) that are triggered when there is sufficient sediment from the Paria River, mobilize sand stored in the river channel and redeposit it as sandbars and beaches and associated backwater and riparian habitats (Melis 2011). This LTEMP EIS uses current comprehensive scientific data and modeling to consider possible improvements related to the use of high-flow experiments (HFEs), as well as possible intervening flow operations that may help better achieve the goal of building and retaining sandbars.
- *Humpback chub.* Since the 1995 EIS, the status of the humpback chub (*Gila cypha*), listed as an endangered species, has continued to be an issue of concern since the population in Grand Canyon, the largest in existence, declined during the late 1990s, coincident with higher flow volumes, cooler water temperatures, and high nonnative trout abundance, but has since partially rebounded over the last decade when water temperatures were warmer and trout abundance lower (Yackulic et al. 2014; Yard et al. 2011). Uncertainty in future humpback chub population response to interactions among flows, nonnative trout, food base, and water temperatures remains. This EIS explicitly examines the scientific uncertainties related to the relationships among trout, temperature, and the humpback chub population and considers both flow (e.g., trout management flows) and non-flow options (e.g., mechanical removal) and adaptive and experimental actions to improve the status of humpback chub.
- *Rainbow trout fishery.* Rainbow trout (*Oncorhynchus mykiss*) are the basis of the recreational fishery at Lees Ferry. Since 1964, the tailwaters of Glen Canyon Dam have supported a recreational rainbow trout fishery that has grown in importance and reputation to anglers locally, nationally, and internationally. Anglers from around the world travel to Lees Ferry to fish for high-quality rainbow trout. This blue-ribbon recreational sport fishery has become a financial and economic mainstay for the community of Marble Canyon, the City of Page, and Coconino County, as well as contributing to the statewide economy. This EIS evaluates the effects of flow and non-flow actions of LTEMP alternatives and adaptive and experimental actions on the Glen Canyon rainbow trout fishery.
- *Other native and nonnative fish.* In addition to humpback chub, the razorback sucker (*Xyrauchen texanus*), also listed as endangered, and three other native fish still occur in the Colorado River below Glen Canyon Dam. Razorback

sucker were thought to be extirpated from the Grand Canyon but have recently been found in western Grand Canyon. Populations of bluehead and flannelmouth suckers have fluctuated since the 1995 EIS. Numerous nonnative fish species are also found in the Colorado River and tributaries, and are numerically dominated by rainbow trout above the Little Colorado River. Brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), common carp (*Cyprinus carpio*), and other species occur in many locations in lower numbers. There is concern that the nonnative fish compete with or prey upon the native or endangered fish to varying degrees. The effects of dam operations were examined in the 1995 EIS, and much additional information has been accumulated about the effects of dam operations on native and nonnative fish. This EIS applies the best available science and modeling methods to further consider the impacts of a variety of dam operations and non-flow actions on native and nonnative fish and guide future experimentation regarding these flow regimes to reduce the negative interactions of nonnative fish with native fish.

- *Cultural resources.* Cultural resources occur along the river corridor downstream from Glen Canyon Dam in Glen, Marble, and Grand Canyons. In this EIS, cultural and natural resources are treated separately; however, it is recognized that many Tribes view these resources as being interconnected and view the river system as an integral component of the cultural landscape. These resources are found both within the area directly affected by river flows as well as on elevated terraces that have not been inundated by flows since construction of the dam. Research conducted since the 1995 EIS on the relationship between sand deposits and wind processes continues to provide data that suggest that windblown sand changes the surface of some sites of archaeological and cultural concern where sand supply and wind are active agents (Draut and Rubin 2008; Draut 2012b; Sankey and Draut 2014). Additional research downstream from the dam is examining the relationship between dam operations and ongoing erosion in areas of limited sand supply (Collins et al. 2014). This LTEMP EIS reexamines these relationships in light of the most recent scientific studies.
- *Riparian vegetation.* Vegetation along the river corridor is affected by the magnitude and seasonal pattern of river flows. Vegetation studies conducted since 1995 indicate that riparian vegetation composition, structure, distribution, and function are closely tied to ongoing dam operations. This EIS considers approaches to protecting, mitigating adverse impacts on, and improving vegetation within the Colorado River Ecosystem.
- *Hydropower.* Power generated by Glen Canyon Dam serves 5.8 million retail customers in Arizona, Colorado, Nebraska, Nevada, New Mexico, Utah, and Wyoming. Since 1995, new modeling tools have been created to better analyze dam operations for hydropower and the impacts of altering operations on electrical generation and capacity. This LTEMP EIS applies peer-reviewed

science and modeling methods to further consider the impacts of a variety of dam operations on power generation and capacity, and considers operations that can maintain or increase hydropower generation while protecting and improving downstream resources. The status of the Basin Fund would be considered prior to implementing experiments as explained in Section 2.2.4.3.

Additional concerns related to dam operations were raised by the public at scoping meetings and in comments submitted during the scoping of the EIS. Such concerns included restoration of the downstream Colorado River Ecosystem; reestablishment of ecosystem patterns and processes to their pre-dam range of natural variability; elimination or minimization of further beach erosion; facilitation of sediment redeposition; in situ maintenance and preservation of the integrity of cultural and archeological resources; elimination of adverse impacts and other direct, indirect, and cumulative impacts on native species and assistance in their recovery; nonnative fish management; assistance in repropagation of the native riparian plant communities; and improving the hydropower resource. Public scoping is discussed further in Section 1.5.

1.3 LEAD AND COOPERATING AGENCIES AND CONSULTING TRIBES

Federal agencies having management objectives include Reclamation, NPS, U.S. Fish and Wildlife Service (FWS), Bureau of Indian Affairs (BIA), and Western Area Power Administration (WAPA).

1.3.1 Lead Agencies

The DOI, through Reclamation and NPS, prepared this LTEMP EIS with assistance from Argonne National Laboratory (Argonne). Reclamation is primarily responsible for operating Glen Canyon Dam. NPS is primarily responsible for conservation of the natural and cultural resources and visitor experience in GCNP, GCNRA, and LMNRA. Reclamation and NPS are joint-lead agencies in this process and have cooperated on all aspects of the production of this LTEMP EIS, including the overall NEPA/EIS process, communication and consultation with Cooperating Agencies and other stakeholders, and project schedule.

1.3.2 Cooperating Agencies and Consulting Tribes

Reclamation and NPS initially invited 25 federal, Tribal, state, and local government agencies to participate as Cooperating Agencies. Regular meetings with Cooperating Agencies have been held during the LTEMP EIS development process.

In addition, 43 Tribes were formally invited to enter into government-to-government consultation. In accordance with the requirements identified in Executive Order (E.O.) 13175, "Consultation and Coordination with Indian Tribal Governments" (U.S. President 2000); the President's memorandum of April 29, 1994, "Government-to-Government Relations with Native American Tribal Governments" (U.S. President 1994a); "Department of the Interior Policy on

Consultation with Indian Tribes;” the President’s memorandum of November 5, 2009, “Tribal Consultation” (U.S. President 2009); agency-specific guidance on Tribal interactions; and applicable natural and cultural resource laws and regulations (e.g., NEPA, ESA, National Historic Preservation Act [NHPA], and Migratory Bird Treaty Act); Reclamation and NPS coordinate and consult with federally recognized Tribes whose interests might be affected by activities being considered in the LTEMP EIS. Regular meetings have been held with Tribes who indicated an interest in consultation in the LTEMP EIS development process.

The Cooperating Agencies include BIA, FWS, WAPA, Arizona Game and Fish Department (AZGFD), Colorado River Board of California, Colorado River Commission of Nevada, Upper Colorado River Commission, Salt River Project, Utah Associated Municipal Power Systems, Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians, Navajo Nation, and the Pueblo of Zuni. Two additional Tribes—the Fort Mojave Indian Tribe and the Gila River Indian Community—accepted the invitation to participate as consulting parties. Nine others—the Pueblo of Santa Ana, the Fort Yuma Quechan, the Pueblo of Nambe, the Pueblo of Santa Clara, the Pueblo of Zia, the Southern Ute Indian Tribe, the Ute Mountain Ute Indian Tribe, the Paiute Indian Tribe of Utah, and Yavapai-Apache Nation—preferred to be on the mailing list and kept informed regarding the LTEMP EIS.

1.4 OBJECTIVES AND RESOURCE GOALS OF THE LTEMP

The DOI has identified several primary objectives of operating Glen Canyon Dam under the LTEMP, as well as more specific goals to improve resources within the Colorado River Ecosystem through experimental and management actions. These objectives and resource goals were considered in the formulation and development of alternatives in this EIS.

The following is a list of the objectives of the LTEMP:

- Develop an operating plan for Glen Canyon Dam in accordance with the GCPA to protect, mitigate adverse impacts to, and improve the values for which GCNP and GCNRA were established, including, but not limited to, natural and cultural resources and visitor use, and to do so in such a manner as is fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the U.S. Supreme Court in *Arizona v. California*, and the provisions of CRSPA and the Colorado River Basin Project Act of 1968 that govern the allocation, appropriation, development, and exportation of the waters of the Colorado River Basin (see Section 1.9.4) and in conformance with the Criteria for Coordinated Long-Range Operations of Colorado River Reservoirs which are currently implemented by the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead.
- Ensure the LTEMP does not affect water delivery to the communities and agriculture that depend on Colorado River water consistent with applicable determinations of annual water release volumes from Glen Canyon Dam made

pursuant to the LROC for Colorado River Basin Reservoirs, which are currently implemented through the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead.

- Consider potential future modifications to Glen Canyon Dam operations and other flow and non-flow actions to protect and improve downstream resources.
- Maintain or increase Glen Canyon Dam electric energy generation, load following capability, and ramp rate capability, and minimize emissions and costs to the greatest extent practicable, consistent with improvement and long-term sustainability of downstream resources.
- Respect the interests and perspectives of American Indian Tribes.
- Make use of the latest relevant scientific studies, especially those conducted since 1996.
- Determine the appropriate experimental framework that allows for a range of programs and actions, including ongoing and necessary research, monitoring, studies, and management actions in keeping with the adaptive management process.
- Ensure Glen Canyon Dam operations and non-flow actions under the LTEMP are consistent with the GCPA, ESA, NHPA, CRSPA, and other applicable federal laws.

Reclamation and NPS developed resource goals considering public input and desired future conditions (DFCs) previously adopted by the Adaptive Management Work Group (AMWG). The following resource goals were identified:

1. *Archaeological and Cultural Resources*. Maintain the integrity of potentially affected NRHP-eligible or listed historic properties in place, where possible, with preservation methods employed on a site-specific basis.
2. *Natural Processes*. Restore, to the extent practicable, ecological patterns and processes within their range of natural variability, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems.
3. *Humpback Chub*. Meet humpback chub recovery goals, including maintaining a self-sustaining population, spawning habitat, and aggregations in the Colorado River and its tributaries below the Glen Canyon Dam.
4. *Hydropower and Energy*. Maintain or increase Glen Canyon Dam electric energy generation, load following capability, and ramp rate capability, and

- minimize emissions and costs to the greatest extent practicable, consistent with improvement and long-term sustainability of downstream resources.
5. *Other Native Fish.* Maintain self-sustaining native fish species populations and their habitats in their natural ranges on the Colorado River and its tributaries.
 6. *Recreational Experience.* Maintain and improve the quality of recreational experiences for the users of the Colorado River Ecosystem. Recreation includes, but is not limited to, flatwater and whitewater boating, river corridor camping, and angling in Glen Canyon.
 7. *Sediment.* Increase and retain fine sediment volume, area, and distribution in the Glen, Marble, and Grand Canyon reaches above the elevation of the average base flow for ecological, cultural, and recreational purposes.
 8. *Tribal Resources.* Maintain the diverse values and resources of traditionally associated Tribes along the Colorado River corridor through Glen, Marble, and Grand Canyons.
 9. *Rainbow Trout Fishery.* Achieve a healthy high-quality recreational rainbow trout fishery in GCNRA and reduce or eliminate downstream trout migration consistent with NPS fish management and ESA compliance.
 10. *Nonnative Invasive Species.* Minimize or reduce the presence and expansion of aquatic nonnative invasive species.
 11. *Riparian Vegetation.* Maintain native vegetation and wildlife habitat, in various stages of maturity, such that they are diverse, healthy, productive, self-sustaining, and ecologically appropriate.

Overlying these goals is the understanding that operations under LTEMP will continue to deliver water in a manner that is fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in *Arizona v. California*, and the provisions of CRSPA and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin, and consistent with applicable determinations of annual water release volumes from Glen Canyon Dam made pursuant to the LROC for Colorado River Basin Reservoirs, which are currently implemented through the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead. As such, water delivery is an overarching consideration for dam operations that will necessarily inform the actions that can be taken to achieve the resource goals set forth above.

1.5 SCOPE OF THE EIS

On December 10, 2009, then Secretary of the Interior Ken Salazar announced the need to develop the LTEMP for Glen Canyon Dam. The Secretary emphasized the inclusion of stakeholders, particularly those in the GCDAMP, in the development of the LTEMP. This decision triggered the NEPA process and the need to conduct public scoping in preparation of this LTEMP EIS.

The *Federal Register* NOI to prepare an EIS and hold public scoping meetings was published on July 6, 2011, which marked the beginning of the public comment period. The scoping comment period ended January 31, 2012. A total of six public meetings and one web-based meeting were held in Arizona, Colorado, Nevada, and Utah in November 2011. A total of 447 individuals, groups, or organizations submitted scoping comments. Results of the public scoping process are described in the Scoping Summary Report (Reclamation and NPS 2012). There have also been formal and informal consultations with Tribes, which are described in Chapter 5.

The affected geographic region and resources of interest and the primary issues of concern to the public identified in scoping are summarized in the following sections. These inputs were used by the lead agencies to formulate a suite of alternative actions that could meet the purpose and need of the proposed action and to guide the comparative analysis of impacts of the alternatives in this EIS. The alternatives are described in Chapter 2.

The annual amount of water released under the LTEMP will be determined by the LROC, which is currently implemented through the 2007 Interim Guidelines until 2026; the guidelines for determining annual releases after that date will be determined under a separate process pursuant to the terms of the 2007 Guidelines. The LTEMP EIS assumes the annual volumes would be determined in accordance with the LROC and evaluates the effects on resources from the management of monthly, hourly, and daily releases from Glen Canyon Dam under various alternatives.

1.5.1 Affected Region and Resources

In general, the region examined in this EIS includes the area potentially affected by implementation of the LTEMP (including normal management and experimental operations of Glen Canyon Dam and non-flow actions). This area includes Lake Powell, Glen Canyon Dam, and the river downstream to Lake Mead. More specifically, the scope primarily encompasses the Colorado River Ecosystem, which includes the Colorado River mainstream corridor and interacting resources in associated riparian and terrace zones, located primarily from the forebay of Glen Canyon Dam to the western boundary of GCNP. It includes the area where dam operations impact physical, biological, recreational, cultural, and other resources. Portions of GCNRA, GCNP, and LMNRA outside the Colorado River Ecosystem were also included in the affected region for certain resources due to the potential effects of LTEMP operations. In addition, for resources such as socioeconomics, air quality, and hydropower, the affected region was larger and included areas potentially affected by indirect impacts of the LTEMP. The

potentially affected regions for these resources are specifically identified in Chapters 3 and 4. Figure 1-1 portrays the project area in context with the geographic regions of northern Arizona, southwestern Utah, and southern Nevada.

1.5.2 Impact Topics Selected for Detailed Analysis

Topics for analysis in the EIS were selected on the basis of public scoping comments, joint-lead agency guidance, meetings with Tribes and stakeholders, and relevant laws and regulations. A complete list of issues raised and discussed during scoping is available in the Scoping Summary Report (Reclamation and NPS 2012). Direct, indirect, and cumulative impacts of the effects of the proposed action, in combination with the effects of past, present, and reasonably foreseeable future projects, were analyzed in the LTEMP EIS for the following impact topics:

- Water resources, including annual, monthly, and hourly patterns of releases, water temperature, and water quality;
- Sediment resources, including sand and sandbars within the active river channel, and sand that accumulates in the Colorado River delta of Lake Mead;
- Natural processes that support ecological systems within the Colorado River Ecosystem;
- Aquatic ecology, including aquatic food base for fishes, nonnative fishes (warmwater, coolwater, and trout), native fishes (including the endangered humpback chub and razorback sucker), and aquatic parasites;
- Vegetation, including Old High Water Zone vegetation, New High Water Zone vegetation, wetlands, and special status plant species;
- Wildlife, including terrestrial invertebrates, amphibians and reptiles, birds, mammals, and special status wildlife species;
- Cultural resources, including archeological resources, historic and prehistoric structures, cultural landscapes, traditional cultural properties, and ethnographic resources important to American Indian Tribes;
- Tribal resources, including vegetation, wildlife, fish, and wetlands, water rights, traditional cultural places, traditional knowledge, and continued access to important resources within Glen and Grand Canyons;
- Visual resources in GCNRA, GCNP, and LMNRA;
- Recreation, visitor use, and experience as related to fishing, boating, and camping activities in the Colorado River and on Lakes Powell and Mead;

- Wilderness and visitor wilderness experience;
- Hydropower, including the amount and value of hydropower generation at Glen Canyon Dam, marketable electrical capacity, capital and operating costs, and rate impacts;
- Socioeconomics, including recreational use values, nonuse economic value, employment and income, and environmental justice;
- Air quality effects related to changes in Glen Canyon Dam operations, including air emissions; and
- Climate change, including the effects of Glen Canyon operations on greenhouse gas emissions and the effects of climate change on future impacts of Glen Canyon Dam operations.

1.5.3 Impact Topics Dismissed from Detailed Analysis

The following topics suggested during scoping were dismissed from analysis in the LTEMP EIS for the reasons stated below:

- *Extirpated Species*. The reintroduction of extirpated species is beyond the scope of the LTEMP EIS, but was addressed for fish within the NPS Comprehensive Fisheries Management Plan (NPS 2013e).
- *Prime and Unique Agricultural Lands*. The Farmland Protection Act of 1981, as amended, requires federal agencies to consider adverse effects on prime and unique farmlands resulting in conversion of these lands to nonagricultural uses. There are no agricultural lands in GCNP or GCNRA, and proposed alternatives would not have direct or indirect effects on downstream agricultural lands. Therefore, this topic is dismissed from further analysis.
- *Land Use in GCNP and GCNRA*. Land use and development of visitor and park facilities in GCNP and GCNRA are managed under the NPS Organic Act, NPS 2006 Management Policies (NPS 2006a) and associated Directors' Orders, GCNP and GCNRA enabling legislation, the Wilderness Act, and other such policies and regulations. None of the proposed alternatives would fundamentally affect land use in the project area. Therefore, this topic is dismissed from further consideration.
- *Soundscapes*. For the LTEMP EIS, soundscapes are not addressed as an individual resource; however, effects of man-made noise are discussed under the following impact topics: Wildlife (Section 4.7); Recreation, Visitor Use, and Experience (Section 4.11); and Wilderness (Section 4.12). Impacts on soundscape are expected to be negligible on the small number of days when

noise-producing fish management and vegetation restoration activities take place.

1.6 ROLE OF ADAPTIVE MANAGEMENT

Since the 1996 ROD was signed by the Secretary, adaptive management has played a significant role in the operations of the Glen Canyon Dam and management of the resources downstream. The DOI is committed to continuing the Adaptive Management Program and Adaptive Management Work Group. The DOI promotes the use of adaptive management as a tool for resource management (DOI 2008) and has adopted the following definition put forth by the National Research Council's Panel on Adaptive Management for Resource Stewardship (NRC 2004):

Adaptive Management is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals; increases scientific knowledge; and reduces tensions among stakeholders.

In addition, the DOI (Williams et al. 2009) published a technical guide describing how and in what situations one can implement adaptive management.

1.6.1 History of the Existing Adaptive Management Program

The 1996 ROD specified several environmental commitments, the first of which was adaptive management. The GCDAMP was established to comply with the monitoring and consultation requirements of the GCPA. The components of the GCDAMP were first proposed in the 1995 Glen Canyon Dam EIS, and it was established in 1997 under the direction of the Secretary of the Interior.

The GCDAMP creates a process for monitoring and assessing the effects of current operations of Glen Canyon Dam on downstream resources and using the results to develop recommendations for modifying operating criteria and other resource management actions. The GCDAMP includes the AMWG, a federal advisory committee that is appointed by the Secretary. The AMWG consists of stakeholders, including federal and state resource management agencies; representatives of the seven basin states; American Indian Tribes; contractors for the purchase of federal hydroelectric power; environmental and conservation organizations; recreational; and

other interest groups. The AMWG recommends suitable monitoring and research programs and may make other recommendations to the Secretary as well. The Technical Working Group (TWG) was also proposed in the 1995 EIS and was established to serve as a technical subcommittee to the AMWG. The GCMRC serves as the research branch of the GCDAMP, under the authority of the USGS. Monitoring and research conducted by GCMRC and others since 1996 have improved the understanding of riverine geomorphology and how dam operations can assist in the conservation of natural and cultural resources below the dam. The GCDAMP also includes an external and independent scientific review panel, the science advisors, who serve to peer review research and monitoring programs of the GCDAMP.

1.6.2 Relationship of Adaptive Management to NEPA and Changes to Operations

The 1995 EIS (Reclamation 1995) described adaptive management as the process “whereby the effects of dam operations on downstream resources would be assessed and the results of those resource assessments would form the basis for future modifications of dam operations.” In describing the commitment to adaptive management in the 1996 ROD (Reclamation 1996), the Secretary specified that “any operational changes will be carried out in compliance with NEPA.” In the 2011 NOI (DOI 2011b) that announced the LTEMP process, the DOI specified that a NEPA process would be used to document and evaluate impacts of the alternatives. By articulating and planning for critical uncertainties (Sections 1.7 and 2.1, and Appendix C) upfront, the LTEMP EIS puts forth an adaptive management plan for the next 20 years that is flexible and allows the experimental, operational, and management changes specified and analyzed in the LTEMP to proceed without additional NEPA analysis.

The LTEMP uses an adaptive management and experimental framework to refine existing information regarding the effects of dam operations and management actions on affected resources. Information gathered through the adaptive management and experimental process may be used to adjust operations within the range of the actions analyzed for impacts in this EIS.

1.7 ROLE OF DECISION ANALYSIS IN THE EIS PROCESS

The joint lead agencies used a structured decision analysis process to support the evaluation of alternatives in response to requests from some of the Glen Canyon Dam AMWG stakeholders to have additional substantive input into the EIS. The joint leads view structured decision analysis as a structured, scientific method to help evaluate complex alternatives; integrate information and critical uncertainties regarding the effects of independent environmental processes and resource response on outcomes; and bring additional transparency to the EIS process.

While structured decision analysis informed the analysis of the joint leads, it was not the only method by which a preferred alternative was identified. The identification of a preferred alternative was based on the full EIS analysis and considerations relating to qualitative and quantitative evaluations of impacts. Public comment, socioeconomic considerations, AMWG stakeholder input, and other factors were also considered in this identification.

The joint-lead agencies partnered with the USGS Patuxent Wildlife Research Center to incorporate formal decision-analysis tools in the LTEMP EIS. Decision-analysis tools are used to help formally parse out complex problems into manageable pieces, while keeping track of multiple objectives (Gregory and Keeney 2002). Appendix C further describes the decision-analysis tools and methodology as related to the LTEMP EIS.

The joint-lead agencies, other DOI agencies, including the BIA, FWS, and USGS, and Argonne technical staff developed performance metrics to evaluate achievement of the resource goals, identified critical uncertainties, and evaluated a preliminary and final set of alternatives in a process that incorporated decision-analysis tools. Performance metrics provide a quantitative, transparent, and objective method to assess the performance of the alternatives against each of the resource goals. Input from some Cooperating Agencies, Tribes, and other stakeholders was used to prepare a final set of performance metrics used in the LTEMP EIS analysis. Six of the seven Basin States and some of the Tribes and other stakeholders elected not to participate in this process for various reasons. The resulting performance metrics are presented in Appendix B.

Participating stakeholders ranked and weighted the importance of each performance metric according to their preferences for the value of the metric to swing from its lowest to its highest value, representing the range of effects on resources measured by the metric. This process is referred to as “swing-weighting.” The results of swing weighting under structured decision analysis are included in the analysis of alternatives in Chapter 4 and are discussed in further detail in Appendix C.

While the decision analysis process helped inform the analysis of the joint-lead agencies, it was not used as the method by which a preferred alternative was identified or the only method by which the environmental impacts were fully analyzed. The determination of the preferred alternative was based on the analyses presented in this EIS. Furthermore, public comment, socioeconomic considerations, AMWG stakeholder input, and other factors were considered in the preparation of this EIS.

1.8 HISTORY, LOCATION, AND SETTING

1.8.1 History and Purpose of Glen Canyon Dam

Glen Canyon Dam, pictured in Figure 1-2, was authorized by CRSPA and completed by Reclamation in 1963 (DOI 2011b). Glen Canyon Dam is the second highest concrete-arch dam in the United States (exceeded only by the Hoover Dam) and rises 710 ft above bedrock within the steep sandstone walls of Glen Canyon. It was constructed to harness the potential of the Colorado River to provide for the water and power needs of millions of people (Reclamation 2008a).

The CRSPA was enacted for “the comprehensive development of the water resources of the Upper Colorado River Basin, for the purposes, among others, of regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of

the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, providing for the reclamation of arid and semiarid land, for the control of floods, and for the generation of hydroelectric power, as an incident of the foregoing purposes.” The Glen Canyon Dam is specifically managed to regulate the release of water in a way that allows the Upper Colorado River Basin states of Utah, Colorado, Wyoming, and New Mexico to use their share of the Colorado River water. It also helps provide water to the Lower Colorado River Basin states of California, Nevada, and Arizona, consistent with the Colorado River Compact of 1922 and subsequent water delivery commitments (DOI 2011b). There is more than 26 million acre-feet (maf) of water storage capacity in Lake Powell, created by Glen Canyon Dam. This stored water has made it possible to successfully sustain the needs of cities, industries, and agriculture throughout the West during extended dry periods (Reclamation 2008a).

As identified under the CRSPA, another authorized purpose of Glen Canyon Dam is to generate hydroelectric power, which is a clean, renewable, and reliable energy source (DOI 2011b). The hydroelectric power is marketed and delivered by WAPA to municipalities, rural electric cooperatives, American Indian Tribes, and governmental agencies in Wyoming, Utah, Colorado, New Mexico, Arizona, and Nevada. The dam’s hydroelectric generators, which have a total capacity of 1,320 megawatts (MW), produce about 5 billion kilowatt-hours (kWh) of hydroelectric power annually to help meet the electrical needs of about 5.8 million customers (Reclamation 2008a). In addition, Glen Canyon Dam serves as a backup facility for power and transmission outages across the Southwest. Revenues from production of hydropower fund the Basin Fund, including the operations and maintenance of CRSP facilities, repay costs for participating projects, and help fund the Salinity Control Forum and many important environmental programs associated with Glen and Grand Canyons (Reclamation 2008a).

1.8.2 Location of Glen Canyon Dam and LTEMP Affected Area

The location of Glen Canyon Dam is shown in the upper right-hand corner of Figure 1-3, which shows the LTEMP affected area from Glen Canyon Dam to Lake Mead. Below Glen Canyon Dam, the Colorado River flows for 15 mi through the GCNRA, which is managed by NPS and encompasses more than 1.2 million acres of land in northern Arizona and southern Utah (DOI 2011b; NPS 2013c).

At about 15 mi downstream from the dam, Lee Ferry, Arizona, marks the end of Glen Canyon and the official division between the upper and lower Colorado River (Reclamation 2008b, 2011b). The confluence of the Paria River represents the beginning of Marble Canyon and the northern boundary of GCNP. For the next 277 mi, the Colorado River flows through the GCNP to Pearce Ferry, which marks the upper reaches of Lake Mead. Lake Mead extends from Pearce Ferry to Hoover Dam.

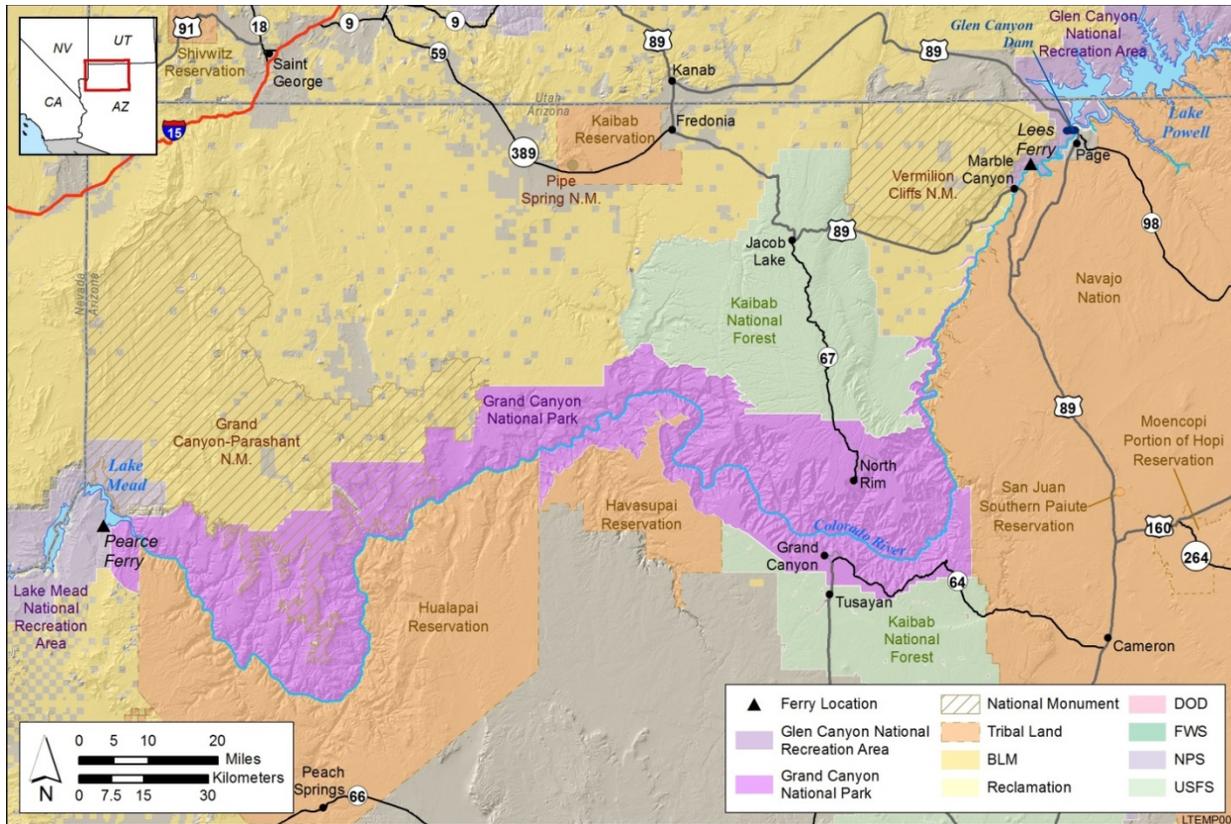


FIGURE 1-3 Map of the Colorado River between Lake Powell and Lake Mead (This map is for illustrative purposes only, not for jurisdictional determinations; potential area of effects varies by resource and is addressed in Chapters 3 and 4.)

The western boundary of the Navajo Indian Reservation lies near the Colorado River from Lake Powell through Glen and Marble Canyons. However, various orders and statutes reserved and withdrew land within one-quarter mile of the Colorado River to the United States for power purposes. The Kaibab Paiute Indian Reservation is on the plateau north of GCNP. The Havasupai Indian Reservation surrounds upper Havasu Creek, immediately south of GCNP. The Hualapai Indian Reservation comprises the southern portion of western Grand Canyon, adjacent to GCNP.

1.8.3 Operation of the Glen Canyon Dam

Glen Canyon Dam currently operates under the Modified Low Fluctuating Flow (MLFF) regime in conjunction with an adaptive management program outlined in the 1996 ROD for the 1995 EIS (Reclamation 1996). Dam releases are made according to the MLFF constraints and are presented in Table 1-1.

TABLE 1-1 Glen Canyon Dam Release Constraints under Modified Low Fluctuating Flows (after Reclamation 1995)

Parameter	Value	Conditions
<i>Flow</i>		
Maximum ^a	25,000 cfs	
Minimum	5,000 cfs	7:00 p.m. to 7:00 a.m.
	8,000 cfs	7:00 a.m. to 7:00 p.m.
<i>Ramp Rates</i>		
Ascending	4,000 cfs/hour	
Descending	1,500 cfs/hour	
<i>Daily Flow Range^b</i>	5,000 to 8,000 cfs	

^a May be exceeded for emergencies and during extreme hydrological conditions.

^b Daily flow range limit is 5,000 cfs for months with release volumes less than 0.6 maf; 6,000 cfs for monthly release volumes of 0.6 maf to 0.8 maf; and 8,000 cfs for monthly volumes over 0.8 maf.

The 1995 EIS analyzed an array of reasonable alternatives “to allow the Secretary to balance competing interests and to meet statutory responsibilities for protecting downstream resources and producing hydropower, and to protect affected Native American interests.” The goal of selecting a preferred alternative in the 1996 ROD was “not to maximize benefits for the most resources, but rather to find an alternative dam operating plan that would permit recovery and long-term sustainability of downstream resources while limiting hydropower capability and flexibility only to the extent necessary to achieve recovery and long-term sustainability.” MLFF was selected as the preferred alternative in that ROD (Reclamation 1996). The 1996 ROD reduced daily flow fluctuations below those of historic release patterns and provided occasional high steady releases of short duration (referred to as Habitat Maintenance Flows or Beach Habitat Building Flows) to protect or enhance downstream resources while allowing limited flexibility for power operations.

Dam operations are affected by a number of physical factors, such as reservoir elevation, annual runoff, and discharge capacity. Operations are also constrained by legal and institutional factors specified in federal laws, interstate compacts, international treaties, and Supreme Court decisions. Criteria and guidelines for annual operations are contained in the LROC and 2007 Interim Guidelines as determined by the Secretary, with participation by the Basin States.

Water can be released from Glen Canyon Dam in three ways—via powerplant, river outlet works, and spillway releases. Powerplant releases are the largest and preferred means of release, as they result in the generation of hydroelectric power. The powerplant houses eight electric generator turbines, which have the capacity to produce a maximum of 1,320 MW of electric power.

The powerplant can release a maximum of about 33,200 cfs of water. Maximum discharges are less when the reservoir is less than full, while MLFF limits maximum flows to 25,000 cfs under normal circumstances.

River outlet works bypass the powerplant, with releases of up to 15,000 cfs, and are almost always combined with powerplant releases, with a maximum operational release capacity of about 48,200 cfs.

Spillway releases are only used to avoid overtopping of the dam or to lower the level of Lake Powell based on emergency and safety constraints. Such releases bypass both the powerplant and the river outlet works. The reservoir elevation at which the spillways could be accessed is 3,700 ft. The combined capacity of the right and left spillways is 208,000 cfs. Spillway releases are avoided whenever possible; the combined release capacity of all three means of release is about 256,000 cfs.

1.8.4 History, Purpose, and Significance of the National Park System Units

The overarching purpose of the National Park System, as set forth in the NPS's Organic Act, "is to conserve the scenery, natural and historic objects, and wild life in the System units and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (54 USC § 100101(a)). Each unit of the National Park System is authorized or established by an act of Congress or Presidential proclamation (or sometimes both) to conserve the unit's unique and significant resources. A park's purposes, as described in its enabling legislation or proclamation, are the foundation on which later management decisions are based to conserve resources while providing for the enjoyment of future generations. This mission is further discussed and clarified in *Management Policies 2006* (NPS 2006d). Described below are the park system units relevant to this project: GCNP, GCNRA, and LMNRA.

1.8.4.1 Grand Canyon National Park

GCNP was established as a National Monument in 1908, given National Park status in 1919, and recognized as a World Heritage Site in 1979 (NPS 1995). The park attracts nearly 5 million visitors annually from the United States and around the world. The purpose of the park "is to be managed to preserve and protect its natural and cultural resources and ecological processes, as well as its scenic, aesthetic and scientific values; and provide opportunities for visitors to experience and understand the environmental interrelationships, resources, and values of the Grand Canyon without impairing the resources" (NPS 1995). Specifically, "the purpose of Grand Canyon National Park is to preserve and protect Grand Canyon's unique geologic, paleontologic, and other natural and cultural features for the benefit and enjoyment of the visiting public; provide the public opportunity to experience Grand Canyon's outstanding natural and cultural features, including natural quiet and exceptional scenic vistas; and protect and interpret Grand Canyon's extraordinary scientific and natural values" (NPS 2010a).

The significance of GCNP can be found in the richness of its resources (NPS 2010a):

Grand Canyon is one of the planet's most iconic geologic landscapes. During the last 6 million yr, the Colorado River carved Grand Canyon; these same erosional and tectonic processes continually shape the canyon today. Grand Canyon's exposed layers span more than one-third of Earth's history, and record tectonic and depositional environments ranging from mountain building to quiet seas. Taken as a whole, Grand Canyon, with its immense size, dramatic and colorful geologic record exposures, and complex geologic history, is one of our most scenic and scientifically valued landscapes.

The force and flow of the Colorado River along with its numerous and remarkably unaltered tributaries, springs, and seeps provide plants and animals an opportunity to flourish in this otherwise arid environment. These vital resources represent transmission of local aquatic recharge from high-elevation rims to the arid inner canyon. There are hundreds of known seeps and springs throughout the park, and probably more to be discovered.

Wilderness landscapes are an important current resource. Park boundaries extend beyond canyon walls to include 1,904 sq. miles (1,218,376 acres) of which 94 percent is managed as wilderness. When combined with additional contiguous public and Tribal lands, this area comprises one of the largest U.S. undeveloped areas. Grand Canyon offers outstanding opportunities for visitor experiences including extended solitude, natural quiet, clean air, dark skies, and a sense of freedom from the mechanized world's rigors.

GCNP is considered one of the finest examples in the world of arid-land erosion (NPS 1995). The park contains several major ecosystems, from the mixed Mohave Desert scrub of the lower canyon to the coniferous forests of the North Rim, and serves as an ecological refuge for relatively undisturbed remnants of dwindling ecosystems (such as boreal forest and desert riparian communities) and numerous rare, endemic, or specially protected (threatened/endangered) plant and animal species, including the California condor (NPS 1995, 2013c). The Grand Canyon protects an important cultural history. More than 12,000 years of human occupation have resulted in an extensive archeological record. The park preserves thousands of archeological sites, many of which remain unknown.

Eleven American Indian Tribes have known ties to the Grand Canyon, and some consider the canyon their original homeland and place of origin. The 11 federally recognized associated Tribes are Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians, Las Vegas Band of Paiute Indians, Moapa Band of Paiute Indians, Navajo Nation, Paiute Indian Tribe of Utah, San Juan Southern Paiute Tribe, Yavapai-Apache Nation, and Zuni Tribe.

The scenic vistas, qualities, and values of GCNP are internationally recognized and include a variety of landscapes and water features. The Grand Canyon is also known for its natural quiet and opportunities for solitude. The natural, cultural, and scenic qualities of the

Grand Canyon give rise to inspirational and spiritual values and a sense of timelessness (NPS 1995).

1.8.4.2 Glen Canyon National Recreation Area

The GCNRA was established by Congress in 1972 and occupies approximately 1,255,000 ac of northern Arizona and southeastern Utah adjacent to Lake Powell (NPS 1979). Congress directed NPS to manage the GCNRA so as to provide for public outdoor recreation use and enjoyment of Lake Powell and lands adjacent thereto in the States of Arizona and Utah and to preserve scenic, scientific, and historic features contributing to public enjoyment of the area (Public Law [P.L.] 92-593). In 2012, GCNRA attracted approximately 2 million visitors (NPS 2014f), of which approximately 10,000 utilized the Lees Ferry trout fishery.

The GCNRA ecosystem typifies the Colorado Plateau, supporting habitat for a diverse range of plants and animals. The region is arid to semi-arid, and the ecosystem is complex and often fragile (NPS 1979). Several rare and federally listed plant and animal species within the Colorado River Ecosystem are found in the GCNRA (NPS 2013b) and are addressed in Sections 3.6.3 and 3.7.5.

Glen Canyon has been occupied periodically by humans from about 11,500 years ago through the present (NPS 1979, 2013a). Several different prehistoric cultures and current Native American groups are represented in the cultural history of Glen Canyon, and the recreation area occupies a cultural interface zone, where different groups historically came into contact with one another (NPS 2013a). In the late 1800s, the crossing at Lees Ferry and the Hole-in-the-Rock trail became important points on the migration route of Mormon settlers moving westward (NPS 1979).

1.8.4.3 Lake Mead National Recreation Area

The LMNRA was established on October 8, 1964. Its purpose is to provide diverse public recreation, benefit, and use on Lakes Mead and Mohave and surrounding lands in a manner that preserves the ecological, geological, cultural, historical, scenic, scientific, and wilderness resources of the park. LMNRA includes two reservoirs, Lakes Mead and Mohave, along 140 mi of the former Colorado River from the southern tip of Nevada to the northwest corner of Arizona. It occupies approximately 1,495,800 ac in southeastern Nevada and northwestern Arizona, and is the fourth largest unit of the national park system outside the state of Alaska. Approximately 60% of the park is located in Arizona and 40% is located in Nevada (NPS 2002c).

LMNRA offers dramatic scenery and a diverse array of land- and water-based recreational opportunities in close proximity to several large urban centers of the southwestern United States. With more than 6 million visitors each year, the park supports some of the nation's highest levels of water-based recreational and backcountry use and is an integral component of the region's economy (NPS 2002c).

Situated in the northeastern Mojave Desert near the interface with the Great Basin Desert to the north and the Sonoran Desert to the south, LMNRA preserves a great diversity of biological resources, intact habitat, and ecological connectivity in the region, including many threatened and endangered species and rare natural communities. It showcases a remarkable collection of geological and paleontological features spanning more than 1.7 billion years of earth history (USGS 2014a). The diversity of cultural resources found at LMNRA—both on land and submerged—remains as evidence of a 10,000-year continuum of human history in the region (NPS 2013f). LMNRA also includes vast backcountry and wilderness lands, including nine separate designated wilderness areas that serve to preserve ecological resources and processes and provide exemplary opportunities for primitive recreation and desert solitude (NPS 2002c).

1.8.5 Tribal Lands

Numerous laws and treaties have established Indian reservations within or adjacent to the project area (see Figure 1-4). Traditional territory and traditional use lands extend well beyond

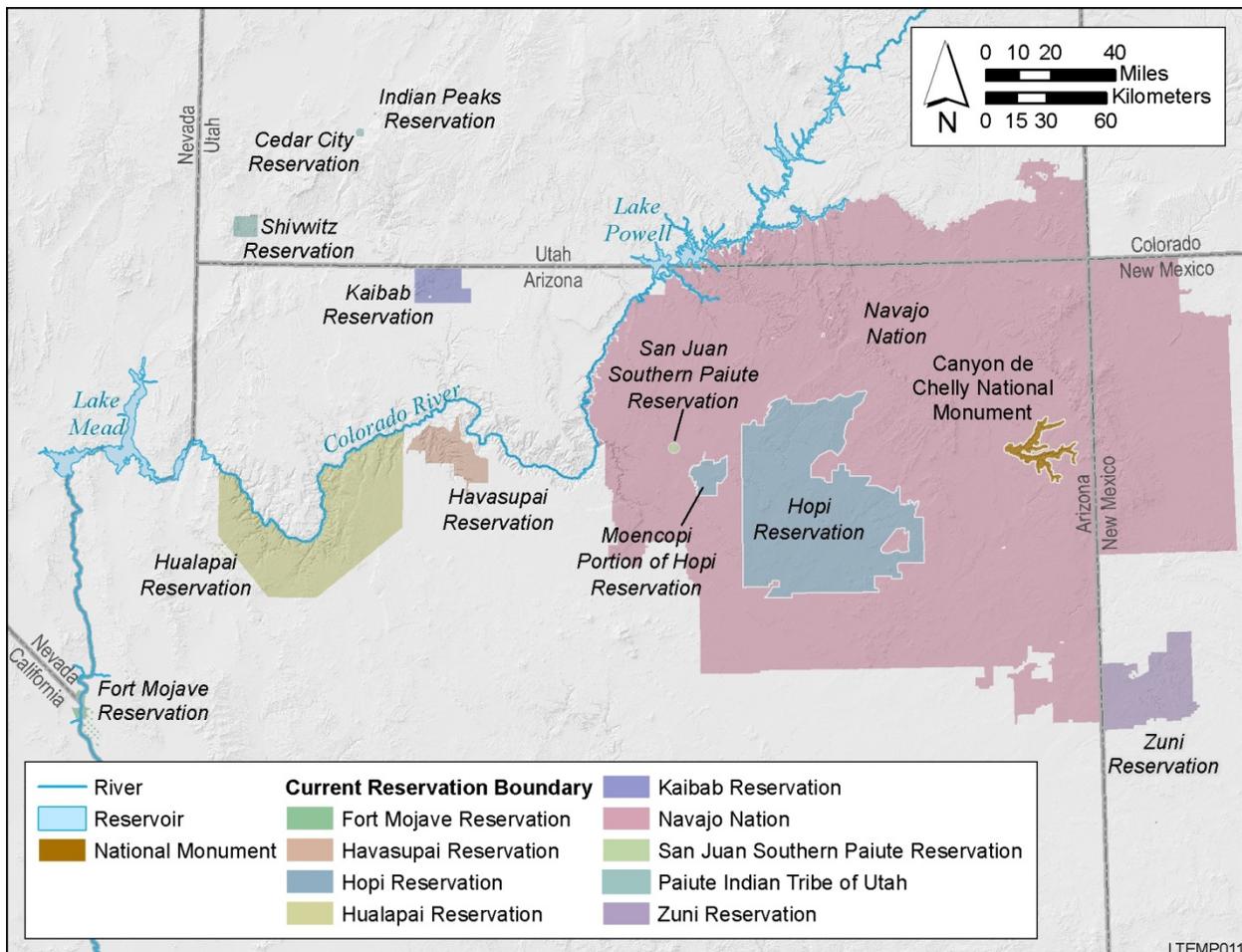


FIGURE 1-4 Indian Reservations within or Adjacent to the LTEMP EIS Project Area

these boundaries. The following sections summarize laws, treaties, and traditional use areas of Tribes with ancestral, spiritual, religious, or economic ties to the project area. These Tribes served as Cooperating Agencies (Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Navajo Nation, Kaibab Band of Paiute Indians, and Pueblo of Zuni) or a consulting Tribe (Fort Mojave). Tribal connections to resources in and around the Colorado River and the canyons are described in Chapter 3.

1.8.5.1 Fort Mojave Tribe

The Fort Mojave Indian Reservation was established through the Executive Orders of December 1, 1910, and February 2, 1911. The reservation is located along the Colorado River, near Needles, California, and encompasses 42,000 ac covering Mohave County, Arizona; Clark County, Nevada; and San Bernardino County, California (Fort Mojave Indian Tribe 2012).

Traditional Mojave territory encompasses most of the Mojave Desert in the State of California, from the Whipple Mountains, the Turtle Mountains, the Granite Mountains, the Eagle Mountains, the Little San Bernardino Mountains, and the San Bernardino Mountains in the south, west to the San Gabriel and Tehachapi Mountains, north to Granite and Soda Lakes and the Providence Mountains and Paiute Valley in the State of Nevada, to the Black, Buck, and Mojave Mountains to the east in the State of Arizona (CSRI 2002 [U.S. Court of Claims 1950-1960: Docket 283]).

1.8.5.2 Havasupai Tribe

The Havasupai Indian Reservation was established by the Executive Orders of June 8 and November 23, 1880, and March 31, 1882, and expanded by the Act of March 4, 1944 (58 Stat. 110), and the Grand Canyon Enlargement Act (88 Stat. 2089, 1975). In 1975, the Grand Canyon National Park Enlargement Act restored 185,000 ac to the Havasupai Reservation and identified 95,300 ac of traditional use lands within GCNP that were made available for traditional Havasupai practices.

The Havasupai Reservation consists of 188,077 ac of canyon and plateau along the western portion of the Grand Canyon's south rim. Additional traditional use lands are located within GCNP north of the reservation from the plateau to the Colorado River and extend from approximately river mile (RM) 116 to RM 165 (Havasupai 2012).

The Indian Claims Commission determined in 1968 that as of 1880, the Havasupai Tribe exclusively occupied, as their original territory, the land on the Coconino Plateau bounded by the mid-stream of the Colorado River on the north, the Hualapai Reservation on the west, south to the Trinity Mountain, Mount Floyd and easterly to Sitgreaves Mountain, north to Mount Kendrick and along the Little Colorado River on the east to the Colorado River.

The Grand Canyon Enlargement Act of 1975 replaced a portion of the Tribal lands, permitted the traditional uses of park lands, and placed restrictions on the use of portions of the

Havasupai Reservation within GCNP in order to preserve the scenic and natural values of the park (16 USC 228i(b)(7)).

1.8.5.3 Hopi Tribe

The original Hopi Reservation was established by the Executive Order of December 16, 1882, as a 1 × 1 degree latitude/longitude rectangular region. Subsequent partitioning of this original reservation area between the Hopi Tribe and Navajo Nation has resulted in a smaller reservation area, encompassing about 1.5 million ac in parts of Coconino and Navajo Counties, Arizona. There are 11 main Hopi villages within the central portion of the Hopi Reservation and two additional villages located to the west at Moencopi, on a non-contiguous portion of the Hopi Reservation (Figure 1-4).

The Hopi people view their traditional homeland as much larger than the current reservation. It encompasses an area running from near the confluence of the San Juan and Colorado Rivers in the north, southwest to the area of the Havasupai Reservation, southward past Williams and out to the Mogollon Rim in the south, and eastward to the Lupton area on the Arizona–New Mexico border. Even this area is but a small portion of the lands occupied by the ancestors of the Hopi people, which include portions of Colorado, Utah, Arizona, and New Mexico.

1.8.5.4 Hualapai Tribe

The Hualapai Reservation was established by Executive Orders of January 4, 1883; June 2, 1911; May 29, 1912; and July 18, 1913. The reservation encompasses 992,463 ac just south of the Colorado River. The reservation borders the river corridor for approximately 108 mi from approximately RM 164.5 to RM 273.5 (NPS 2006b).

Hualapai traditional territory is bounded by the Colorado River from the Big Bend near Hoover Dam-Lake Mead to the Little Colorado River on the north, the San Francisco Peaks on the east, the Bill Williams and Santa Maria Rivers on the south, and the Colorado River from its confluence with the Bill Williams River to Lake Mead on the west (Reclamation 1995).

1.8.5.5 Navajo Nation

The Navajo Indian Reservation was established by the Treaty of June 1, 1868 (15 Stat. 667). Between 1868 and 1918, various Executive Orders added lands to, or removed lands from, the reservation. The Act of May 25, 1918 (40 Stat. 561, 570), prohibited the creation of, or any additions to, Indian reservations in New Mexico and Arizona “except by Act of Congress.” Congress added land to the Navajo Indian Reservation by the Act of May 23, 1930 (46 Stat. 378), amended by the Act of February 21, 1931 (46 Stat. 378), and the Act of March 1, 1933 (47 Stat. 1418). The Act of June 14, 1934 (48 Stat. 960), describes the exterior boundaries

of the 17.6-million-ac reservation in Arizona, subject to various exclusions and conditions set out in the act.

The traditional Navajo homeland, or *Dinetah*, is bounded by four sacred mountains: *Sissnaajinii* (Blanca Peak, near Alamosa, Colorado) on the east; *Tsoo Dzil* (Mount Taylor near Grants, New Mexico) on the south; *Dook' o' oosliid* (San Francisco Peaks near Flagstaff, Arizona) on the west; and *Dibe Ntsaa* (La Plata Mountains near Durango, Colorado) on the north. Traditional use areas extend well beyond this boundary encompassing areas associated with the Little Colorado River, the Colorado River and its tributaries, and alongside the rim. According to Navajo oral tradition, in aboriginal times, Tribal members ranged as far as the Gulf of California. Documented histories were shared during the initial EIS in 1995 from the Navajo Nation Historic Preservation Department (NNHPD), taken from the cultural resources inventory report (Roberts et al. 1995).

1.8.5.6 Pueblo of Zuni

The Zuni Indian Reservation was established by the Executive Orders of March 16, 1877, May 1, 1883, and March 3, 1885, and was expanded by the Proclamation of November 30, 1917 (40 Stat. 1723); the Congressional Act of June 20, 1935 (49 Stat. 393); the Executive Order of August 13, 1949; and the Congressional Act of March 16, 1962 (76 Stat. 33). The Pueblo of Zuni is located approximately 150 mi west of Albuquerque, New Mexico, and encompasses approximately 450,000 ac (Pueblo of Zuni 2013). In addition to the lands established by Executive Orders and Presidential proclamation, two additional non-contiguous areas are included in the Zuni Reservation: the Zuni Salt Lake (1 mi²) added in 1978 and Kolhu'wala:wa (Zuni Heaven) in Arizona consisting of 14 mi² added on August 28, 1984.

The traditional territory of the Zuni Tribe is bounded by the San Francisco Peaks on the northwest corner and by portions of the Little Colorado River and Pueblo Colorado Wash on the far northern boundary. The view of Pueblo of Zuni is that traditional use extends considerably beyond the traditional territorial boundaries and includes GCNP and GCNRA (Reclamation 1995; Dongoske 2012). It also should be noted that the Zunis are considered an Indian Tribe of Arizona.

1.8.5.7 Southern Paiute Tribes

The Southern Paiute Tribes that have ties to the region and who are most directly tied to the project area include the Kaibab Band of Paiute Indians; the Paiute Indian Tribe of Utah, which consists of five bands of Southern Paiute (Cedar Band, Indian Peaks Band, Kanosh Band, Koosharem Band, and Shivwits Band); and the San Juan Southern Paiute. The Kaibab Band of Paiute Indians and the Paiute Indian Tribe of Utah are also members of the Southern Paiute Consortium. The Kaibab Band represents the consortium in matters pertaining to Glen Canyon Dam and Colorado River management, and served as a Cooperating Agency on the LTEMP EIS.

The Kaibab Band of Paiute Indians Reservation was established by the Executive Orders of June 11, 1913, and July 17, 1917. The reservation is located approximately 50 mi north of the Grand Canyon. The reservation encompasses approximately 121,000 ac and includes five Tribal villages and two non-Indian communities (Kaibab Paiute 2013).

The Paiute Indian Tribe of Utah Reservation was established on April 3, 1980, by an Act of Congress (94 Stat. 317, 1980) and consists of 10 separate land parcels located in 4 southwestern Utah counties, covering 33,709 ac (PITU 2013).

The San Juan Southern Paiute were given 5,400 ac of land within the Navajo Reservation boundary when their leaders signed a treaty with the Navajo Nation on May 20, 2000. Approximately 5,100 ac of this land is located near Tuba City, Arizona, with the remaining 300 ac located just south of Lake Powell (NPS 2013d).

The traditional lands of the Southern Paiute people are bounded by more than 600 mi of the Colorado River, extending from the Kaiparowits Plateau in southern Utah to Blythe, California (Bullets et al. 2012). These lands extend from the Colorado River northward, inclusive of the Grand and Glen Canyons, into Beaver County, Utah, and from the Escalante River drainage on the east within GCNRA to Death Valley on the west, including the Virgin River drainage, the Muddy River drainage, and the area around present-day Las Vegas, Nevada (ICC 1965).

1.9 LAWS AND REGULATIONS RELATED TO OPERATIONS OF GLEN CANYON DAM AND PARK MANAGEMENT

The following lists of laws, regulations, and treaties are presented here to provide context for the management of the Colorado River because they must be complied with for operation of Glen Canyon Dam and for park management, and may or may not specifically apply to this action. Nothing in this EIS is intended to interpret the authorities listed below.

1.9.1 Environmental Laws and Executive Orders

- Bald and Golden Eagle Protection Act of 1940, as amended 1962 (16 USC 668c)
- Clean Air Act of 1970 (33 USC 1251 et seq.)
- Clean Water Act of 1972 (33 USC 1251 et seq.)
- Endangered Species Act of 1973 (16 USC 1531–1544, 87 Stat. 884)
- E.O. 11514, “Protection and Enhancement of Environmental Quality,” as amended by E.O. 11991, “Relating to Protection and Enhancement of Environmental Quality” (U.S. President 1970)

- E.O. 11988, “Floodplain Management” (U.S. President 1977a)
- E.O. 11990, “Protection of Wetlands” (U.S. President 1977b)
- E.O. 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” (U.S. President 1994b)
- E.O. 13112, “Invasive Species” (U.S. President 1999)
- E.O. 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds” (U.S. President 2001)
- Fish and Wildlife Coordination Act of 1934 (16 USC 661 et seq.)
- The Grand Canyon Protection Act of 1992 (P.L. 102-575)
- Migratory Bird Treaty Act of 1918, as amended 2008 (16 USC 703)
- National Environmental Policy Act of 1969, as amended (42 USC 4321 et seq.)
- National Park Service Organic Act of 1916 (16 USC 1–4, 22, and 43, as amended)
- Redwoods National Park Expansion Act of 1978 (Redwoods Amendment) (16 USC 1a-1)
- Wild and Scenic Rivers Act of 1968 (16 USC 1271 et seq.)
- Wilderness Act of 1964 (16 USC 1131–1136)

1.9.2 Cultural/Historical Laws and Executive Orders

- Antiquities Act of 1906 (16 USC 431–433)
- Archaeological and Historic Preservation Act of 1974 (16 USC 469 et seq.)
- Archaeological Resources Protection Act of 1979 (16 USC 470 et seq., P.L. 96-95)
- E.O. 11593, “Protection and Enhancement of the Cultural Environment” (U.S. President 1971)
- Historic Sites, Buildings, and Antiquities Act of 1935 (16 USC 461 et seq., as amended by P.L. 89-249)

- National Historic Preservation Act of 1966 (54 USC 300101 et seq., P.L. 89-665)

1.9.3 American Indian and Tribal Consultation Laws and Executive Orders

- American Indian Religious Freedom Act of 1978 (P.L. 95-431, 92 Stat. 469, 42 USC 1996)
- E.O. 13007, “Indian Sacred Sites” (U.S. President 1996)
- E.O. 13175, “Consultation and Coordination with Indian Tribal Governments” (U.S. President 2000)
- Native American Graves Protection and Repatriation Act of 1990 (P.L. 101-601, 104 Stat. 3048, 25 USC 3001 et seq.)

1.9.4 Laws Establishing Criteria Related to Power Marketing

- Colorado River Storage Project Act of 1956 (P.L. 84-485, 70 Stat. 105)
- Department of Energy Organization Act of 1977 (P.L. 95-91, 91 Stat. 565, 42 USC 7101)
- Flood Control Act of 1944 (P.L. 78-534, 58 Stat. 887)
- Reclamation Project Act of 1939 (P.L. 76-260, 53 Stat. 1187, 43 USC 485)

1.9.5 Law of the River

The treaties, compacts, decrees, statutes, regulations, contracts, and other legal documents and agreements applicable to the allocation, appropriation, development, exportation, and management of the waters of the Colorado River Basin are often referred to as the Law of the River. There is no single, universally agreed upon definition of the Law of the River, but it is useful as a shorthand reference to describe this longstanding and complex body of legal agreements governing the Colorado River. Documents generally considered to be part of the Law of the River include those listed in Table 1-2.

1.10 RELATED ACTIONS

Numerous ongoing and completed plans, policies, actions, and initiatives are related to the operation of the Glen Canyon Dam and Colorado River with respect to the proposed federal action analyzed in this EIS. Reclamation and NPS have identified documents that would assist

TABLE 1-2 Selected Documents Included in the Law of the River^a

1899	The Rivers and Harbors Act (Mar. 3)	1948	The Upper Colorado River Basin Compact (Oct. 11)
1902	The Reclamation Act (Jun. 17)	1954	Consolidated Parker Dam Power Project and Davis Dam Project Act (May 28)
1904	Reclamation of Indian Lands in Yuma, Colorado River and Pyramid Lake Indian Reservations Act (Apr. 21)	1954	Palo Verde Diversion Dam Act (Aug. 31)
1904	Yuma Project authorized by the Secretary (May 10), pursuant to Section 4 of the Reclamation Act of June 17, 1902	1956	Change Boundaries, Yuma Auxiliary Project Act (Feb. 15)
1910	Warren Act (Feb. 21)	1956	The Colorado River Storage Project Act (Apr. 11)
1910	Protection of Property Along the Colorado River Act (Jun. 25)	1958	Water Supply Act (Jul. 3)
1912	Patents Act and Water-Right Certificates Act (Aug. 9 and 26)	1958	Boulder City Act (Sept. 2)
1917	Yuma Auxiliary Project Act (Jan. 25)	1960	Report of the Special Master, Simon H. Rifkind, <i>Arizona v. California</i> (Dec. 5)
1918	Availability of Money for Yuma Auxiliary Project Act (Feb. 11)	1964	International Flood Control Measures, Lower Colorado River Act (Aug. 10)
1920	Sale of Water for Miscellaneous Purposes Act (Feb. 25)	1965	Southern Nevada (Robert B. Griffith) Water Project Act (Oct. 22)
1920	Federal Power Act (Jun. 10)	1968	The Colorado River Basin Project Act (Sept. 30)
1922	The Colorado River Compact (Nov. 24)	1970	Criteria for the Coordinated Long Range Operation of Colorado River Reservoirs (Jun. 8), amended Mar. 21, 2005
1925	The Colorado River Front Work Act (Mar. 3)	1970	Supplemental Irrigation Facilities, Yuma Division Act (Sept. 25)
<i>(1927–1946)</i>	and Levee System Acts (Jan. 21, 1927–Jun. 28, 1946)		
1928	The Boulder Canyon Project Act (Dec. 21)	1972	43 CFR Part 417 Lower Basin Water Conservation Measures (Sept. 7)
1929	The California Limitation Act (Mar. 4)	1974	The Colorado River Basin Salinity Control Act (Jun. 24)
1931	The California Seven Party Agreement (Aug. 18)	1984	Hoover Power Plant Act (Aug. 17)
1935	The Parker and Grand Coulee Dams Authorization (Aug. 30)	1991	Reclamation States Emergency Drought Relief Act
1939	The Parker Dam Power Project Appropriation Act (May 2)	1992	Grand Canyon Protection Act (Oct. 30)
1939	The Reclamation Project Act (Aug. 4)	1999	Offstream Storage of Colorado River Water and Development and Release of Intentionally Created Unused Apportionment in the Lower Division States (Nov. 1) (Reclamation 1999a)
1940	The Boulder Canyon Project Adjustment Act (Jul. 19)	2003	Colorado River Water Delivery Agreement (Oct. 10)
1944	The Flood Control Act (Dec. 22)	2006	The Consolidated Decree entered by the U.S. Supreme Court in <i>Arizona v. California</i> (1964)
1944	The Mexican Water Treaty (Feb. 3); subsequent minutes of the International Boundary and Water Commission	2007	Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead
1947	Gila Project Act (Jul. 30)		

^a Years in italics indicate amendments or related actions.

Source: Reclamation (2007b).

the reader in understanding the issues analyzed in this process and underscore the importance of collaboration among agency and stakeholder participants.

1.10.1 Biological Opinions

- Final Biological Opinion for the Proposed Adoption of Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead (FWS 2007a).
- Final Biological Opinion on the Operation of Glen Canyon Dam, including High-Flow Experiments and Nonnative Fish Control (FWS 2011c). This replaced former Biological Opinions from 1995 to 2009.
- Final Biological Opinion on the Comprehensive Fisheries Management Plan, Coconino and Mohave Counties, Arizona (FWS 2013a).

1.10.2 Environmental Impact Statements and Related Documents

Operation of Glen Canyon Dam: Environmental Impact Statement and Record of Decision (Reclamation 1996). Glen Canyon Dam currently operates under provisions of the 1996 ROD (Reclamation 1996) for the Glen Canyon Dam EIS (Reclamation 1995). The Secretary accepted the recommendation of the 1995 EIS and signed the 1996 ROD (Reclamation 1996) that selected MLFF as the operating system for the dam. The flow parameters of MLFF are presented in Section 1.8.3 of this EIS.

A component of the final Glen Canyon Dam EIS (Reclamation 1995) and the environmental commitments identified in the 1996 ROD (Reclamation 1996) was the implementation of a Programmatic Agreement regarding operations of the Glen Canyon Dam. This agreement, along with subsequent monitoring and remedial action plans and the 2007 Comprehensive Treatment Plan, set a strategy for long-term management of archaeological sites affected by the operations of Glen Canyon Dam. In addition, separate, action-specific Memoranda of Agreement were established among the signatories to the agreements, primarily Reclamation, NPS, Arizona State Historic Preservation Office, and affiliated Tribes for actions related to the High Flow Experimental Protocol EA (Reclamation 2011b) and the Nonnative Fish Control EA (Reclamation 2011a).

Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (Reclamation 2007b). In 2005, spurred by a multi-year drought, decreasing system storage, and growing demands for Colorado River water, the Secretary directed Reclamation to work with the Basin States to develop additional strategies for addressing the coordinated management of the reservoirs of the Colorado River system. In response, Reclamation began to develop and adopt interim operational guidelines that would address the operation of Lake Powell and Lake Mead during drought and low-reservoir conditions. Adopted in 2007, these Interim Guidelines would be used each year (through 2025

for water supply determinations and through 2026 for reservoir operating decisions) in implementing the LROC for the Colorado River reservoirs pursuant to the 1968 Colorado River Basin Project Act. This ROD did not modify the authority of the Secretary to determine monthly, daily, hourly, or instantaneous releases from Glen Canyon Dam.

The completed Interim Guidelines determine the availability of Colorado River water for use in the Lower Basin, on the basis of Lake Mead's water surface elevation, as a way to conserve reservoir storage and provide water users and managers with greater certainty regarding the reduction of water deliveries during drought and other low-reservoir conditions. The Interim Guidelines also proposed a coordinated operation plan for Lake Powell and Lake Mead, basing releases and conserved amounts on predetermined levels in both reservoirs, which would minimize shortages in the Lower Basin and decrease the risk of curtailments in the Upper Basin. In addition, the Interim Guidelines established a mechanism for storing and delivering conserved water from Lake Mead, referred to as Intentionally Created Surplus, intended to minimize the severity and likelihood of potential future shortages. Nothing in this LTEMP EIS is intended to affect, or will affect, future decisions that may be made regarding the implementation of the LROC after the Interim Guidelines expire in 2026.

Colorado River Management Plan: Final Environmental Impact Statement and Record of Decision (NPS 2006a). This Final EIS (NPS 2005a) presents a visitor use management plan for the Colorado River corridor in the Grand Canyon. The ROD (NPS 2006a) was approved in early 2006, and the CRMP were published later in the year (NPS 2006b). The CRMP's section on research, monitoring, and mitigation for the plan focuses on the impacts of visitor use and is a consideration for the LTEMP EIS analysis.

Lower Colorado River Multi-Species Conservation Program—Final Programmatic Environmental Impact Statement/Environmental Impact Report (DOI 2004). This Programmatic EIS evaluates the impacts of implementing the Lower Colorado River Multi-Species Conservation Program Conservation Plan. It is intended to avoid, minimize, and fully mitigate the incidental take of the covered species from the implementation of the covered activities to the maximum extent practicable. The Conservation Plan also is intended to contribute to the recovery of species listed as threatened or endangered under the ESA and reduce the likelihood for future listing of unlisted covered species along the lower Colorado River. The ROD (DOI 2005) was approved in 2005.

General Management Plan for Grand Canyon National Park (NPS 1995). This plan guides the management of resources, visitor use, and general development at the park over a 10- to 15-year period. The primary purpose of the plan is to provide a foundation from which to protect park resources while providing for meaningful visitor experiences. A secondary purpose is to encourage compatible activities on adjacent lands so as to minimize adverse effects on the park.

Backcountry Management Plan, Grand Canyon National Park, Arizona (NPS 1988). This plan defines the primary policies that manage visitor use and resource protection for the undeveloped areas of GCNP. GCNP has started work on a Backcountry Management Plan and EIS. The park's existing Backcountry Management Plan is being updated to comply with current

NPS laws and policies and the park's 1995 General Management Plan. Once completed, the revised Backcountry Management Plan will guide management decisions regarding the park's backcountry and wilderness resources into the future.

Lake Mead National Recreation Area General Management Plan—Final Environmental Impact Statement (NPS 1986). This plan presents short-term and long-term strategies for meeting the management objectives of LMNRA. It addresses resource management, resource use, and park development challenges. The plan was intended to guide park management for 25 years or longer when it was issued. The purpose of the plan is to provide a cohesive framework for management decisions, management proposals, concession planning, and guidance for short-term decision-making.

Glen Canyon National Recreation Area General Management Plan—Final Environmental Impact Statement (NPS 1979). This plan and wilderness recommendation lays out proposals for meeting four levels of management objectives for GCNRA, ranging from general to specific. The first-level objective is to manage GCNRA to maximize its recreational enjoyment. Objective levels 2 through 4 address increasingly specific objectives, including those for cultural, Tribal, mineral, and grazing resources and management of the reservoir. The plan presents a management zoning proposal to divide GCNRA into four management zones: natural, recreation and resource utilization, cultural, and development.

1.10.3 Environmental Assessments and Related Documents

Nonnative Fish Control Environmental Assessment (Reclamation 2011a). In this assessment, Reclamation proposed to conduct research, monitoring, and specific actions to control nonnative fish in the Colorado River downstream from Glen Canyon Dam in an effort to help conserve native fish. The purpose of the action was to minimize the negative impacts of competition and predation on an endangered fish, the humpback chub. The action was needed because competition and predation by nonnative fishes, particularly rainbow trout and brown trout, may be contributing to a reduction in survival and recruitment of young humpback chub and threatening the potential recovery of the species. Rainbow trout and brown trout are not native to the Colorado River Basin and have been introduced into the region as sport fish. The Finding of No Significant Impact (FONSI) (Reclamation 2012b) was signed in May of 2012.

High-Flow Experiment Protocol Environmental Assessment (Reclamation 2011b). This experimental protocol was developed following analysis of a series of high-flow experimental releases. The protocol is intended to improve conservation of limited sediment resources in the Colorado River below Glen Canyon Dam. The FONSI (Reclamation 2012a) was signed in May of 2012.

Environmental Assessment, Comprehensive Fisheries Management Plan for Grand Canyon National Park and Glen Canyon National Recreation Area (NPS 2013e). The NPS is implementing a CFMP, in coordination with the Arizona Game and Fish Department (AZGFD), the FWS, Reclamation, and the USGS GCMRC, for all fish-bearing waters in GCNP and GCNRA below Glen Canyon Dam. The intent of the CFMP is to maintain a thriving native

fish community within GCNP and a highly valued recreational rainbow trout fishery in the Glen Canyon reach of GCNRA. NPS released a FONSI on December 9, 2013, for the CFMP.

Environmental Assessment and Assessment of Effect, Exotic Plant Management Plan Grand Canyon National Park, Arizona (NPS 2009a). GCNP is using integrated pest management techniques to control and contain exotic plant species within park boundaries. Exotic plant species displace natural vegetation and consequently affect long-term health of native plant and animal communities.

1.10.4 Other Actions, Programs, Plans, and Projects

Additional actions, programs, plans, or projects involving the Colorado River may continue to operate or be contemplated during the life of the LTEMP. These items, which are not directly linked to LTEMP, include:

Colorado River Basin Salinity Control Program (Reclamation 2014c). The Colorado River and its tributaries provide municipal and industrial water to about 27 million people and irrigation water to nearly 4 million ac of land in the United States. The threat of salinity is a major concern in both the United States and Mexico. In June 1974, Congress enacted the Colorado River Basin Salinity Control Act (P.L. 93-320), which directed the Secretary to proceed with a program to enhance and protect the quality of water available in the Colorado River for use in the United States and Republic of Mexico.

Lake Powell Pipeline Project (WCWCD 2012). Washington, Kane, and Iron Counties in Utah are pursuing the construction of a pipeline that would run from Lake Powell, near Glen Canyon Dam, through Kane County, to Sand Hollow Reservoir, which is located approximately 10 mi east of St. George. The pipeline would then run parallel to Interstate 15 into Iron County. The pipeline would be 158 mi long and bring 70,000 ac-ft of water to Washington County, 10,000 ac-ft to Kane County, and 20,000 ac-ft to Iron County.

Final Wilderness Recommendation, Grand Canyon National Park, 2010 Update. The 1980 Final Wilderness Recommendation submitted to the DOI includes 1,143,918 ac proposed for wilderness designation, and includes 26,461 ac as potential wilderness pending the resolution of boundary and motorized boat use issues. The Colorado River was identified as potential wilderness. In 2010, NPS conducted internal reviews and included refinements to the proposed wilderness acreage estimates. All refinements were consistent with the intent of the original document submitted to the DOI in 1980.

Grand Canyon National Park Foundation Statement for Planning and Management (NPS 2010a). The Foundation Statement provides a base for future planning, as required by NPS, to help guide park management. The Foundation Statement summarizes fundamental resources and values critical to maintaining Grand Canyon's natural, cultural, and experiential value into the future. Because this Foundation Statement is based on laws and policies that define GCNP and its mission, the Statement should remain relatively unchanged.

Glen Canyon National Recreation Area and Rainbow Bridge National Monument Foundation Document for Management and Planning (NPS 2014i). The Foundation Statement provides a base for future planning, as required by NPS, to help guide park management. The Foundation Statement summarizes fundamental resources and values critical to maintaining Glen Canyon and Rainbow Bridge's natural, cultural, and experiential value into the future. Because this Foundation Statement is based on laws and policies that define GCNRA and its mission, the Statement should remain relatively unchanged.

Management and Control of Tamarisk and Other Invasive Vegetation at Backcountry Seeps, Springs, and Tributaries in Grand Canyon National Park (NPS 2008). Grand Canyon National Park's backcountry seeps, springs, and tributaries of the Colorado River are among the most pristine watersheds and desert riparian habitats remaining in the coterminous United States. This report contains the details from the invasive plant control and monitoring efforts completed for one phase (Phase II-B) of the three-phase project. Reports for the previous two phases are also available on the NPS website.

Strategic Plan for Glen Canyon National Recreation Area and Rainbow Bridge National Monument FY2007–FY2011 (NPS 2006c). This 5-year Strategic Plan has been written for GCNRA and Rainbow Bridge National Monument (NM). Because Rainbow Bridge NM is administered by GCNRA, this strategic plan covers both units of the NPS.

Grand Canyon National Park Resource Management Plan (NPS 1997). The purpose of the Resource Management Plan was to provide long-term guidance and direction for the stewardship of the natural, cultural, and recreational resources of GCNP.

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