

## 1 INTRODUCTION

1  
2  
3  
4 The U.S. Department of the Interior (DOI), through the Bureau of Reclamation  
5 (Reclamation) and National Park Service (NPS) proposes to develop and implement a Long-  
6 Term Experimental and Management Plan (LTEMP) for operations of Glen Canyon Dam, the  
7 largest unit of the Colorado River Storage Project (CRSP). The LTEMP would provide a  
8 framework for adaptively managing Glen Canyon Dam operations over the next 20 years  
9 consistent with the Grand Canyon Protection Act of 1992 (GCPA) and other provisions of  
10 applicable federal law. The LTEMP would determine specific options for dam operations,  
11 non-flow actions, and appropriate experimental and management actions that will meet the  
12 GCPA's requirements and minimize impacts on resources within the area impacted by dam  
13 operations, commonly referred to as the Colorado River Ecosystem, including those of  
14 importance to American Indian Tribes.

15  
16 This LTEMP Draft Environmental Impact Statement (DEIS) has been prepared to  
17 identify the potential environmental effects of implementing the proposed federal action. In  
18 addition, this DEIS identifies and analyzes the environmental issues and consequences associated  
19 with taking no action, as well as a reasonable range of alternatives to no action for implementing  
20 the proposed federal action. The alternatives addressed in this DEIS include a broad range of  
21 operations and experimental actions that together allow for a full evaluation of possible impacts  
22 of the proposed action. DOI, through Reclamation and NPS, has determined these alternatives  
23 represent a reasonable range of options that would meet the purpose, need, and objectives (as  
24 described below) of the proposed action. This DEIS has been developed in accordance with the  
25 National Environmental Policy Act of 1969, as amended (NEPA), following implementing  
26 regulations developed by the President's Council on Environmental Quality (CEQ) in Title  
27 40 *Code of Federal Regulations* (CFR) Parts 1500 to 1508 and DOI regulations implementing  
28 NEPA in 43 CFR Part 46.

29  
30 Reclamation and NPS are joint-lead agencies for the LTEMP DEIS because of their  
31 complementary roles in operating Glen Canyon Dam (Reclamation's role) and managing the  
32 resources of Glen Canyon National Recreation Area (GCNRA) and Grand Canyon National Park  
33 (GCNP) (NPS's role). As joint leads, both agencies have been equally involved in the  
34 development of all aspects of the LTEMP DEIS. Major phases of LTEMP DEIS development  
35 included (1) public and internal scoping, (2) identification of alternatives to be considered for  
36 evaluation and their characteristics, (3) identification of elements common to all alternatives,  
37 (4) analysis of the consequences of the alternatives, (5) government-to-government consultation  
38 with traditionally associated Tribes, and (6) preparation of the DEIS.

39  
40 The first Environmental Impact Statement (EIS) on the operation of Glen Canyon Dam  
41 was published in 1995 (Reclamation 1995). The 1996 Record of Decision (ROD)  
42 (Reclamation 1996) selected the Modified Low Fluctuating Flow Alternative as the preferred  
43 means of operating Glen Canyon Dam. The ROD incorporated the GCPA requirement that the  
44 Secretary of the Interior (hereafter referred to as the Secretary) undertake research and  
45 monitoring to determine if revised dam operations were achieving the resource protection  
46 objectives of the final EIS and the ROD. The ROD also led to the establishment of the Glen

1 Canyon Dam Adaptive Management Program (GCDAMP), administered by Reclamation with  
2 technical expertise provided by the U.S. Geological Survey's (USGS's) Grand Canyon  
3 Monitoring and Research Center (GCMRC).  
4

5 The following passage was included in the 1995 EIS for the purposes of providing  
6 background and context to the public. This section provides relevant content and context for this  
7 LTEMP DEIS and is therefore reproduced here for public information:  
8

9 The underlying project purpose(s) is defined by section 1 of the Colorado River  
10 Storage Project Act of 1956 (43 United States Code (U.S.C.) 620), which  
11 authorized the Secretary to "construct, operate, and maintain" Glen Canyon Dam:  
12

13 ...for the purposes, among others, of regulating the flow of the Colorado River,  
14 storing water for beneficial consumptive use, making it possible for the States of  
15 the Upper Basin to utilize, consistently with the provisions of the Colorado River  
16 Compact, the apportionments made to and among them in the Colorado River  
17 Compact and the Upper Colorado River Basin Compact, respectively, providing  
18 for the reclamation of arid and semiarid land, for the control of floods, and for the  
19 generation of hydroelectric power, as an incident of the foregoing purposes...  
20

21 In 1968, Congress enacted the Colorado River Basin Project Act (43 U.S.C. 1501  
22 et seq.). This act provided for a program for further comprehensive development  
23 of Colorado River Basin water resources. Section 1501(a) states:  
24

25 This program is declared to be for the purposes, among others, of regulating the  
26 flow of the Colorado River; controlling flood; improving navigation; providing  
27 for the storage and delivery of waters of the Colorado River for reclamation of  
28 lands, including supplemental water supplies, and for municipal, industrial, and  
29 other beneficial purposes; improving water quality; providing for basic public  
30 outdoor recreation facilities; improving conditions for fish and wildlife, and the  
31 generation and sale of electrical power as an incident of the foregoing purposes.  
32

33 In addition, the Criteria for Coordinated Long Range Operation of Colorado River  
34 Reservoirs (including Glen Canyon Dam) were mandated by section 1552 of the  
35 Colorado River Basin Project Act. Article 1.(2) of these criteria requires that the  
36 Annual Operating Plan for Colorado River reservoirs:  
37

38 ...shall reflect appropriate consideration of the uses of the reservoirs for all  
39 purposes, including flood control, river regulation, beneficial consumptive uses,  
40 power production, water quality control, recreation, enhancement of fish and  
41 wildlife, and other environmental factors.  
42

43 The Colorado River Compact (1922) and the Upper Colorado River Basin  
44 Compact (1948) do not affect obligations to Native American interests.  
45 Article VII and Article XIX, part a respectively, of the 1922 and 1948 compacts  
46 provide that:

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

3  
4 The Colorado River Storage Project Act of 1956, the Colorado River Basin  
5 Project Act of 1968, and the associated Criteria for Coordinated Long-Range  
6 Operation of Colorado River Reservoirs (Long-Range Operating Criteria) did not  
7 alter these compact provisions.

8  
9 In addition to the Secretary's decision calling for a reevaluation, Congress  
10 subsequently enacted the Grand Canyon Protection Act of 1992. Section 1802 (a)  
11 of the act requires the Secretary to operate Glen Canyon Dam:

12  
13 ... in accordance with the additional criteria and operating plans specified in  
14 section 1804 and exercise other authorities under existing law in such a manner as  
15 to protect, mitigate adverse impacts to, and improve the values for which Grand  
16 Canyon National Park and Glen Canyon National Recreational Area were  
17 established, including, but not limited to natural and cultural resources and visitor  
18 use.

19  
20 Section 1802(b) of the act further requires that the above mandate be implemented  
21 in a manner fully consistent with existing law<sup>1</sup>. Section 1802(c) states that the  
22 purposes for which Grand Canyon National Park and Glen Canyon National  
23 Recreation Area were established are unchanged by the act. Section 1804 (a) of  
24 the act requires the Secretary to complete an EIS no later than October 30, 1994,  
25 following which, under section 1804 (c), the Secretary is to 'exercise other  
26 authorities under existing law, so as to ensure that Glen Canyon Dam is operated  
27 in a manner consistent with section 1802.' Section 1804 (c) also requires that the  
28 criteria and operating plans are to be 'separate from and in addition to those  
29 specified in section 602 (b) of the Colorado River Basin Project Act of 1968.'

30  
31 Glen Canyon Dam was completed by the Bureau of Reclamation (Reclamation) in  
32 1963, prior to enactment of the National Environmental Policy Act of 1969  
33 (NEPA). Consequently, no EIS was filed regarding the construction or operation  
34 of Glen Canyon Dam. Since the dam has long been completed, alternatives to the  
35 dam itself have been excluded from the scope of the analysis.

36  
37 The DOI has evaluated information developed through the GCDAMP to more fully  
38 inform decisions regarding operation of Glen Canyon Dam over the next 20 years and to inform  
39 other management and experimental actions within the LTEMP. Revised dam operations and  
40 other actions will be considered and analyzed under alternatives in this DEIS.

41  

---

<sup>1</sup> 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.

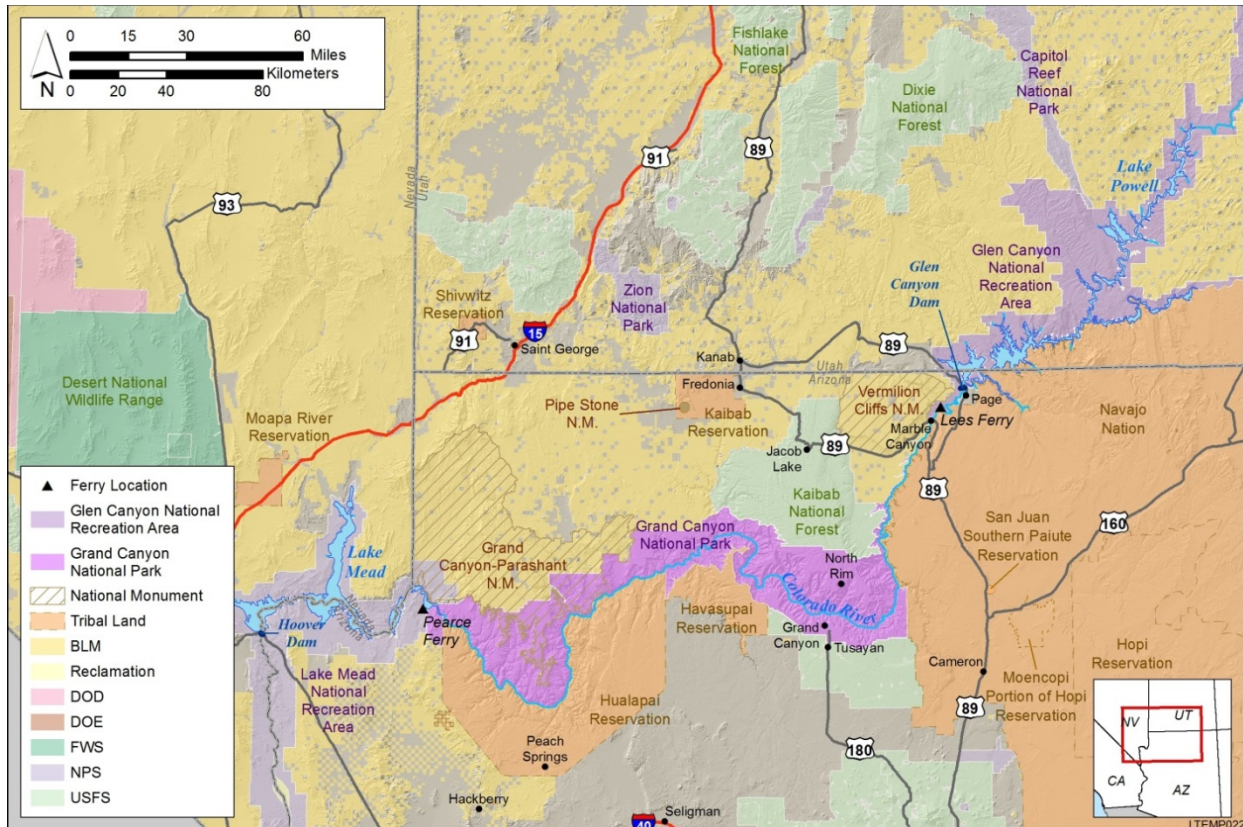
1 The LTEMP will incorporate information gathered since the 1996 ROD, including status  
2 reports developed in coordination with the GCDAMP and Reclamation and NPS compliance  
3 documents supporting adaptive management efforts for the Glen Canyon Dam. These include,  
4 but are not limited to, the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

10  
11 A previous planning process, called the Long Term Experimental Plan (LTEP) for the  
12 operation of Glen Canyon Dam, commenced in late 2006. In February 2008, the LTEP EIS was  
13 put on hold until the completion of environmental compliance on a 5-year plan of experimental  
14 flows (2008–2012), including a high-flow test completed in March 2008 and yearly fall steady  
15 flows conducted each year in September and October from 2008 to 2012. As stated in the Notice  
16 of Intent (NOI) in the *Federal Register* on July 6, 2011 (DOI 2011b), the LTEMP DEIS  
17 supersedes the LTEP EIS. This LTEMP DEIS draws on the environmental documentation and  
18 updated information developed for the LTEP EIS.

## 19 20 21 **1.1 DESCRIPTION OF THE PROPOSED ACTION**

22  
23 The proposed federal action considered in this DEIS, as described in the 2011 NOI and as  
24 further refined in this DEIS, is the development and implementation of a structured, long-term  
25 experimental and management plan for operations of Glen Canyon Dam. The LTEMP and the  
26 Secretary’s decision would provide a framework for adaptively managing Glen Canyon Dam  
27 operations and other management and experimental actions over the next 20 years consistent  
28 with the GCPA and other provisions of applicable federal law. The LTEMP would determine  
29 specific options for dam operations (including hourly, daily, and monthly release patterns),  
30 non-flow actions, and appropriate experimental and management actions that will meet the  
31 GCPA’s requirements, maintain or improve hydropower production, and minimize impacts on  
32 resources, including those of importance to American Indian Tribes. The locations of Glen  
33 Canyon Dam, Lake Powell, the Colorado River between Lake Powell and Lake Mead, and  
34 adjacent lands are shown in Figure 1-1. Glen Canyon Dam is shown in Figure 1-2.

35  
36 Under the LTEMP, water will continue to be delivered in a manner that is fully consistent  
37 with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the  
38 Water Treaty of 1944 with Mexico, the decree of the Supreme Court in *Arizona v. California*,  
39 and the provisions of the Colorado River Storage Project Act of 1956 (CRSPA) and the Colorado  
40 River Basin Project Act of 1968 that govern allocation, appropriation, development, and  
41 exportation of the waters of the Colorado River Basin, and consistent with applicable  
42 determinations of annual water release volumes from Glen Canyon Dam made pursuant to the  
43 Long-Range Operating Criteria for (LROC) Colorado River Basin Reservoirs, which are  
44 currently implemented through the 2007 Interim Guidelines for Lower Basin Shortages and  
45 Coordinated Operations for Lake Powell and Lake Mead. This LTEMP DEIS analyzes  
46 alternative-specific ways to manage monthly, daily, and hourly releases from Glen Canyon Dam.



1

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

6

7

8

## 1.2 PURPOSE OF AND NEED FOR ACTION

9

10

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.

13

14

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.

19

20

21

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*

24



1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

**FIGURE 1-2 Glen Canyon Dam**

*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 eliminated from further consideration, as described in Chapter 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

1 beaches and associated backwater and riparian habitats (Melis et al. 2011).  
2 This LTEMP DEIS uses current comprehensive scientific data and modeling  
3 to consider possible improvements related to the use of high-flow experiments  
4 (HFEs), as well as possible intervening flow operations that may help better  
5 achieve the goal of retaining sand bars.  
6

- 7 • *Humpback chub*. Since the 1995 EIS, the status of the humpback chub  
8 (*Gila cypha*), listed as an endangered species, has continued to be an issue of  
9 concern since the population in Grand Canyon, the largest in existence,  
10 declined during the late 1990s, coincident with higher flow volumes, cooler  
11 water temperatures, and high nonnative trout abundance, but has since  
12 partially rebounded over the last decade when water temperatures were  
13 warmer and trout abundance lower (Yackulic et al. 2014; Yard et al.  
14 2011). Uncertainty in future humpback chub population response to  
15 interactions among flows, nonnative trout, food base, and water temperatures  
16 remains. This DEIS explicitly examines the scientific uncertainties related to  
17 the relationships among trout, temperature, and the humpback chub  
18 population and considers both flow (e.g., trout management flows) and  
19 non-flow options (e.g., mechanical removal) and adaptive and experimental  
20 actions to improve the status of humpback chub.  
21
- 22 • *Rainbow trout fishery*. Rainbow trout (*Oncorhynchus mykiss*) are the basis of  
23 the recreational fishery at Lees Ferry. Since 1964, the tailwaters of Glen  
24 Canyon Dam have supported a recreational rainbow trout fishery that has  
25 grown in importance and reputation locally, regionally, nationally, and  
26 internationally. Anglers from around the world travel to Lees Ferry to fish for  
27 high-quality rainbow trout. This blue-ribbon recreational sport fishery has  
28 become a financial and economic mainstay for the community of Marble  
29 Canyon, the City of Page, and Coconino County, as well as contributing to the  
30 statewide economy. The existence of this fishery is due primarily to the  
31 operations of Glen Canyon Dam and the aquatic productivity and food base  
32 that its operations support. This DEIS evaluates the effects of flow and non-  
33 flow actions of LTEMP alternatives on the Glen Canyon trout fishery.  
34
- 35 • *Other native and nonnative fish*. In addition to humpback chub, the razorback  
36 sucker (*Xyrauchen texanus*), also listed as endangered, and three other native  
37 fish still occur in the Colorado River below Glen Canyon Dam. Razorback  
38 sucker were thought to be extirpated from the Grand Canyon but have recently  
39 been found in western Grand Canyon. Populations of bluehead and  
40 flannelmouth suckers have fluctuated since the 1995 EIS. Numerous  
41 nonnative fish species are also found in the Colorado River and tributaries,  
42 and are numerically dominated by rainbow trout above the Little Colorado  
43 River. Brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*),  
44 common carp (*Cyprinus carpio*), and other species occur in many locations in  
45 lower numbers. There is concern that the nonnative fish compete with or prey  
46 upon the native or endangered fish to varying degrees. The effects of dam

1 operations were examined in the 1995 EIS, and much additional information  
2 has been accumulated about the effects of dam operations on native and  
3 nonnative fish. This DEIS applies the best available science and modeling  
4 methods to further consider the impacts of a variety of dam operations and  
5 non-flow actions on native and nonnative fish and determine what future  
6 experimentation is needed regarding these flow regimes to reduce the negative  
7 interactions of nonnative fish with native fish.  
8

- 9 • *Cultural resources.* Cultural resources occur along the river corridor  
10 downstream from Glen Canyon Dam in Glen, Marble, and Grand Canyons.  
11 These resources are found both within the area directly affected by river flows  
12 as well as on elevated terraces that have not been inundated by flows since  
13 construction of the dam. Research conducted since the 1995 EIS on the  
14 relationship between sand deposits and wind processes continues to provide  
15 data that suggest that windblown sand changes the surface of some sites of  
16 archaeological and cultural concern where sand supply and wind are active  
17 agents (Draut and Rubin 2008; Draut 2012; Sankey and Draut 2014).  
18 Additional research downstream from the dam is examining the relationship  
19 between dam operations and ongoing erosion in areas of limited sand supply  
20 (Collins et al. 2014). This LTEMP DEIS reexamines these relationships in  
21 light of the most recent scientific studies.  
22
- 23 • *Riparian vegetation.* Vegetation along the river corridor is affected by the  
24 magnitude and seasonal pattern of river flows. Vegetation studies conducted  
25 since 1995 indicate that riparian vegetation composition, structure,  
26 distribution, and function are closely tied to ongoing dam operations. This  
27 DEIS considers approaches to protecting, mitigating, and improving  
28 vegetation in Glen and Grand Canyons.  
29
- 30 • *Hydropower.* Power generated by Glen Canyon Dam serves 5.8 million retail  
31 customers in Arizona, Colorado, Nebraska, Nevada, New Mexico, Utah, and  
32 Wyoming. Since 1995, new modeling tools have been created to better  
33 analyze dam operations for hydropower and the impacts of altering operations  
34 on electrical generation and capacity. This LTEMP DEIS applies peer-  
35 reviewed science and modeling methods to further consider the impacts of a  
36 variety of dam operations on power generation and capacity, and considers  
37 operations that can minimize impacts on or improve hydropower and the  
38 Basin Fund while striving to protect and improve other downstream resources.  
39

40 Additional concerns related to dam operations were raised by the public at scoping  
41 meetings and in comments submitted during the scoping of the DEIS. Such concerns included  
42 restoration of the downstream Colorado River ecosystem; reestablishment of ecosystem patterns  
43 and processes to their pre-dam range of natural variability; elimination or minimization of further  
44 beach erosion; facilitation of sediment redeposition; in situ maintenance and preservation of the  
45 integrity of cultural and archeological resources; elimination of adverse impacts on native  
46 species and assistance in their recovery; nonnative fish management; assistance in repropagation



1 of the native riparian plant communities; and improving the hydropower resource. Public  
2 scoping is discussed further in Section 1.5.

### 5 **1.3 LEAD AND COOPERATING AGENCIES AND CONSULTING TRIBES**

6  
7 Federal agencies having management objectives include Reclamation, NPS, U.S. Fish  
8 and Wildlife Service (FWS), Bureau of Indian Affairs (BIA), and Western Area Power  
9 Administration (Western).

#### 12 **1.3.1 Lead Agencies**

13  
14 The DOI, through Reclamation and NPS, prepared this LTEMP DEIS with assistance  
15 from Argonne National Laboratory (Argonne). Reclamation is primarily responsible for  
16 operating Glen Canyon Dam. NPS is primarily responsible for conservation of the natural and  
17 cultural resources and visitor experience in GCNP, GCNRA, and Lake Mead National  
18 Recreation Area (LMNRA). Reclamation and NPS are joint-lead agencies in this process and  
19 have cooperated on all aspects of the production of this LTEMP DEIS, including the overall  
20 NEPA/EIS process, communication and consultation with Cooperating Agencies and other  
21 stakeholders, and project schedule.

#### 24 **1.3.2 Cooperating Agencies and Consulting Tribes**

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

29  
30 In addition, 43 Tribes were formally invited to enter into government-to-government  
31 consultation. In accordance with the requirements identified in Executive Order (E.O.) 13175,  
32 “Consultation and Coordination with Indian Tribal Governments” (U.S. President 2000); the  
33 President’s memorandum of April 29, 1994, “Government-to-Government Relations with Native  
34 American Tribal Governments” (U.S. President 1994a); “Department of the Interior Policy on  
35 Consultation with Indian Tribes;” the President’s memorandum of November 5, 2009, “Tribal  
36 Consultation” (U.S. President 2009); agency-specific guidance on Tribal interactions; and  
37 applicable natural and cultural resource laws and regulations (e.g., NEPA, ESA, National  
38 Historic Preservation Act [NHPA], and Migratory Bird Treaty Act); Reclamation and NPS  
39 coordinate and consult with federally recognized Tribes whose interests might be affected by  
40 activities being considered in the LTEMP DEIS. Regular meetings have been held with Tribes  
41 who indicated an interest in consultation in the LTEMP DEIS development process.

42  
43 The Cooperating Agencies include three federal entities (BIA, FWS, and Western), three  
44 state agencies (Arizona Game and Fish Department, Colorado River Board of California, and the  
45 Colorado River Commission of Nevada), the Upper Colorado River Commission, two public  
46 utilities (Salt River Project and Utah Associated Municipal Power Systems), and six Tribes

1 (the Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians, Navajo  
2 Nation, and the Pueblo of Zuni). Two additional Tribes—the Fort Mojave Indian Tribe and the  
3 Gila River Indian Community—accepted the invitation to participate as consulting parties. Nine  
4 others—the Pueblo of Santa Ana, the Fort Yuma Quechan, the Pueblo of Nambe, the Pueblo of  
5 Santa Clara, the Pueblo of Zia, the Southern Ute Indian Tribe, the Ute Mountain Ute Indian  
6 Tribe, the Paiute Indian Tribe of Utah, and Yavapai-Apache Nation—preferred to be on the  
7 mailing list and kept informed regarding the LTEMP DEIS.  
8  
9

#### 10 **1.4 OBJECTIVES AND RESOURCE GOALS OF THE LTEMP**

11

12 The DOI has identified several primary objectives of operating Glen Canyon Dam under  
13 the LTEMP, as well as more specific goals to improve resources within the Colorado River  
14 Ecosystem<sup>2</sup> through experimental and management actions. These objectives and resource goals  
15 were considered in the formulation and development of alternatives in this DEIS.  
16

17 The following is a list of the objectives of the LTEMP:  
18

- 19 • Develop an operating plan for Glen Canyon Dam in accordance with the  
20 GCPA to protect, mitigate adverse impacts on, and improve the values for  
21 which GCNP and GCNRA were established, including, but not limited to,  
22 natural and cultural resources and visitor use, and to do so in such a manner as  
23 is fully consistent with and subject to the Colorado River Compact, the Upper  
24 Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the  
25 decree of the U.S. Supreme Court in *Arizona v. California*, and the provisions  
26 of CRSPA and the Colorado River Basin Project Act of 1968 that govern the  
27 allocation, appropriation, development, and exportation of the waters of the  
28 Colorado River Basin (see Section 1.9.4) and in conformance with the Criteria  
29 for Coordinated Long-Range Operations of Colorado River Reservoirs as  
30 currently implemented by the 2007 Interim Guidelines for Lower Basin  
31 Shortages and Coordinated Operations for Lake Powell and Lake Mead.  
32
- 33 • Ensure water delivery to the communities and agriculture that depend on  
34 Colorado River water consistent with applicable determinations of annual  
35 water release volumes from Glen Canyon Dam made pursuant to the LROC  
36 for Colorado River Basin Reservoirs, which are currently implemented  
37 through the 2007 Interim Guidelines for Lower Basin Shortages and  
38 Coordinated Operations for Lake Powell and Lake Mead.  
39

---

<sup>2</sup> 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).

- 1 • Consider potential future modifications to Glen Canyon Dam operations and  
2 other flow and non-flow actions to protect and improve downstream  
3 resources.
- 4
- 5 • Maintain or increase Glen Canyon Dam electric energy generation, load  
6 following capability, and ramp rate capability, and minimize emissions and  
7 costs to the greatest extent practicable, consistent with improvement and long-  
8 term sustainability of downstream resources.
- 9
- 10 • Respect the interests and perspectives of American Indian Tribes.
- 11
- 12 • Make use of the latest relevant scientific studies, especially those conducted  
13 since 1996.
- 14
- 15 • Determine the appropriate experimental framework that allows for a range of  
16 programs and actions, including ongoing and necessary research, monitoring,  
17 studies, and management actions in keeping with the adaptive management  
18 process.
- 19
- 20 • Identify the need for a Recovery Implementation Program for endangered fish  
21 species below Glen Canyon Dam.
- 22
- 23 • Ensure Glen Canyon Dam operations are consistent with the GCPA, ESA,  
24 NHPA, CRSPA, and other applicable federal laws.
- 25

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

- 29
- 30 1. *Archaeological and Cultural Resources*. Maintain the integrity of potentially  
31 affected NRHP-eligible or listed historic properties in place, where possible,  
32 with preservation methods employed on a site-specific basis.
- 33
- 34 2. *Natural Processes*. Restore, to the extent practicable, ecological patterns and  
35 processes within their range of natural variability, including the natural  
36 abundance, diversity, and genetic and ecological integrity of the plant and  
37 animal species native to those ecosystems.
- 38
- 39 3. *Humpback Chub*. Meet humpback chub recovery goals, including maintaining  
40 a self-sustaining population, spawning habitat, and aggregations in the  
41 humpback chub's natural range in the Colorado River and its tributaries below  
42 the Glen Canyon Dam.
- 43
- 44 4. *Hydropower and Energy*. Maintain or increase Glen Canyon Dam electric  
45 energy generation, load following capability, and ramp rate capability, and

- 1 minimize emissions and costs to the greatest extent practicable, consistent  
2 with improvement and long-term sustainability of downstream resources.  
3  
4 5. *Other Native Fish*. Maintain self-sustaining native fish species populations  
5 and their habitats in their natural ranges on the Colorado River and its  
6 tributaries.  
7  
8 6. *Recreational Experience*. Maintain and improve the quality of recreational  
9 experiences for the users of the Colorado River ecosystem. Recreation  
10 includes, but is not limited to, flatwater and whitewater boating, river corridor  
11 camping, and angling in Glen Canyon.  
12  
13 7. *Sediment*. Increase and retain fine sediment volume, area, and distribution in  
14 the Glen, Marble, and Grand Canyon reaches above the elevation of the  
15 average base flow for ecological, cultural, and recreational purposes.  
16  
17 8. *Tribal Resources*. Maintain the diverse values and resources of traditionally  
18 associated Tribes along the Colorado River corridor through Glen, Marble,  
19 and Grand Canyons.  
20  
21 9. *Rainbow Trout Fishery*. Achieve a healthy high-quality recreational rainbow  
22 trout fishery in GCNRA and reduce or eliminate downstream trout migration  
23 consistent with NPS fish management and ESA compliance.  
24  
25 10. *Nonnative Invasive Species*. Minimize or reduce the presence and expansion  
26 of aquatic nonnative invasive species.  
27  
28 11. *Riparian Vegetation*. Maintain native vegetation and wildlife habitat, in  
29 various stages of maturity, such that they are diverse, healthy, productive,  
30 self-sustaining, and ecologically appropriate.  
31

32 In addition, the LTEMP was developed to ensure that water delivery continues in a  
33 manner that is fully consistent with and subject to the Colorado River Compact, the Upper  
34 Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the  
35 Supreme Court in *Arizona v. California*, and the provisions of CRSPA and the Colorado River  
36 Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of  
37 the waters of the Colorado River Basin, and consistent with applicable determinations of annual  
38 water release volumes from Glen Canyon Dam made pursuant to the LROC for Colorado River  
39 Basin Reservoirs, which are currently implemented through the 2007 Interim Guidelines for  
40 Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead.  
41  
42

### 43 **1.5 SCOPE OF THE DEIS**

44

45 On December 10, 2009, then Secretary of the Interior Ken Salazar announced the need to  
46 develop the LTEMP for Glen Canyon Dam. The Secretary emphasized the inclusion of

1 stakeholders, particularly those in the GCDAMP, in the development of the LTEMP. This  
2 decision triggered the NEPA process and the need to conduct public scoping in preparation of  
3 this LTEMP DEIS.

4  
5 The *Federal Register* NOI to prepare an EIS and hold public scoping meetings was  
6 published on July 6, 2011, which marked the beginning of the public comment period. The  
7 scoping comment period ended January 31, 2012. A total of six public meetings and one web-  
8 based meeting were held in Arizona, Colorado, Nevada, and Utah in November 2011. A total of  
9 447 individuals, groups, or organizations submitted scoping comments. Results of the public  
10 scoping process are described in the Scoping Summary Report (Reclamation and NPS 2012).

11  
12 The affected geographic region and resources of interest and the primary issues of  
13 concern to the public identified in scoping are summarized in the following sections. These  
14 inputs were used by the lead agencies to formulate a suite of alternative actions that could meet  
15 the purpose and need of the proposed action and to guide the comparative analysis of impacts of  
16 the alternatives in this DEIS. The alternatives are described in Chapter 2.

17  
18 The annual amount of water released under the LTEMP will be determined by the 2007  
19 Interim Guidelines until 2026; the guidelines for determining annual releases after that date will  
20 be determined under a separate process that, pursuant to the terms of the 2007 Guidelines, is  
21 anticipated to begin in 2020 and be subject to public review. This LTEMP DEIS evaluates the  
22 effects on resources from the management of monthly, hourly, and daily releases from Glen  
23 Canyon Dam under various alternatives.

### 24 25 26 **1.5.1 Affected Region and Resources**

27  
28 In general, the region examined in this DEIS includes the area potentially affected by  
29 implementation of the LTEMP (normal and experimental operations of Glen Canyon Dam and  
30 non-flow actions). This area includes Lake Powell, Glen Canyon Dam, and the river downstream  
31 to Lake Mead. More specifically, the scope primarily encompasses the Colorado River  
32 Ecosystem, which includes the Colorado River mainstream corridor and interacting resources in  
33 associated riparian and terrace zones, located primarily from the forebay of Glen Canyon Dam to  
34 the western boundary of GCNP. It includes the area where dam operations impact physical,  
35 biological, recreational, cultural, and other resources. Portions of GCNRA, GCNP, and LMNRA  
36 are included within this area. For certain resources, such as socioeconomics, air quality, and  
37 hydropower, the affected region was larger and included areas potentially affected by indirect  
38 impacts of the LTEMP. The potentially affected regions for these resources are specifically  
39 identified in Chapters 3 and 4. Figure 1-1 portrays the project area in context with the geographic  
40 regions of northern Arizona, southwestern Utah, and southern Nevada.

41  
42 The primary resources that could be impacted by the proposed action include sediment  
43 resources, aquatic and terrestrial ecological resources, historic and cultural resources, resources  
44 of importance to American Indian Tribes, recreational resources, and wilderness in the vicinity  
45 of the Glen and Grand Canyons, as well as socioeconomic resources, hydropower resources, and  
46 air quality.

1 **1.5.2 Impact Topics Selected for Detailed Analysis**  
2

3 Topics for analysis in the DEIS were selected on the basis of public scoping comments,  
4 joint-lead agency guidance, meetings with Tribes and stakeholders, and relevant laws and  
5 regulations. A complete list of issues raised and discussed during scoping is available in the  
6 Scoping Summary Report (Reclamation and NPS 2012). The following topics were analyzed in  
7 the LTEMP DEIS:  
8

- 9 • Water resources, including annual, monthly, and hourly patterns of releases,  
10 water temperature, and water quality;  
11
- 12 • Sediment resources, including sand and sandbars within the active river  
13 channel, and sand that accumulates in the Colorado River delta of Lake Mead;  
14
- 15 • Natural processes that support ecological systems within the Colorado River  
16 Ecosystem;  
17
- 18 • Aquatic resources, including aquatic food base for fishes, nonnative fishes  
19 (warmwater, coolwater, and trout), native fishes (including the endangered  
20 humpback chub and razorback sucker), and aquatic parasites;  
21
- 22 • Riparian vegetation, including Old High Water Zone vegetation, New High  
23 Water Zone vegetation, wetlands, and special status plant species;  
24
- 25 • Wildlife, including terrestrial invertebrates, amphibians and reptiles, birds,  
26 mammals, and special status wildlife species;  
27
- 28 • Cultural resources, including archeological resources, historic and prehistoric  
29 structures, cultural landscapes, traditional cultural properties, and  
30 ethnographic resources important to American Indian Tribes;  
31
- 32 • Tribal resources, including vegetation, wildlife, fish, and wetlands, water  
33 rights, traditional cultural places, traditional knowledge, and continued access  
34 to important resources within Glen and Grand Canyons;  
35
- 36 • Recreation, visitor use, and experience as related to fishing, boating, and  
37 camping activities in the Colorado River and on Lakes Powell and Mead;  
38
- 39 • Wilderness and visitor wilderness experience;  
40
- 41 • Hydropower, including the amount and value of hydropower generation at  
42 Glen Canyon Dam, marketable electrical capacity, capital and operating costs,  
43 and residential electricity bills of electricity customers;  
44
- 45 • Socioeconomics, including recreational use values, nonuse economic value,  
46 employment and income, and environmental justice;

- 1 • Air quality effects related to changes in Glen Canyon Dam operations,  
2 including effects on visibility in the region and air emissions;  
3
- 4 • Climate change, including the effects of Glen Canyon operations on  
5 greenhouse gas emissions and the effects of climate change on future impacts  
6 of Glen Canyon Dam operations; and  
7
- 8 • Cumulative impacts of the effects of the proposed action in combination with  
9 the effects of past, present, and reasonably foreseeable future projects on the  
10 environment.  
11

### 13 1.5.3 Impact Topics Dismissed from Detailed Analysis

14  
15 The following topics suggested during scoping were dismissed from analysis in the  
16 LTEMP DEIS for the reasons stated below:  
17

- 18 • *Extirpated Species*. The reintroduction of extirpated species is beyond the  
19 scope of the LTEMP DEIS, but was addressed for fish within the NPS  
20 Comprehensive Fisheries Management Plan (NPS 2013e).  
21
- 22 • *New Infrastructure, Including Temperature Control Devices (TCDs) and*  
23 *Sediment Augmentation*. New infrastructure was determined to be outside the  
24 scope of the LTEMP DEIS as well as being economically infeasible at this  
25 time. Consideration of new infrastructure would require additional  
26 engineering analyses, separate NEPA assessments (environmental assessment  
27 [EA] or EIS), and potential Congressional authorizations prior to  
28 implementation. Research and monitoring related to sediment deposition,  
29 erosion, and turbidity, as well as temperature effects on fish, are ongoing and  
30 are considered within this plan.  
31
- 32 • *Prime and Unique Agricultural Lands*. The Farmland Protection Act of 1981,  
33 as amended, requires federal agencies to consider adverse effects on prime  
34 and unique farmlands resulting in conversion of these lands to nonagricultural  
35 uses. There are no agricultural lands in GCNP or GCNRA, and proposed  
36 alternatives would not have direct or indirect effects on downstream  
37 agricultural lands. Therefore, this topic is dismissed from further analysis.  
38
- 39 • *Land Use in GCNP and GCNRA*. Land use and development of visitor and  
40 park facilities in GCNP and GCNRA are managed under the NPS Organic  
41 Act, NPS 2006 Management Policies (NPS 2006a), and associated Directors'  
42 Orders, GCNP and GCNRA enabling legislation, the Wilderness Act, and  
43 other such policies and regulations. None of the proposed alternatives would  
44 fundamentally affect land use in GCNP and GCNRA. Therefore, this topic is  
45 dismissed from further consideration.  
46

- *Soundscapes*. For the LTEMP DEIS, 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.



1           The GCDAMP creates a process for monitoring and assessing the effects of current  
2 operations of Glen Canyon Dam on downstream resources and using the results to develop  
3 recommendations for modifying operating criteria and other resource management actions. The  
4 GCDAMP includes the AMWG, a federal advisory committee that is appointed by the Secretary.  
5 The AMWG consists of stakeholders, including federal and state resource management agencies;  
6 representatives of the seven basin states; American Indian Tribes; contractors for the purchase of  
7 federal hydroelectric power; environmental and conservation organizations; recreational; and  
8 other interest groups. The AMWG recommends suitable monitoring and research programs and  
9 may make other recommendations to the Secretary as well. The Technical Working Group  
10 (TWG) was also proposed in the 1995 EIS and was established to serve as a technical  
11 subcommittee to the AMWG. The GCMRC serves as the research branch of the GCDAMP,  
12 under the authority of the USGS. Monitoring and research conducted by GCMRC and others  
13 since 1996 have improved the understanding of riverine geomorphology and how dam operations  
14 can assist in the conservation of natural and cultural resources below the dam. The GCDAMP  
15 also includes an external and independent scientific review panel, the science advisors, who  
16 serve to peer review research and monitoring programs of the GCDAMP.  
17  
18

### 19 **1.6.2 Relationship of Adaptive Management to NEPA and Changes to Operations**

20

21           The 1995 EIS (Reclamation 1995) described adaptive management as the process  
22 “whereby the effects of dam operations on downstream resources would be assessed and the  
23 results of those resource assessments would form the basis for future modifications of dam  
24 operations.” In describing the commitment to adaptive management in the 1996 ROD  
25 (Reclamation 1996), the Secretary specified that “any operational changes will be carried out in  
26 compliance with NEPA.” In the 2011 NOI (DOI 2011b) that announced the LTEMP process, the  
27 DOI specified that a NEPA process would be used to document and evaluate impacts of the  
28 alternatives. By articulating and planning for critical uncertainties (Sections 1.7 and 2.1, and  
29 Appendix C) upfront, the LTEMP DEIS puts forth an adaptive management plan for the next  
30 20 years that is flexible and should allow the experimental, operational, and management  
31 changes specified in the LTEMP to proceed without additional NEPA analysis.  
32

33           The LTEMP uses an adaptive and experimental framework to refine existing information  
34 regarding the effects of dam operations and management actions on affected resources.  
35 Information gathered through the adaptive and experimental process may be used to adjust  
36 operations within the range of the impacts analyzed in this DEIS.  
37  
38

## 39 **1.7 ROLE OF DECISION ANALYSIS IN THE DEIS PROCESS**

40

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

1 While structured decision analysis informed the analysis of the joint leads, it was not the  
2 only method by which a preferred alternative is selected. The selection of a preferred alternative  
3 was based on the full DEIS analysis and considerations relating to qualitative and quantitative  
4 evaluations of impacts. Public comment, socioeconomic considerations, AMWG stakeholder  
5 input, and other factors were all considered in this decision.  
6

7 The joint-lead agencies partnered with the USGS Patuxent Wildlife Research Center to  
8 incorporate formal decision-analysis tools in the LTEMP DEIS. Decision-analysis tools are used  
9 to help formally parse out complex problems into manageable pieces, while keeping track of  
10 multiple objectives (Gregory and Keeney 2002). Appendix C further describes the decision-  
11 analysis tools and methodology as related to the LTEMP DEIS.  
12

13 The joint-lead agencies, other DOI agencies, including the BIA, FWS, and USGS, and  
14 Argonne technical staff developed performance metrics to evaluate achievement of the resource  
15 goals, identified critical uncertainties, and evaluated a preliminary and final set of alternatives in  
16 a process that incorporated decision-analysis tools. Performance metrics provide a quantitative,  
17 transparent, and objective method to assess the performance of the alternatives against each of  
18 the resource goals. Input from some Cooperating Agencies, Tribes, and other stakeholders was  
19 used to prepare a final set of performance metrics used in the LTEMP DEIS analysis. Six of the  
20 seven Basin States and some of the tribes and other stakeholders elected not to participate in this  
21 process for various reasons. The resulting performance metrics are presented in Appendix B.  
22

23 Participating stakeholders ranked and weighted the importance of each performance  
24 metric according to their preferences for the value of the metric to swing from its lowest to its  
25 highest value, representing the range of effects on resources measured by the metric. This  
26 process is referred to as “swing-weighting.” The results of swing weighting under structured  
27 decision analysis are included in the analysis of alternatives in Chapter 4 and are discussed in  
28 further detail in Appendix C.  
29

30 While the decision analysis process helped inform the analysis of the joint-lead agencies,  
31 it was not used as the method by which a preferred alternative was selected or the only method  
32 by which the environmental impacts were fully analyzed. The determination of the preferred  
33 alternative was based on the analyses presented in this DEIS. Furthermore, public comment,  
34 socioeconomic considerations, AMWG stakeholder input, and other factors were considered in  
35 the preparation of this DEIS.  
36  
37

## 38 **1.8 HISTORY, LOCATION, AND SETTING**

### 39 **1.8.1 History and Purpose of Glen Canyon Dam**

40  
41  
42  
43 Glen Canyon Dam, pictured in Figure 1-2, was authorized by CRSPA and completed by  
44 Reclamation in 1963 (DOI 2011b). Glen Canyon Dam is the second highest concrete-arch dam  
45 in the United States (exceeded only by the Hoover Dam) and rises 710 ft above bedrock within  
46 the steep sandstone walls of Glen Canyon. It was constructed to harness the potential of the

1 Colorado River to provide for the water and power needs of millions of people  
2 (Reclamation 2008a).

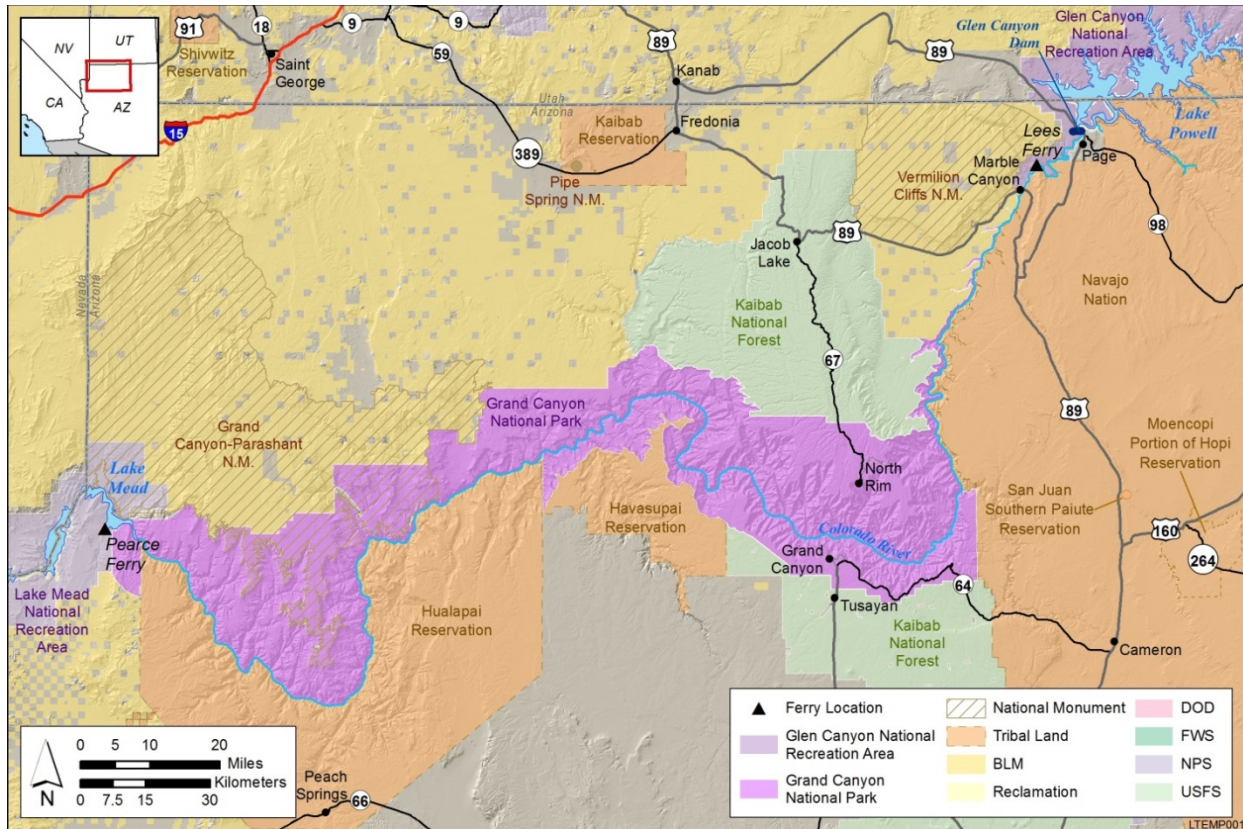
3  
4 The CRSPA was enacted for “the comprehensive development of the water resources of  
5 the Upper Colorado River Basin, for the purposes, among others, of regulating the flow of the  
6 Colorado River, storing water for beneficial consumptive use, making it possible for the States of  
7 the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the  
8 apportionments made to and among them in the Colorado River Compact and the Upper  
9 Colorado River Basin Compact, respectively, providing for the reclamation of arid and semiarid  
10 land, for the control of floods, and for the generation of hydroelectric power, as an incident of the  
11 foregoing purposes.” The Glen Canyon Dam is specifically managed to regulate the release of  
12 water that allows the Upper Colorado River Basin states of Utah, Colorado, Wyoming, and  
13 New Mexico to use their share of the Colorado River, especially during times of drought, while  
14 also providing the required delivery of water to the Lower Colorado River Basin states of  
15 California, Nevada, and Arizona, as required by the Colorado River Compact of 1922 and  
16 subsequent water delivery commitments (DOI 2011b). There is more than 26 million acre-feet  
17 (maf) of water storage capacity in Lake Powell, created by Glen Canyon Dam. This stored water  
18 has made it possible to successfully weather extended dry periods by sustaining the needs of  
19 cities, industries, and agriculture throughout the West (Reclamation 2008a).

20  
21 As identified under the CRSPA, another authorized purpose of Glen Canyon Dam is to  
22 generate hydroelectric power, which is a clean, renewable, and reliable energy source  
23 (DOI 2011b). The hydroelectric power is marketed and delivered by Western to municipalities,  
24 rural electric cooperatives, American Indian Tribes, and governmental agencies in Wyoming,  
25 Utah, Colorado, New Mexico, Arizona, and Nevada. The dam’s hydroelectric generators, which  
26 have a total capacity of 1,320 megawatts, produce about 5 billion kilowatt-hours of hydroelectric  
27 power annually to help meet the electrical needs of about 5.8 million customers  
28 (Reclamation 2008a). In addition, revenues from production of hydropower fund operations and  
29 maintenance of CRSP facilities repay costs for participating projects and help fund many  
30 important environmental programs associated with Glen and Grand Canyons  
31 (Reclamation 2008a).

### 32 33 34 **1.8.2 Location of Glen Canyon Dam and LTEMP Affected Area**

35  
36 The location of Glen Canyon Dam is shown in the upper right-hand corner of Figure 1-3,  
37 which shows the LTEMP affected area from Glen Canyon Dam to Lake Mead. Below Glen  
38 Canyon Dam, the Colorado River flows for 15 miles through the GCNRA, which is managed by  
39 the NPS and encompasses more than 1.2 million acres of land in northern Arizona and southern  
40 Utah (DOI 2011b; NPS 2013c).

41  
42 At about 15 mi downstream from the dam, Lees Ferry, Arizona, marks the end of Glen  
43 Canyon and the official division between the upper and lower Colorado River  
44 (Reclamation 2008b, 2011b). Just downstream from Lees Ferry, the confluence of the Paria  
45 River represents the beginning of Marble Canyon and the northern boundary of GCNP. For the



1

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

5

6

7

next 277 mi, the Colorado River flows through the GCNP to Pearce Ferry, which marks the  
 8 upper reaches of Lake Mead. Lake Mead extends from Pearce Ferry to Hoover Dam.

9

10

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

17

18

### 19 **1.8.3 Operation of the Glen Canyon Dam**

20

Glen Canyon Dam currently operates under the Modified Low Fluctuating Flow (MLFF)  
 21 regime in conjunction with an adaptive management program outlined in the 1996 ROD for the  
 22 1995 EIS (Reclamation 1996). Dam releases practiced under MLFF are presented in Table 1-1.  
 23

24

1  
2

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

Parameter	Value	Conditions
<i>Flow</i>		
Maximum <sup>a</sup>	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<sup>b</sup></i>	5,000 to 8,000 cfs	

<sup>a</sup> May be exceeded for emergencies and during extreme hydrological conditions.

<sup>b</sup> 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.

3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17

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.

18  
19  
20  
21  
22  
23

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. Guidelines for annual operations are contained in the LROC and 2007 Interim Guidelines as determined by the Secretary, with participation by the Basin States.

24  
25  
26  
27  
28

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.

1 The powerplant can release a maximum of about 33,200 cfs of water. Maximum  
2 discharges are less when the reservoir is less than full, while MLFF limits maximum flows to  
3 25,000 cfs under normal circumstances.  
4

5 River outlet works are used when there is a need to release more water than can be passed  
6 through the powerplant. River outlet works releases of up to 15,000 cfs are almost always  
7 combined with powerplant releases, with a maximum operational release capacity of about  
8 48,200 cfs.  
9

10 Spillway releases are only used to avoid overtopping of the dam or to lower the level of  
11 Lake Powell based on emergency and safety constraints. Such releases bypass both the  
12 powerplant and the river outlet works. The reservoir elevation at which the spillways could be  
13 accessed is 3,700 ft. The combined capacity of the right and left spillways is 208,000 cfs.  
14 Spillway releases are avoided whenever possible; the combined release capacity of all three  
15 means of release is about 256,000 cfs.  
16  
17

#### 18 **1.8.4 History, Purpose, and Significance of the National Park System Units**

19

20 The overarching purpose of the National Park System, as set forth in the NPS's Organic  
21 Act, "is to conserve the scenery, natural and historic objects, and wild life in the System units  
22 and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such  
23 manner and by such means as will leave them unimpaired for the enjoyment of future  
24 generations" (54 U.S.C. § 100101(a)). Each unit of the National Park System is authorized or  
25 established by an act of Congress or Presidential proclamation (or sometimes both) to conserve  
26 the unit's unique and significant resources. A park's purposes, as described in its enabling  
27 legislation or proclamation, are the foundation on which later management decisions are based to  
28 conserve resources while providing for the enjoyment of future generations. This mission is  
29 further discussed and clarified in *Management Policies 2006* (NPS 2006d). Described below are  
30 the park system units relevant to this project: GCNP, GCNRA, and LMNRA.  
31  
32

##### 33 **1.8.4.1 Grand Canyon National Park**

34

35 GCNP was established as a National Monument in 1908, given National Park status in  
36 1919, and recognized as a World Heritage Site in 1979 (NPS 1995). The park attracts nearly  
37 5 million visitors annually from the United States and around the world. The purpose of the park  
38 "is to be managed to preserve and protect its natural and cultural resources and ecological  
39 processes, as well as its scenic, aesthetic and scientific values; and provide opportunities for  
40 visitors to experience and understand the environmental interrelationships, resources, and values  
41 of the Grand Canyon without impairing the resources" (NPS 1995). Specifically, "the purpose of  
42 Grand Canyon National Park is to preserve and protect Grand Canyon's unique geologic,  
43 paleontologic, and other natural and cultural features for the benefit and enjoyment of the  
44 visiting public; provide the public opportunity to experience Grand Canyon's outstanding natural  
45 and cultural features, including natural quiet and exceptional scenic vistas; and protect and  
46 interpret Grand Canyon's extraordinary scientific and natural values" (NPS 2010a).

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

2  
3 Grand Canyon is one of the planet's most iconic geologic landscapes. During the  
4 last 6 million yr, the Colorado River carved Grand Canyon; these same erosional  
5 and tectonic processes continually shape the canyon today. Grand Canyon's  
6 exposed layers span more than one-third of Earth's history, and record tectonic  
7 and depositional environments ranging from mountain building to quiet seas.  
8 Taken as a whole, Grand Canyon, with its immense size, dramatic and colorful  
9 geologic record exposures, and complex geologic history, is one of our most  
10 scenic and scientifically valued landscapes.

11  
12 The force and flow of the Colorado River along with its numerous and  
13 remarkably unaltered tributaries, springs, and seeps provide plants and animals an  
14 opportunity to flourish in this otherwise arid environment. These vital resources  
15 represent transmission of local aquatic recharge from high-elevation rims to the  
16 arid inner canyon. There are hundreds of known seeps and springs throughout the  
17 park, and probably more to be discovered.

18  
19 Wilderness landscapes are an important current resource and future preserve. Park  
20 boundaries extend beyond canyon walls to include 1,904 sq. miles  
21 (1,218,376 acres) of which 94 percent is managed as wilderness. When combined  
22 with additional contiguous public and Tribal lands, this area comprises one of the  
23 largest U.S. undeveloped areas. Grand Canyon offers outstanding opportunities  
24 for visitor experiences including extended solitude, natural quiet, clean air, dark  
25 skies, and a sense of freedom from the mechanized world's rigors.

26  
27 GCNP is considered one of the finest examples in the world of arid-land erosion  
28 (NPS 1995). The park contains several major ecosystems, from the mixed Mohave Desert scrub  
29 of the lower canyon to the coniferous forests of the North Rim, and serves as an ecological  
30 refuge for relatively undisturbed remnants of dwindling ecosystems (such as boreal forest and  
31 desert riparian communities) and numerous rare, endemic, or specially protected  
32 (threatened/endangered) plant and animal species, including the California condor (NPS 1995,  
33 2013c). The Grand Canyon protects an important cultural history. More than 12,000 years of  
34 human occupation have resulted in an extensive archeological record. The park preserves  
35 thousands of archeological sites, many of which remain unknown.

36  
37 Eleven American Indian Tribes have known ties to the Grand Canyon, and some consider  
38 the canyon their original homeland and place of origin. The 11 federally recognized associated  
39 Tribes are Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians,  
40 Las Vegas Band of Paiute Indians, Moapa Band of Paiute Indians, Navajo Nation, Paiute Indian  
41 Tribe of Utah, San Juan Southern Paiute Tribe, Yavapai-Apache Nation, and Zuni Tribe.

42  
43 The scenic vistas, qualities, and values of GCNP are internationally recognized and  
44 include a variety of landscapes and water features. The Grand Canyon is also known for its  
45 natural quiet and opportunities for solitude. The natural, cultural, and scenic qualities of the

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

#### 3 4 5 **1.8.4.2 Glen Canyon National Recreation Area** 6

7 The GCNRA was established by Congress in 1972 and occupies approximately  
8 1,255,000 ac of northern Arizona and southeastern Utah adjacent to Lake Powell (NPS 1979).  
9 Congress directed NPS to manage the GCNRA so as to provide for public outdoor use and  
10 enjoyment of Lake Powell and lands adjacent thereto in the States of Arizona and Utah and to  
11 preserve scenic, scientific, and historic features contributing to public enjoyment of the area  
12 (Public Law [P.L.] 92-593). In 2012, GCNRA attracted approximately 2 million visitors  
13 (NPS 2014f).  
14

15 The GCNRA ecosystem typifies the Colorado Plateau, supporting habitat for a diverse  
16 range of plants and animals. The region is arid to semi-arid, and the ecosystem is complex and  
17 often fragile (NPS 1979). Several rare and federally listed plant and animal species are found in  
18 the GCNRA: Navajo sedge, Jones cycladenia, the northern leopard frog, Colorado pikeminnow,  
19 humpback chub, and razorback sucker (NPS 2013b).  
20

21 Glen Canyon has been occupied periodically by humans from about 11,500 years ago  
22 through the present (NPS 1979, 2013a). Several different prehistoric cultures and current Native  
23 American groups are represented in the cultural history of Glen Canyon, and the recreation area  
24 occupies a cultural interface zone, where different groups historically came into contact with one  
25 another (NPS 2013a). In the late 1800s, the crossing at Lees Ferry and the Hole-in-the-Rock trail  
26 became important points on the migration route of Mormon settlers moving westward  
27 (NPS 1979).  
28  
29

#### 30 **1.8.4.3 Lake Mead National Recreation Area** 31

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

41 LMNRA offers dramatic scenery and a diverse array of land- and water-based  
42 recreational opportunities in close proximity to several large urban centers of the southwestern  
43 United States. With more than 6 million visitors each year, the park supports some of the  
44 nation's highest levels of water recreational and backcountry use and is an integral component of  
45 the region's economy (NPS 2002c).  
46

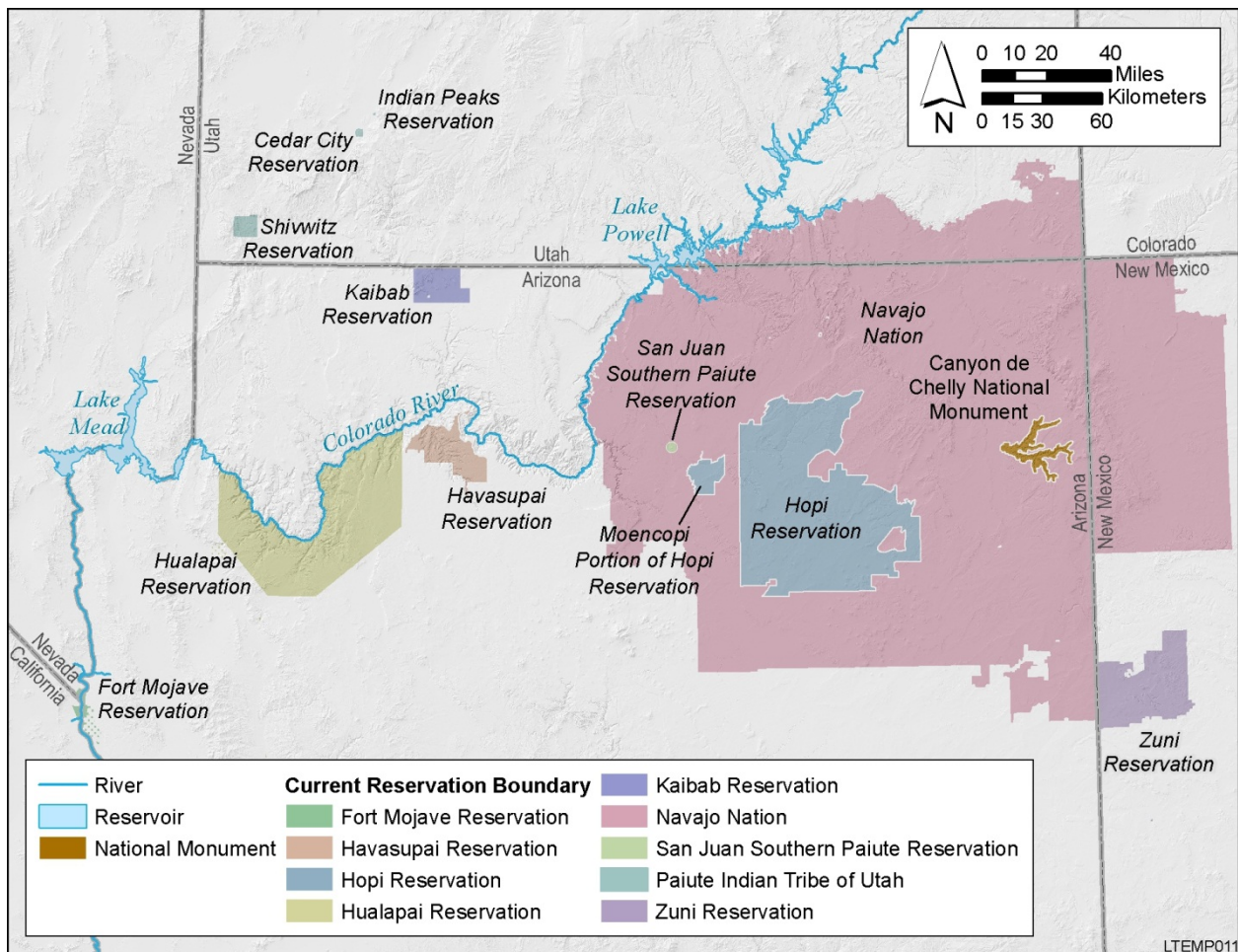


1 Situated in the northeastern Mojave Desert near the interface with the Great Basin Desert  
 2 to the north and the Sonoran Desert to the south, LMNRA preserves a great diversity of  
 3 biological resources, intact habitat, and ecological connectivity in the region, including many  
 4 threatened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

11  
 12  
 13  
 14  
 15  
 16  
 17  
 18

### 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



19  
 20

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

1 these boundaries. The following sections summarize laws, treaties, and traditional use areas of  
2 Tribes with ancestral, spiritual, religious, or economic ties to the project area. Tribal connections  
3 to resources in and around the Colorado River and the canyons are described in Chapter 3.  
4  
5

#### 6 **1.8.5.1 Navajo Nation**

7

8 The Navajo Indian Reservation was established by the Treaty of June 1, 1868  
9 (15 Stat. 667). Between 1868 and 1918 various executive orders added lands to, or removed  
10 lands from, the reservation. The Act of May 25, 1918 (40 Stat. 561, 570), prohibited the creation  
11 of, or any additions to, Indian reservations in New Mexico and Arizona “except by Act of  
12 Congress.” Congress added land to the Navajo Indian Reservation by the Act of May 23, 1930  
13 (46 Stat. 378), amended by the Act of February 21, 1931 (46 Stat. 378), and the Act of March 1,  
14 1933 (47 Stat. 1418). The Act of June 14, 1934 (48 Stat. 960), describes the exterior boundaries  
15 of the 17.6-million-ac reservation in Arizona, subject to various exclusions and conditions set out  
16 in the act.  
17

18 The traditional Navajo homeland, or *Dinétaah*, is bounded by four sacred mountains:  
19 *Siss Naajinii* (Blanca Peak, near Alamosa, Colorado) on the east; *Tsoo Dzil* (Mount Taylor near  
20 Grants, New Mexico) on the south; *Dook’o’oosliid* (San Francisco Peaks near Flagstaff,  
21 Arizona) on the west; and *Dibé Ntsaa* (La Plata Mountains near Durango, Colorado) on the  
22 north. Traditional use areas extend well beyond this boundary (Reclamation 1995).  
23  
24

#### 25 **1.8.5.2 Hualapai**

26

27 The Hualapai Reservation was established by Executive Orders of January 4, 1883;  
28 June 2, 1911; May 29, 1912; and July 18, 1913. The reservation encompasses 992,463 ac just  
29 south of the Colorado River. The reservation borders the river corridor for approximately 108 mi  
30 from approximately river mile (RM) 164.5 to RM 273.5 (NPS 2006b).  
31

32 Hualapai traditional territory is bounded by the Colorado River from the Big Bend near  
33 Hoover Dam-Lake Mead to the Little Colorado River on the north, the San Francisco Peaks on  
34 the east, the Bill Williams and Santa Maria Rivers on the south, and the Colorado River from its  
35 confluence with the Bill Williams River to Lake Mead on the west (Reclamation 1995).  
36  
37

#### 38 **1.8.5.3 Havasupai**

39

40 The Havasupai Indian Reservation was established by the Executive Orders of June 8 and  
41 November 23, 1880, and March 31, 1882, and expanded by the Act of March 4, 1944  
42 (58 Stat. 110), and the Grand Canyon Enlargement Act (88 Stat. 2089, 1975). In 1975, the Grand  
43 Canyon National Park Enlargement Act restored 185,000 ac to the Havasupai Reservation and  
44 identified 95,300 ac of traditional use lands within GCNP that were made available for  
45 traditional Havasupai practices.  
46

1 The Havasupai Reservation consists of 188,077 ac of canyon and plateau along the  
2 western portion of the Grand Canyon's south rim. Additional traditional use lands are located  
3 within GCNP north of the reservation from the plateau to the Colorado River and extend from  
4 approximately RM 116 to RM 165 (Havasupai 2012).  
5

6 The Indian Claims Commission determined in 1968 that as of 1880, the Havasupai Tribe  
7 exclusively occupied, as their original territory, the land on the Coconino Plateau bounded by the  
8 mid-stream of the Colorado River on the north, the Hualapai Reservation on the west, south to  
9 the Trinity Mountain, Mount Floyd and easterly to Sitgreaves Mountain, north to Mount  
10 Kendricks and along the Little Colorado River on the east to the Colorado River.  
11

12 The Grand Canyon Enlargement Act of 1975 replaced a portion of the tribal lands,  
13 permitted the traditional uses of park lands, and placed restrictions on the use of portions of the  
14 Havasupai Reservation within GCNP in order to preserve the scenic and natural values of the  
15 park (16 USC 228i(b)(7)).  
16  
17

#### 18 **1.8.5.4 Southern Paiute Tribes**

19

20 The Southern Paiute Tribes that have ties to the region and who are most directly tied to  
21 the project area include the Kaibab Band of Paiute Indians; the Paiute Indian Tribe of Utah,  
22 which consists of five bands of Southern Paiute (Cedar Band, Indian Peaks Band, Kanosh Band,  
23 Koosharem Band, and Shivwits Band); and the San Juan Southern Paiute. The Kaibab Band of  
24 Paiute Indians and the Paiute Indian Tribe of Utah are also members of the Southern Paiute  
25 Consortium. The Kaibab Band represents the consortium in matters pertaining to Glen Canyon  
26 Dam and Colorado River management.  
27

28 The Kaibab Band of Paiute Indians Reservation was established by the Executive Orders  
29 of June 11, 1913, and July 17, 1917. The reservation is located approximately 50 mi north of the  
30 Grand Canyon. The reservation encompasses approximately 121,000 ac and includes five Tribal  
31 villages and two non-Indian communities (Kaibab Paiute 2013).  
32

33 The Paiute Indian Tribe of Utah Reservation was established on April 3, 1980, by an Act  
34 of Congress (94 Stat. 317, 1980) and consists of 10 separate land parcels located in 4  
35 southwestern Utah counties, covering 33,709 ac (PITU 2013).  
36

37 The San Juan Southern Paiute were given 5,400 ac of land within the Navajo Reservation  
38 boundary when their leaders signed a treaty with the Navajo Nation on May 20, 2000.  
39 Approximately 5,100 ac of this land is located near Tuba City, Arizona, with the remaining  
40 300 ac located just south of Lake Powell (NPS 2013d).  
41

42 The traditional lands of the Southern Paiute people are bounded by more than 600 mi of  
43 the Colorado River, extending from the Kaiparowits Plateau in southern Utah to Blythe,  
44 California (Bullets et al. 2012). These lands extend from the Colorado River northward,  
45 inclusive of the Grand and Glen Canyons, into Beaver County, Utah, and from the Escalante  
46 River drainage on the east within GCNRA to Death Valley on the west, including the Virgin

1 River drainage, the Muddy River drainage, and the area around present-day Las Vegas, Nevada  
2 (ICC 1965).

### 5 **1.8.5.5 Hopi**

6  
7 The original Hopi Reservation was established by the Executive Order of December 16,  
8 1882, as a  $1 \times 1$  degree latitude/longitude rectangular region. Subsequent partitioning of this  
9 original reservation area between the Hopi Tribe and Navajo Nation has resulted in a smaller  
10 reservation area, encompassing about 1.5 million ac in parts of Coconino and Navajo Counties,  
11 Arizona. There are 11 main Hopi villages within the central portion of the Hopi Reservation and  
12 two additional villages located to the west at Moencopi, on a non-contiguous portion of the Hopi  
13 Reservation (Figure 1-4).

14  
15 The Hopi people view their traditional homeland as much larger than the current  
16 reservation. It encompasses an area running from near the confluence of the San Juan and  
17 Colorado Rivers in the north, southwest to the area of the Havasupai Reservation, southward past  
18 Williams and out to the Mogollon Rim in the south, and eastward to the Lupton area on the  
19 Arizona–New Mexico border. Even this area is but a small portion of the lands occupied by the  
20 ancestors of the Hopi people, which include portions of Colorado, Utah, Arizona, and  
21 New Mexico.

### 22 23 24 **1.8.5.6 Pueblo of Zuni**

25  
26 The Zuni Indian Reservation was established by the Executive Orders of March 16, 1877,  
27 May 1, 1883, and March 3, 1885, and was expanded by the Proclamation of November 30, 1917  
28 (40 Stat. 1723); the Congressional Act of June 20, 1935 (49 Stat. 393); the Executive Order of  
29 August 13, 1949; and the Congressional Act of March 16, 1962 (76 Stat. 33). The Pueblo of Zuni  
30 is located approximately 150 mi west of Albuquerque, New Mexico, and encompasses  
31 approximately 450,000 ac (Pueblo of Zuni 2013). In addition to the lands established by  
32 Executive Orders and Presidential proclamation, two additional non-contiguous areas are  
33 included in the Zuni Reservation: the Zuni Salt Lake (1 mi<sup>2</sup>) added in 1978 and Kolhu'wala:wa  
34 (Zuni Heaven) in Arizona consisting of 14 mi<sup>2</sup> added on August 28, 1984.

35  
36 The traditional territory of the Zuni Tribe is bounded by the San Francisco Peaks on the  
37 northwest corner and by portions of the Little Colorado River and Pueblo Colorado Wash on the  
38 far northern boundary. The view of Pueblo of Zuni is that traditional use extends considerably  
39 beyond the traditional territorial boundaries and includes GCNP and GCNRA  
40 (Reclamation 1995; Dongoske 2012). It also should be noted that the Zunis are considered an  
41 Indian Tribe of Arizona.

1           **1.8.5.7 Fort Mojave**  
2

3           The Fort Mojave Indian Reservation was established through the Executive Orders of  
4 December 1, 1910, and February 2, 1911. The reservation is located along the Colorado River,  
5 near Needles, California, and encompasses 42,000 ac covering Mohave County, Arizona; Clark  
6 County, Nevada; and San Bernardino County, California (Fort Mojave Indian Tribe 2012).  
7

8           Traditional Mojave territory encompasses most of the Mojave Desert in the State of  
9 California, from the Whipple Mountains, the Turtle Mountains, the Granite Mountains, the Eagle  
10 Mountains, the Little San Bernardino Mountains, and the San Bernardino Mountains in the  
11 south, west to the San Gabriel and Tehachapi Mountains, north to Granite and Soda Lakes and  
12 the Providence Mountains and Paiute Valley in the State of Nevada, to the Black, Buck, and  
13 Mojave Mountains to the east in the State of Arizona (CSRI 2002 [U.S. Court of Claims 1950-  
14 1960: Docket 283]).  
15  
16

17           **1.9 LAWS AND REGULATIONS RELATED TO OPERATIONS OF GLEN CANYON**  
18           **DAM AND PARK MANAGEMENT**  
19

20           The following lists of laws, regulations, and treaties are presented here to provide context  
21 for the management of the Colorado River because they must be complied with for operation of  
22 Glen Canyon Dam and for park management, and may or may not specifically apply to this  
23 action. Nothing in this DEIS is intended to interpret the authorities listed below.  
24  
25

26           **1.9.1 Environmental Laws and Executive Orders**  
27

- 28           • Bald and Golden Eagle Protection Act of 1940, as amended 1962  
29           (16 USC 668c)
- 30
- 31           • Clean Air Act of 1970 (33 USC 1251 et seq.)  
32
- 33           • Clean Water Act of 1972 (33 USC 1251 et seq.)  
34
- 35           • Endangered Species Act of 1973 (16 USC 1531-1544, 87 Stat. 884)  
36
- 37           • E.O. 11514, “Protection and Enhancement of Environmental Quality,” as  
38           amended by E.O. 11991, “Relating to Protection and Enhancement of  
39           Environmental Quality” (U.S. President 1970)  
40
- 41           • E.O. 11988, “Floodplain Management” (U.S. President 1977a)  
42
- 43           • E.O. 11990, “Protection of Wetlands” (U.S. President 1977b)  
44
- 45           • E.O. 13112, “Invasive Species” (U.S. President 1999)  
46

- 1 • E.O. 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds”  
2 (U.S. President 2001)  
3
- 4 • Fish and Wildlife Coordination Act of 1934 (16 USC 661 et seq.)  
5
- 6 • Migratory Bird Treaty Act of 1918, as amended 2008 (16 USC 703)  
7
- 8 • National Environmental Policy Act of 1969, as amended (42 USC 4321  
9 et seq.)  
10
- 11 • National Park Service Organic Act of 1916 (16 USC 1-4, 22, and 43, as  
12 amended)  
13
- 14 • Redwoods National Park Expansion Act of 1978 (Redwoods Amendment)  
15 (16 USC 1a-1)  
16
- 17 • Wild and Scenic Rivers Act of 1968 (16 USC 1271 et seq.)  
18
- 19 • Wilderness Act of 1964 (16 USC 1131–1136)  
20  
21

### 22 **1.9.2 Cultural/Historical Laws and Executive Orders**

- 23
- 24 • Antiquities Act of 1906 (16 USC 431–433)  
25
- 26 • Archaeological and Historic Preservation Act of 1974 (16 USC 469 et seq.)  
27
- 28 • Archaeological Resources Protection Act of 1979 (16 USC 470 et seq.,  
29 P.L. 96-95)  
30
- 31 • E.O. 11593, “Protection and Enhancement of the Cultural Environment”  
32 (U.S. President 1971)  
33
- 34 • Historic Sites, Buildings, and Antiquities Act of 1935 (16 USC 461 et seq., as  
35 amended by P.L. 89-249)  
36
- 37 • National Historic Preservation Act of 1966 (54 USC 300101 et seq., P.L. 89-  
38 665)  
39  
40

### 41 **1.9.3 American Indian and Tribal Consultation Laws and Executive Orders**

- 42
- 43 • American Indian Religious Freedom Act of 1978 (P.L. 95-431, 92 Stat. 469,  
44 42 USC 1996)  
45
- 46 • E.O. 13007, “Indian Sacred Sites” (U.S. President 1996)  
47

- 1 • E.O. 13175, “Consultation and Coordination with Indian Tribal Governments”  
2 (U.S. President 2000)  
3
- 4 • Native American Graves Protection and Repatriation Act of 1990  
5 (P.L. 101-601, 104 Stat. 3048, 25 USC 3001 et seq.)  
6  
7

#### 8 **1.9.4 Law of the River**

9  
10 The treaties, compacts, decrees, statutes, regulations, contracts, and other legal  
11 documents and agreements applicable to the allocation, appropriation, development, exportation,  
12 and management of the waters of the Colorado River Basin are often referred to as the Law of  
13 the River. There is no single, universally agreed upon definition of the Law of the River, but it is  
14 useful as a shorthand reference to describe this longstanding and complex body of legal  
15 agreements governing the Colorado River. Documents generally considered to be part of the Law  
16 of the River include those listed in Table 1-2.  
17  
18

### 19 **1.10 RELATED ACTIONS**

20  
21 Numerous ongoing and completed plans, policies, actions, and initiatives are related to  
22 the operation of the Glen Canyon Dam and Colorado River with respect to the proposed federal  
23 action analyzed in this DEIS. Reclamation and NPS have identified documents that would assist  
24 the reader in understanding the issues analyzed in this process and underscore the importance of  
25 collaboration among agency and stakeholder participants.  
26  
27

#### 28 **1.10.1 Biological Opinions**

- 29  
30 • Final Biological Opinion for the Proposed Adoption of Colorado River  
31 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for  
32 Lake Powell and Lake Mead (FWS 2007a).  
33
- 34 • Final Biological Opinion on the Operation of Glen Canyon Dam, including  
35 High-Flow Experiments and Nonnative Fish Control (FWS 2011c). This  
36 replaced former Biological Opinions from 1995 to 2009.  
37
- 38 • Final Biological Opinion on the Comprehensive Fisheries Management Plan,  
39 Coconino and Mohave Counties, Arizona (FWS 2013a).  
40  
41

#### 42 **1.10.2 Environmental Impact Statements and Related Documents**

43  
44 **Operation of Glen Canyon Dam: Environmental Impact Statement and Record of**  
45 **Decision (Reclamation 1996).** As discussed in the Introduction, Glen Canyon Dam currently  
46 operates under provisions of the EIS completed in 1995 (Reclamation 1995). The Secretary

1 **TABLE 1-2 Selected Documents Included in the Law of the River<sup>a</sup>**

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)
(1927–1946)	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)		

<sup>a</sup> Years in italics indicate amendments or related actions.

Source: Reclamation (2007b).



1 accepted the recommendation of the 1995 EIS and signed the 1996 ROD (Reclamation 1996)  
2 that selected MLFF as the operating system for the dam. The flow parameters of MLFF are  
3 presented in Section 1.8.3 of this DEIS.  
4

5 A component of the final Glen Canyon Dam EIS (Reclamation 1995) and the  
6 environmental commitments identified in the 1996 ROD (Reclamation 1996) was the  
7 implementation of a Programmatic Agreement regarding operations of the Glen Canyon Dam.  
8 This agreement, along with subsequent monitoring and remedial action plans and the 2007  
9 Comprehensive Treatment Plan, set a strategy for long-term management of archaeological sites  
10 affected by the operations of Glen Canyon Dam. In addition, separate, action-specific  
11 Memoranda of Agreement were established among the signatories to the agreements, primarily  
12 Reclamation, NPS, Arizona State Historic Preservation Office, and affiliated Tribes for actions  
13 related to the High Flow Experimental Protocol EA (Reclamation 2011b) and the Nonnative Fish  
14 Control EA (Reclamation 2011a).  
15

16 **Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated**  
17 **Operations for Lake Powell and Lake Mead (Reclamation 2007b).** In 2005, spurred by a  
18 multi-year drought, decreasing system storage, and growing demands for Colorado River water,  
19 the Secretary directed Reclamation to develop additional strategies for improving the  
20 coordinated management of the reservoirs of the Colorado River system. In response,  
21 Reclamation began to develop and adopt interim operational guidelines that would address the  
22 operation of Lake Powell and Lake Mead during drought and low-reservoir conditions. Adopted  
23 in 2007, these Interim Guidelines would be used each year (through 2025 for water supply  
24 determinations and through 2026 for reservoir operating decisions) in implementing the LROC  
25 for the Colorado River reservoirs pursuant to the 1968 Colorado River Basin Project Act. This  
26 ROD did not modify the authority of the Secretary to determine monthly, daily, hourly, or  
27 instantaneous releases from Glen Canyon Dam.  
28

29 The completed Interim Guidelines determine the availability of Colorado River water for  
30 use in the Lower Basin, on the basis of Lake Mead's water surface elevation, as a way to  
31 conserve reservoir storage and provide water users and managers with greater certainty regarding  
32 the reduction of water deliveries during drought and other low-reservoir conditions. The Interim  
33 Guidelines also proposed a coordinated operation plan for Lake Powell and Lake Mead, basing  
34 releases and conserved amounts on predetermined levels in both reservoirs, which would  
35 minimize shortages in the Lower Basin and decrease the risk of curtailments in the Upper Basin.  
36 In addition, the Interim Guidelines established a mechanism for storing and delivering conserved  
37 water from Lake Mead, referred to as Intentionally Created Surplus, intended to minimize the  
38 severity and likelihood of potential future shortages.  
39

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

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

10  
11           **General Management Plan for Grand Canyon National Park (NPS 1995).** This plan  
12 guides the management of resources, visitor use, and general development at the park over a  
13 10- to 15-year period. The primary purpose of the plan is to provide a foundation from which to  
14 protect park resources while providing for meaningful visitor experiences. A secondary purpose  
15 is to encourage compatible activities on adjacent lands so as to minimize adverse effects on the  
16 park.

17  
18           **Backcountry Management Plan, Grand Canyon National Park, Arizona (NPS 1988).**  
19 This plan defines the primary policies that manage visitor use and resource protection for the  
20 undeveloped areas of GCNP. GCNP has started work on a Backcountry Management Plan and  
21 EIS. The park’s existing Backcountry Management Plan is being updated to comply with current  
22 NPS laws and policies and the park’s 1995 General Management Plan. Once completed, the  
23 revised Backcountry Management Plan will guide management decisions regarding the park’s  
24 backcountry and wilderness resources into the future.

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

33  
34           **Glen Canyon National Recreation Area General Management Plan—Final**  
35 **Environmental Impact Statement (NPS 1979).** This plan and wilderness recommendation lays  
36 out proposals for meeting four levels of management objectives for GCNRA, ranging from  
37 general to specific. The first-level objective is to manage GCNRA to maximize its recreational  
38 enjoyment. Objective levels 2 through 4 address increasingly specific objectives, including those  
39 for cultural, Tribal, mineral, and grazing resources and management of the reservoir. The plan  
40 presents a management zoning proposal to divide GCNRA into four management zones: natural,  
41 recreation and resource utilization, cultural, and development.

1 **1.10.3 Environmental Assessments and Related Documents**  
2

3 **Nonnative Fish Control Environmental Assessment (Reclamation 2011a).** In this  
4 assessment, Reclamation proposed to conduct research, monitoring, and specific actions to  
5 control nonnative fish in the Colorado River downstream from Glen Canyon Dam in an effort to  
6 help conserve native fish. The purpose of the action was to minimize the negative impacts of  
7 competition and predation on an endangered fish, the humpback chub. The action was needed  
8 because competition and predation by nonnative fishes, particularly rainbow trout and brown  
9 trout, may be contributing to a reduction in survival and recruitment of young humpback chub  
10 and threatening the potential recovery of the species. Rainbow trout and brown trout are not  
11 native to the Colorado River Basin and have been introduced into the region as sport fish. The  
12 Finding of No Significant Impact (FONSI) (Reclamation 2012b) was signed in May of 2012.  
13

14 **High-Flow Experiment Protocol Environmental Assessment (Reclamation 2011b).**  
15 This experimental protocol was developed following analysis of a series of high-flow  
16 experimental releases. The protocol is intended to improve conservation of limited sediment  
17 resources in the Colorado River below Glen Canyon Dam. The FONSI (Reclamation 2012a) was  
18 signed in May of 2012.  
19

20 **Environmental Assessment, Comprehensive Fisheries Management Plan for Grand**  
21 **Canyon National Park and Glen Canyon National Recreation Area (NPS 2013e).** The NPS  
22 will implement a CFMP, in coordination with the Arizona Game and Fish Department  
23 (AZGFD), the FWS, Reclamation, and the USGS GCMRC, for all fish-bearing waters in GCNP  
24 and GCNRA below Glen Canyon Dam. The intent of the CFMP is to maintain a thriving native  
25 fish community within GCNP and a highly valued recreational rainbow trout fishery in the Glen  
26 Canyon reach of GCNRA. NPS released a FONSI on December 9, 2013, for the CFMP.  
27

28 **Environmental Assessment and Assessment of Effect, Exotic Plant Management**  
29 **Plan Grand Canyon National Park, Arizona (NPS 2009a).** GCNP proposed using integrated  
30 pest management techniques to control and contain exotic plant species within park boundaries.  
31 Exotic plant species displace natural vegetation and consequently affect long-term health of  
32 native plant and animal communities.  
33

34  
35 **1.10.4 Other Actions, Programs, Plans, and Projects**  
36

37 **Colorado River Basin Salinity Control Program (Reclamation 2014c).** The Colorado  
38 River and its tributaries provide municipal and industrial water to about 27 million people and  
39 irrigation water to nearly 4 million ac of land in the United States. The threat of salinity is a  
40 major concern in both the United States and Mexico. In June 1974, Congress enacted the  
41 Colorado River Basin Salinity Control Act (P.L. 93-320), which directed the Secretary to  
42 proceed with a program to enhance and protect the quality of water available in the Colorado  
43 River for use in the United States and Republic of Mexico.  
44

45 **Lake Powell Pipeline Project (WCWCD 2012).** Washington, Kane, and Iron Counties  
46 in Utah are pursuing the construction of a pipeline that would run from Lake Powell, near Glen

1 Canyon Dam, through Kane County, to Sand Hollow Reservoir, which is located approximately  
2 10 mi east of St. George. The pipeline would then run parallel to Interstate 15 into Iron County.  
3 The pipeline would be 158 mi long and bring 70,000 ac-ft of water to Washington County,  
4 10,000 ac-ft to Kane County, and 20,000 ac-ft to Iron County.  
5

6 **Final Wilderness Recommendation, Grand Canyon National Park, 2010 Update.**

7 The 1980 Final Wilderness Recommendation submitted to the DOI includes 1,143,918 ac  
8 proposed for wilderness designation, and includes 26,461 ac as potential wilderness pending the  
9 resolution of boundary and motorized boat use issues. The Colorado River was identified as  
10 potential wilderness. In 2010, NPS conducted internal reviews and included refinements to the  
11 proposed wilderness acreage estimates. All refinements were consistent with the intent of the  
12 original document submitted to the DOI in 1980.  
13

14 **Grand Canyon National Park Foundation Statement for Planning and Management**  
15 **(NPS 2010a).** The Foundation Statement provides a base for future planning, as required by  
16 NPS, to help guide park management. The Foundation Statement summarizes fundamental  
17 resources and values critical to maintaining Grand Canyon’s natural, cultural, and experiential  
18 value into the future. Because this Foundation Statement is based on laws and policies that define  
19 GCNP and its mission, the Statement should remain relatively unchanged.  
20

21 **Glen Canyon National Recreation Area and Rainbow Bridge National Monument**  
22 **Foundation Document for Management and Planning (NPS 2014i).** The Foundation  
23 Statement provides a base for future planning, as required by NPS, to help guide park  
24 management. The Foundation Statement summarizes fundamental resources and values critical  
25 to maintaining Glen Canyon and Rainbow Bridge’s natural, cultural, and experiential value into  
26 the future. Because this Foundation Statement is based on laws and policies that define GCNRA  
27 and its mission, the Statement should remain relatively unchanged.  
28

29 **Management and Control of Tamarisk and Other Invasive Vegetation at**  
30 **Backcountry Seeps, Springs, and Tributaries in Grand Canyon National Park (NPS 2008).**  
31 Grand Canyon National Park’s backcountry seeps, springs, and tributaries of the Colorado River  
32 are among the most pristine watersheds and desert riparian habitats remaining in the coterminous  
33 United States. This report contains the details from the invasive plant control and monitoring  
34 efforts completed for one phase (Phase II-B) of the three-phase project. Reports for the previous  
35 two phases are also available on the NPS website.  
36

37 **Strategic Plan for Glen Canyon National Recreation Area and Rainbow Bridge**  
38 **National Monument FY2007–FY2011 (NPS 2006c).** This 5-year Strategic Plan has been  
39 written for GCNRA and Rainbow Bridge National Monument (NM). Because Rainbow Bridge  
40 NM is administered by GCNRA, this strategic plan covers both units of the NPS.  
41

42 **Grand Canyon National Park Resource Management Plan (NPS 1997).** The purpose  
43 of the Resource Management Plan was to provide long-term guidance and direction for the  
44 stewardship of the natural, cultural, and recreational resources of GCNP.  
45