RECLAMATION
Managing Water in the West

Report to Congress
Operations of Glen Canyon Dam
Pursuant to the Grand Canyon Protection Act of 1992

2013-2014

U.S. Department of the Interior
Bureau of Reclamation

August 2014

EXECUTIVE SUMMARY

This report by the Department of the Interior (Interior) is submitted pursuant to section 1804 of the Grand Canyon Protection Act (GCPA) of 1992, which provides

> Each year after the date of the adoption of criteria and operating plans pursuant to paragraph (1), the Secretary shall transmit to the Congress and to the Governors of the Colorado River Basin States a report, separate from and in addition to the report specified in section 602(b) of the Colorado River Basin Project Act of 1968 on the preceding year and the projected year operations undertaken pursuant to this Act.

This report provides an update from the last report, submitted by Interior for 2012-2013, and covers activities for 2013 and 2014.

INTRODUCTION

Glen Canyon Dam was authorized for construction by the Colorado River Storage Project Act of 1956. 43 U.S.C. § 620. The dam was completed in 1963 and is operated by the Bureau of Reclamation (Reclamation). In 1992, Congress enacted the GCPA, which requires the Secretary of the Interior (Secretary) to operate Glen Canyon Dam

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

Congress also directed that such operations be undertaken

> 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 vs. California, and the provisions of the Colorado River Storage Project Act of 1956 and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin.

In 1997, the Secretary established the Glen Canyon Dam Adaptive Management Program (GCDAMP) to carry out the requirements of the GCPA. As part of the GCDAMP, the Secretary also established the Adaptive Management Work Group (AMWG), a 25-member federal advisory committee that operates pursuant to the provisions of the Federal Advisory Committee Act, 5 U.S.C. § App. 2. The Secretary's Designee, currently Assistant Secretary for Water and Science Anne Castle, serves as the Chair of the AMWG.

STATUS REPORT

Five agencies within Interior have responsibilities under the GCPA and undertake operations pursuant to the GCPA; the: (1) Bureau of Indian Affairs (BIA); (2) Reclamation; (3) National Park Service (NPS); (4) United States Fish and Wildlife Service (FWS); and (5) United States Geological Survey (USGS). The Western Area Power Administration (Western) also has statutory responsibilities pursuant to the Department of Energy Organization Act, Flood Control Act, Reclamation Project Act, Colorado River Storage Project Act, and GCPA. The role of each responsible Interior agency under the GCPA is briefly addressed below.

Bureau of Indian Affairs

The BIA's mission, among other objectives, includes enhancing quality of life, promoting economic opportunity, and protecting and improving trust assets of Indian Tribes and individual American Indians. This is accomplished within the framework of a government-to-government relationship in which the spirit of Indian self-determination is paramount. As part of the AMWG, BIA works hand-in-hand with interested tribes and other participating agencies to ensure that this fragile, unique, and traditionally important landscape is preserved and protected.

Bureau of Reclamation

Reclamation operates Glen Canyon Dam in accordance with and subject to interstate compacts, an international treaty, federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as the "Law of the River", additional criteria and operating plans specified in section 1804 of the GCPA, and approved experimental plans. Reclamation also provides support to the Secretary's designee in administering the GCDAMP, including coordinating logistics for the AMWG and the Technical Work Group (TWG).

National Park Service

The NPS manages units of the national park system and administers resource-related programs under the authority of various federal statutes, regulations, and executive orders, and in accordance with written policies set forth by the Secretary and the Director of the NPS, including the NPS Management Policies 2006 and the NPS Director's Orders. The NPS manages Grand Canyon National Park and Glen Canyon National Recreation Area under the NPS Organic Act, 16 U.S.C. §§ 1 and 2-4, as amended; other acts of Congress applicable generally to units of the national park system; and the legislation specifically establishing those park units. 16 U.S.C. §§ 221-228j and 16 U.S.C. §§ 460dd through 460dd-9 (2006). The NPS Organic Act directs the NPS to "promote and regulate the use of . . . national parks . . . in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The NPS helps the Secretary achieve the goals outlined in the GCPA through its resource-management and resource-monitoring activities.

U.S. Fish and Wildlife Service

The FWS provides Endangered Species Act (ESA) conservation and associated consultation and recovery leadership with various stakeholders primarily to benefit four listed species: the humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), southwestern willow flycatcher (*Empidonax trailii extimus*), and Kanab ambersnail (*Oxyloma haydeni kanabensi*).

U.S. Geological Survey

The Grand Canyon Monitoring and Research Center (GCMRC) of the USGS was created to fulfill the mandate in the GCPA for the establishment and implementation of a long-term monitoring and research program for natural, cultural, and recreation resources of Grand Canyon National Park and Glen Canyon National Recreation Area. GCMRC provides independent, policy-neutral scientific information to the GCDAMP on (a) the effects of the operation of Glen Canyon Dam and other related factors on resources of the Colorado River ecosystem using an ecosystem approach, and (b) the flow and non-flow measures to mitigate adverse effects. The GCMRC's activities are focused on (a) monitoring the status and trends in natural, cultural, and recreational resources that are affected by dam operations, and (b) working with land and resource management agencies in an adaptive management framework to carry out and evaluate the effectiveness of alternative dam operations and other resource conservation actions described in this report.

2013 OPERATIONS

Bureau of Indian Affairs

In 2013, the BIA continued to consult with stakeholder tribes on formulating funding requests for various projects related to the adaptive management program. The BIA additionally participated in consultation meetings with the tribes regarding the Tribal Consultation Plan, conducted pre-meetings with tribal representatives prior to the AMWG meetings, and participated in ad hoc groups and other meetings regarding cultural and natural resources issues and concerns. Principal among tribal concerns for 2013 was articulating the importance of Traditional Cultural Values and their inclusion in the Long-Term Experimental and Management Plan (LTEMP) Environmental Impact Statement (EIS) process. All parties involved worked to find a way to quantify such values such that they could be adequately analyzed in the LTEMP EIS. The BIA is also a cooperating agency on the LTEMP EIS. The BIA was also involved with the High-Flow Experimental Protocol for Glen Canyon Dam and coordination with the tribes. The BIA continued to provide its portion of funding to tribes for their participation in the GCDAMP. The BIA also participated on the Interior Native American Core Team and various GCDAMP ad hoc groups, and reviewed the development of the hydrograph for the annual operating plan and GCDAMP efforts. Other activities included participating in development of the memoranda of agreement for cultural resources, continued coordination of efforts for tribal participation in the GCDAMP, and working with the Interior Tribal Liaison to maximize tribal consultation and involvement. In August 2013, Chip Lewis was appointed by the Assistant Secretary as BIA's representative to the AMWG in place of Amy Heuslein who retired.

Bureau of Reclamation

Water Operations

As in 2010-2012, a water year (WY) 2013 hydrograph was jointly developed by the Interior AMWG agencies and Western. The recommended hydrograph was consistent with the Law of the River (including the GCPA) and was designed to enhance protection of downstream

resources. This approach to operations is consistent with the Interim Guidelines, operating criteria, or 2007 Record of Decision (ROD), and falls within the parameters of the modified low fluctuating flow (MLFF) alternative adopted in the 1996 ROD. The recommended hydrograph received broad support from the members of the AMWG and was approved by the Secretary on January 15, 2013.

Releases from Lake Powell in WY 2013 continued to reflect consideration of the uses and purposes identified in the authorizing legislation for Glen Canyon Dam and were consistent with the 1996 ROD; the 2012 Environmental Assessment/Finding of No Significant Impact (EA/FONSI) for Development and Implementation of a Protocol for High-flow Experimental Releases from Glen Canyon Dam, Arizona, 2011-2020; and the 2013 hydrograph. The monthly release volumes for WY 2013 are displayed in Table 1. The end of water year 2013 elevation for Lake Powell was 3,591 feet.

Table 1. Lake Powell Monthly Release Volumes
Water Year 2013

Month	Monthly Release Volumes (maf*)
October 2012	0.498
November 2012	0.730
December 2012	0.801
January 2013	.801
February 2013	0.600
March 2013	0.601
April 2013	0.551
May 2013	0.602
June 2013	0.800
July 2013	0.848
August 2013	0.801
September 2013	0.600
Total Releases	8.232

*maf = million acre-feet

The second experimental release under the High-Flow Experimental Protocol was successfully conducted during November 2013. Reclamation released the maximum available capacity (37,000 cubic feet per second [cfs]) during the experiment which began on November 11 and ended on November 16, 2013. Preliminary findings suggest that these releases were successful in transporting sediment accumulated near the confluence of the Colorado and Paria rivers to beaches and sandbars where sediment replenishment was needed.

In 2013, Reclamation continued to fund and support Grand Canyon National Park with several projects including humpback chub translocations in Havasu and Shinumo creeks, nonnative fish removal in Bright Angel creek, fish surveys in the mainstem Colorado River, a staff position for

the permitting office, cultural monitoring, and support staff to complete National Environmental Policy Act (NEPA) compliance for the Glen and Grand Canyon fish management plan.

LTEMP EIS

In 2013, Reclamation and the NPS continued developing the LTEMP EIS using the Department of Energy's Argonne National Laboratory as the third-party contractor, funded by Reclamation.

The LTEMP EIS Team held a structured decision analysis workshop August 5-7, 2013, for the cooperating agencies and AMWG members where results were presented on the performance of the alternatives on the resource objectives. Additionally, participants used decision analysis tools to get input from stakeholders on the alternatives. A second structured analysis workshop was held with the cooperating agencies and AMWG members March 31-April 1, 2014, where the results of the modeling and related analysis of the draft alternatives was presented. In April 2014, the stakeholders were given a swing weighting exercise to help provide input on the LTEMP alternatives. The following entities participated in the exercise: FWS, Arizona Department of Water Resources, Arizona Game and Fish Department, International Fly Fishing Federation, National Parks Conservation Association, Hopi Tribe, Hualapai Tribe, Navajo Nation (water), Salt River Project, Utah Associated Municipal Power Systems, and Colorado River Energy Distributors Association. The co-lead agencies are continuing work on development and analysis of alternatives based on alternatives and analysis methods discussed at the structured decision analysis workshops. The goal of Reclamation and the NPS is to have a public draft EIS ready for the winter of 2014/2015.

Conservation Measures for Humpback Chub and Razorback Sucker

From fiscal years 2009 through 2013, Reclamation funded NPS to remove nonnative rainbow trout and translocate humpback chub into Shinumo Creek. In order to monitor fish movement in Shinumo, Reclamation provided funding and technical support from Utah State University to install a passive integrated transponder (PIT) tag monitoring system near the mouth of the creek. The system consists of solar-powered detectors to confirm the presence and identity of individual fish swimming within about 18 inches of the antennae. Approximately 50 percent of the 902 humpback chub translocated in 2009, 2010, and 2011 were recorded by the remote antenna as having moved out of the creek and into the mainstem Colorado. PIT tag antennae indicate that high emigration rates occur shortly after a translocation. However, the fish that left the creek are contributing to the mainstem aggregations, and sampling conducted in conjunction with the 2013 Shinumo translocation captured a total of 35 humpback chub; of these, 33 were unique individuals (two were captured twice), 11 humpback chub were untagged, and 22 were translocated humpback chub from Shinumo Creek.

The 2013 translocation was made at a new release site approximately 1.5 kilometers upstream of the previous site in an effort to minimize rapid emigration. A "soft" release technique was implemented in which a block net was set below the release pool to allow chub to further acclimate following translocation. After three days, the net was removed and the fish were free to disperse. Prior to the translocation, surveys in the creek located 82 translocated humpback chub, indicating that some have remained in the creek for three-and-a-half years, have growth

rates similar to or higher than those seen in the Little Colorado River, and have attained the minimum size and age required for reproduction. No spawning in Shinumo Creek has been detected yet. Trout have been removed as part of every monitoring trip and the structure of the trout population has shifted from moderate numbers of larger fish to greater numbers of small and young-of-the-year fish. The next milestone for Shinumo will be the detection of spawning and successful reproduction.

Prior to the first translocation of humpback chub into Havasu Creek in 2011, two baseline fish surveys were conducted. These surveys turned up a surprising 13 wild humpback chub considered to be resident fish. Fortunately, very few nonnatives were present in the system. Two hundred and forty-three PIT-tagged humpback chub were translocated into Havasu Creek downstream of Beaver Falls in 2011. The next year, surveys relocated a total of 106 unique individuals. Three of these were ripe males confirmed to have been translocated fish from the 2011 cohort. An additional 300 chub approximately 125 millimeters in length were translocated into Havasu Creek in 2012. Again in May 2013, a follow-up monitoring and translocation trip was conducted. Eight rainbow trout were captured and removed from the system and 269 humpback chub were present as well as other native fish species. Multiple male humpback chub in spawning condition and three ripe females were also captured. As in previous years, a small number (three to five individuals) of mature (>200 millimeters) untagged, likely not translocated, humpback chub were found in Havasu Creek and, for the first time, untagged juvenile humpback chub (121 and 127 millimeters) were captured. The small size of these humpback chub indicates that it is unlikely that they were translocated, but more likely that these two juveniles were the result of natural reproduction occurring in Havasu in 2012. A review of ultrasound images taken of several mature female humpback chub also indicated the presence of developed gametes.

Translocations of humpback chub cannot currently be accomplished in Bright Angel due to the large numbers of brown and rainbow trout that inhabit the creek. Consequently, trout removal efforts were increased in 2012. A fish weir to trap spawning brown trout near the confluence has been utilized for several years and a new and more effective weir was installed in 2012. The weir was maintained from late October 2012 to the first week of February 2013 including through the government shutdown using "excepted" biologists to man the trap. Electrofishing trips were conducted upstream of the weir from September to February in 2012 and 2013 to intensify the trout removal effort. In addition, from November 19 through December 5, 2013, the NPS (in cooperation with GCMRC) initiated the Bright Angel Creek Inflow (BACI) reduction project as a pilot study. The BACI reach is defined as the 5.5-mile section of river between Zoroaster Rapid (RM 85) and Horn Creek Rapid (RM 91). Researchers removed 1,370 rainbow trout and 336 brown trout during the pilot study.

Mainstem Colorado River total captures of humpback chub in 2013 included 116 chub at all aggregations and 44 captured at locations not associated with aggregations. Population estimates for 2013 have not been calculated at this time, but it is apparent that abundance of adult chub has increased or remained stable at all aggregations since sampling began in the 1990s. Humpback chub translocated to Shinumo Creek and Havasu Creek from 2009-2011 contributed to the mainstem aggregations at those tributary mouths.

Grand Canyon National Park employs a permitting specialist and staff who review all proposals for projects to be completed in the park. The GCDAMP through Reclamation provides these

funds to offset the park's administrative burden. In 2013, twelve GCDAMP associated research and collection projects, including tribal monitoring, were permitted with a total of 4,839 user days.

Reclamation continued financial and staff support of a monitoring project for razorback sucker aimed at better understanding the use and life history needs of the species in Lake Mead and western Grand Canyon. Although the project is funded by Reclamation, participants include the NPS, FWS, USGS, Arizona Game and Fish Department, and BioWest. While researchers have known that razorback sucker occupy and are able to reproduce and recruit in Lake Mead since the 1990s, this project has found that the species also uses the Colorado River in western Grand Canyon as far upstream as Lava Falls. Other findings include the presence of juvenile fish in the Lake Mead inflow area indicating recruitment, larval fish at Lava Falls indicating spawning and possible recruitment in the river reach in western Grand Canyon, and long-distance movement of adult razorback suckers throughout Lake Mead and western Grand Canyon indicating that individuals use large areas of both the lake and the river in western Grand Canyon and move readily between these areas.

Tribal Activities

Reclamation continued to fund five American Indian Tribes (Hopi, Hualapai, Pueblo of Zuni, Kaibab-Paiute, and the Navajo Nation) to participate and provide their perspectives to the GCDAMP. They identify and monitor traditional cultural properties and provide annual reports detailing their activities, findings, and monitoring data.

Several government-to-government consultations with interested tribes were conducted throughout the year, and additional staff level meetings and conference calls with interested tribes were also held.

In addition to the high-flow experimental release and consultations for the LTEMP EIS, Reclamation continues to conduct government-to-government consultations with American Indian Tribes as part of the GCDAMP on operations of Glen Canyon Dam and activities of the GCDAMP in services of its responsibilities, including those under Section 106 of the National Historic Preservation Act, Executive Order 13175, Secretarial Order 3206, and the November 5, 2009, Presidential Memorandum on Tribal Consultation.

Reclamation continued implementation of two memoranda of agreement (MOA) to mitigate for adverse effects under Section 106 of the National Historic Preservation Act for the High-Flow Experimental Protocol and nonnative fish management described above. The consultation process leading to execution of these two MOAs included consensus determination of eligibility of the Grand Canyon as a traditional cultural property for several tribes, at their request. Reclamation also continued its efforts with the signatories to update the 1994 Programmatic Agreement for operation of Glen Canyon Dam pursuant to the GCPA.

National Park Service

Three units of the NPS (Glen Canyon National Recreation Area, Grand Canyon National Park, and Lake Mead National Recreation Area) provided essential logistical support for implementation of the November 2013 high-flow experiment (HFE). The park units established individual incident command systems to manage and coordinate activities related to the HFE. Safety was the primary concern, with visitor information and outreach being the primary tool used to communicate the changes in flow release volumes from Glen Canyon Dam. Before and during the HFE, Glen Canyon National Recreation Area staffs were able to successfully work with the three concessionaires on Lake Powell to minimize impacts to their marina operations.

LTEMP EIS

In 2013, the NPS and Reclamation continued developing the LTEMP EIS using the Department of Energy's Argonne National Laboratory as the third-party contractor, funded by Reclamation. Staff from the Intermountain Regional Office, Washington Office, Grand Canyon, Glen Canyon, and Lake Mead all participated in various LTEMP activities.

Archaeological/Cultural Resources

Grand Canyon National Park: Field work in 2013 consisted of condition assessments at 84 river corridor archaeological sites. Testing for subsurface cultural remains was conducted at three sites where camping has adversely impacted surface features. Two of these locations contained intact subsurface cultural remains and will be monitored for additional impact. Trail work was completed at one site where extensive runoff and subsequent erosion resulted in trail damage and threats to intact cultural deposits. Staff participated on two tribal monitoring river trips visiting ethnographic resources to determine condition and threats from a tribal perspective.

Staff worked with archaeologists from the Museum of Northern Arizona to complete the draft report on the excavations of nine sites along the Colorado River. The final report is expected in late 2014.

Glen Canyon National Recreation Area: Work in 2013 focused on continued coordination and consultation with Reclamation and associated tribes concerning the identification and appropriate resolution of adverse effects resulting from high flows. Field observations were conducted prior to, during, and following the high flow to assess changes in resource condition at specific locations. Staff also continued to support GCMRC's monitoring of dam-related topographic changes at select cultural sites.

Tribal Consultation

In 2013, the NPS continued to participate in consultation meetings with the various tribes who are directly involved in the GCDAMP and other Colorado River related programs. Grand Canyon National Park and Glen Canyon National Recreation Area staff continued discussions with tribes and incorporated tribal perspectives into the NPS Fish Management Plan. Tribal

advisors were consulted on specific monitoring and mitigation protocols relative to Grand Canyon National Park's Colorado River Management Plan implementation.

The NPS worked with Reclamation to consult with interested tribes involved in the LTEMP. Consultation is government-to-government and includes all tribes who are interested in the planning effort regardless of their role as a cooperating agency for the EIS.

Humpback Chub Translocation and Fisheries Management

In 2013, the NPS (Grand Canyon National Park and Glen Canyon National Recreation Area) worked with various agencies and the interested public to finalize a comprehensive fisheries management plan for native fish within Grand Canyon National Park and sport fish in the Lees Ferry area of Glen Canyon National Recreation Area. In Grand Canyon, implementation of the fisheries management plan was initiated in 2013 and is continuing in 2014. These efforts include an evaluation of the status and habitat use of newly rediscovered endangered razorback sucker, translocations and monitoring of endangered humpback chub to Havasu and Shinumo creeks, and the removal of nonnative fishes threatening endangered and native fish in Shinumo and Bright Angel creeks and the Bright Angel Creek inflow area of the Colorado River.

Wildlife Surveys and Monitoring

Grand Canyon National Park: In 2013, Grand Canyon National Park activities included assisting researchers with a desert bighorn sheep study to inform connectivity models, determine genetic diversity of herds, and gain insights on desert bighorn sheep ecology. Park biologists continued monitoring condors and Mexican spotted owls.

Glen Canyon National Recreation Area: In 2013, Glen Canyon National Recreation Area and partners conducted wildlife surveys and monitoring on desert bighorn sheep (with Oregon State University), aquatic/riparian invertebrates and terrestrial vertebrates (with Grand Canyon Wildlands Council), and conducted planning activities for northern leopard frog with various partners.

Vegetation Management/Exotic Species Removal

Grand Canyon National Park: In 2013, NPS staff continued to implement exotic plant species removal at priority sites, expand plant collection and propagation efforts in preparation for future watershed restoration projects, and provide hands-on stewardship opportunities. Staff also planted native plant species at Granite Camp as part of a pilot riparian restoration project. Specific accomplishments along the river corridor in Grand Canyon National Park were:

- Continued the Adopt-a-Camp program by working with individuals, Grand Canyon Youth, and commercial companies to remove priority exotic plant species from the camps and attraction sites.
- Initiated the first riparian restoration project in the river corridor at Granite Camp (river mile 94). Protected riparian and upland trees with cages. Maintained the project site all year and re-read the vegetation transects that were installed prior to project initiation.

- Continued propagation of riparian plant species for supplemental planting at Granite Camp or other future riparian restoration projects.
- Removed the following exotic plant species:

    - ✓ African mustard - 2,008 (from camps)
    - ✓ Camelthorn - 6,109 (from camps and attraction sites)
    - ✓ Filaree - 4 (from one camp)
    - ✓ Puncture vine - 75 (from one camp)
    - ✓ Pampas grass - 5 (from along the river corridor)
    - ✓ Perennial pepperweed - 2 (from along the river corridor and at one camp)
    - ✓ Ravenna grass - 78 (from along the river corridor)
    - ✓ Russian olive - 3 (from along the river corridor)
    - ✓ Russian thistle - 4,004 (from camps and at attraction sites)
    - ✓ Sahara mustard - 70,241 (from along the river corridor and at Lees Ferry)
    - ✓ Silverleaf nightshade - 1,325 (from camps and along the river corridor)
    - ✓ Spiny sowthistle - 42 (from camps and along the river corridor)
    - ✓ Tamarisk - 1,717 (from Granite Camp)

Glen Canyon National Recreation Area: In 2013, NPS staff, partners, and volunteers implemented invasive plant management efforts, native plant restoration activities, and vegetation monitoring efforts along the Colorado and Paria rivers below Glen Canyon Dam. Specific accomplishments in Glen Canyon National Recreation Area were:

- Partnered with Grand Canyon Youth, Grand Canyon Wildlands Council, and the Alpine Preparatory Academy at the Lees Ferry 10-acre restoration site to improve fencing around planted cottonwoods and willows to protect from beaver herbivory.
- Grand Canyon Wildlands Council (under cooperative agreement with the NPS) continued monitoring native plant restoration success at Hidden Slough.
- Grand Canyon Wildlands Council and the NPS finalized habitat restoration work plans for Hidden Slough and Leopard Frog Marsh.
- Continued native seed collection and plant propagation efforts for restoration activities at Hidden Slough, Leopard Frog Marsh, and Paria River Bridge.
- Controlled, mapped, and/or monitored the following invasive nonnative species infestations:

    - ✓ Russian olive - 42 (between the Glen Canyon Dam and Glen Canyon/Grand Canyon boundary) and 571 (between the Glen Canyon/Bureau of Land Management boundary and Paria River/Colorado River confluence).
    - ✓ Tamarisk - Continued monitoring of tamarisk leaf beetle impacts at Hidden Slough and Leopard Frog Marsh.

Research Review and Permitting

Grand Canyon's Research Office continues to have one of the largest research and collection permitting programs within the NPS. There are more than 120 researchers that are listed as either principal or co-principal investigators presiding over current studies. In 2013, Grand

Canyon's Research Office received 15 river trip applications to fulfill obligations under the GCDAMP. This was a decrease of two applications, down from the 17 filed in 2012. The GCMRC was issued nine research and collection permits and 15 stand-alone river permits, totaling 4,131 user days. Five tribal research permits with corresponding river trips were permitted for the Hopi, Hualapai, Navajo, Paiute, and Zuni tribes, totaling 932 user days. Overall, 4,839 user days were spent on the river conducting GCDAMP-related research.

For each GCMRC and tribal permit, an interdisciplinary team of technical experts reviewed and provided comments on the research proposal or logistics and assistance was given to the principal investigator in completing the minimum requirement analysis and related compliance documents.

Additionally in 2013, Grand Canyon Science and Resource Management staff participated in GCDAMP-related meetings and river trips; attended and participated in GCMRC's annual reporting meeting; and attended Glen Canyon Dam Technical Work Group meetings, knowledge assessment workshops, and other meetings with the GCMRC and TWG. These discussions are integral to future collaborations and allow for shared input and an increase in the NPS's involvement in the GCDAMP.

Outside of the GCDAMP, the research office continued to review proposals, coordinate efforts, and provide permitting guidance as needed for all GCPA projects in 2013. An additional 49 research permits were issued to independent or university researchers and logistical planning was provided to various disciplines including vegetation baseline monitoring, geomorphology, terrestrial remote sensing, and soundscape monitoring. Grand Canyon staff expects to provide similar and even additional efforts during the current 2014 year.

Resource Monitoring and Mitigation

In 2013, Grand Canyon National Park staff continued the integrated campsite monitoring and mitigation program. The trip conducted in February, following the 2012 HFE, included photographic documentation of campsites, and campsite rehabilitation projects in areas above the 25,000 cfs flow line and pre-dam high-water areas. Grand Canyon staff are continuing to evaluate and refine their monitoring and mitigation protocols to ensure applicability to changing field conditions and management needs.

Grand Canyon National Park, through a cooperative agreement with Northern Arizona University, completed analysis of campsite resource condition monitoring data collected from 2007-2011. The results were used to identify resource conditions and trends, clarify management questions, and refine the study design and survey methods. Annual monitoring will resume in September 2014.

Glen Canyon National Recreation Area staff continued the multi-faceted efforts to prevent aquatic invasive species transport to and from Lake Powell and Lees Ferry. Aquatic invasive species present extreme potential impacts to a wide range of GCPA associated resources.

Greater Grand Canyon Landscape Assessment

In 2012 the NPS, in collaboration with Northern Arizona University and numerous other partners (including federal and state agencies, tribes, universities, non-profit organizations, and special interest groups), initiated the Greater Grand Canyon Landscape Assessment to assess the condition and trends of natural and cultural resources throughout Grand Canyon National Park and contiguous watersheds. During 2013, eight technical work groups, comprised of subject matter experts and interested stakeholders, were convened to help provide expertise and guidance for assessing the identified focal resources. Data for many of the focal resources have been synthesized and used to develop spatial layers that will be used in subsequent analyses. During June 2014, the second interdisciplinary stakeholder workshop will be convened to garner feedback on draft products and provide an opportunity for input into the prioritization process. The remainder of 2014 will entail finalizing condition assessments for the focal resources and drafting a NPS Natural Resource Condition Assessment report which will serve as a baseline for current resource conditions and help guide future park planning and decision making.

U.S. Fish and Wildlife Service

The FWS has been participating in the LTEMP as a cooperating agency and has been active in the development of alternatives and modeling for biological resources through attendance at webinars and providing comments to the joint lead agencies.

The FWS completed the biological opinion for the NPS' Comprehensive Fishery Management Plan, which will guide NPS activities for native and nonnative fish in the Colorado River. The FWS will continue to provide technical assistance to support NPS management work for Grand Canyon National Park and Glen Canyon National Recreation Area, and will continue to participate in the AMWG, TWG, and various ad hoc groups and other related assignments. The FWS is also engaged with Grand Canyon National Park in the development of resource conditions for the Greater Grand Canyon Landscape Assessment process.

In 2013, the FWS conducted four monitoring trips on the Little Colorado River to generate population estimates for humpback chub, and to monitor trends of other native fishes. Since 2006, the Little Colorado River population of humpback chub in Grand Canyon has significantly increased in size, and continues to remain stable at elevated levels. The FWS conducted one trip on the Little Colorado River to monitor the success of upstream translocations of humpback chub within the Little Colorado River. These translocation efforts have been successful, with humpback chub experiencing high growth rates, high survival, and retention (range expansion) in this upper portion of the river. The FWS has continued to work collaboratively with Grand Canyon National Park in the collection and transport of young humpback chub for translocation into Havasu and Shinumo creeks. An additional 500 humpback chub collected in 2013 are also on station at the Southwest Native Aquatic Resources and Recovery Center in Dexter, New Mexico (Dexter), and will be held until they are large enough to be marked with a small tag and translocated in 2014.

The FWS has successfully worked with the GCMRC to initiate a pilot study for collecting small, larval stage humpback chub for use in future translocation efforts. The pilot effort was

successful and the approach will be incorporated into field practices in 2014. The FWS, in cooperation with USGS and Dexter, successfully completed a PIT tag study to determine the smallest size at which humpback chub can be effectively PIT tagged. The study found that humpback chub can be effectively tagged at sizes 20 percent smaller than currently practiced providing the potential for increased understanding of this important early life stage. Finally, the FWS has taken the lead, and continues to work collaboratively with the GCMRC and NPS, to develop and refine a monitoring program to effectively sample mainstem aggregations of humpback chub in the Colorado River in Grand Canyon. In 2013, the FWS, GCMRC, and NPS conducted two sampling trips to estimate the population size of humpback chub in these aggregations. It is encouraging that the effect of translocating humpback chub into Shinumo and Havasu creeks has resulted in a measurable augmentation of these two mainstem aggregations.

U.S. Geological Survey

U.S. Geological Survey/Grand Canyon Monitoring and Research Center

In 2013, the GCMRC continued to serve in its role as the primary science provider to the GCDAMP. The GCMRC's primary activities during 2013 were: (1) conducting an annual reporting meeting that summarized findings from the previous year's research and monitoring activities and summarized knowledge-to-date concerning the Colorado River ecosystem, (2) maintaining a stream flow and sediment transport measurement and internet-based real-time reporting program that was the foundation for planning a November HFE, (3) analysis of those data so as to inform dam and river management activities in the months immediately before the HFE, (4) collection and reporting of data describing resource condition immediately following the HFE, and (5) collection and reporting of native and nonnative fish population data in support of management decisions regarding nonnative fish control. Additionally, GCMRC staff conducted numerous field and laboratory studies as anticipated in the fiscal year 2013/2014 Budget and Work Plan and provided scientific support for development of the LTEMP EIS.

Knowledge Synthesis

In January 2013, GCMRC conducted a meeting with GCDAMP stakeholders during which results from research and monitoring in key resource areas in Glen and Grand Canyons from the previous year were presented. The foci of the January meeting were biology, ecology, hydrology, sediment transport, geomorphology, cultural resources, and recreation resources. Results from research and monitoring conducted by scientists from GCMRC and cooperating agencies were presented. All materials presented at the workshops were made available in electronic postings at the GCMRC and Reclamation websites.

Implementation of Stream-flow and Sediment Measurement Program in Support of the High-Flow Experimental Protocol

The period July 1 to November 30, 2013, marked the second "sediment accumulation period" as defined under the High-Flow Experimental Protocol that was adopted by the Secretary in 2012. This High-Flow Experimental Protocol necessitates the estimation in real time of fine sediment delivery from the Paria River and fine sediment retention in Marble Canyon in the months

immediately prior to the HFE. GCMRC worked in collaboration with the Arizona and Utah Water Science Centers to measure suspended sediment transport and to process field samples in the GCMRC sediment lab. Telemetered data from remotely deployed instruments were shared in real time on the GCMRC website while data from physical samples were shared with Reclamation on a monthly basis in an unmatched effort to provide sediment data in a real-time format for HFE planning purposes. GCMRC staff estimated that between 1,300,000 and 2,300,000 metric tons of fine sediment was delivered from the Paria River to the Colorado River during the period between July 1 and November 10, 2013. The HFE began on November 11 and ended on November 16, 2013.

Analyses of Sediment Transport Data to Inform HFE Planning and Design

GCMRC scientists evaluated sediment transport and sediment mass balance data and made recommendations to Reclamation concerning the design of the HFE hydrograph so as to provide the most effective benefit-to-resource condition and to scientific learning, consistent with the protocol defined in the 2012 published environmental assessment. Following consideration by Reclamation and vetting with various stakeholders, this hydrograph was the one implemented in the November HFE.

Implementation of a Plan to Evaluate HFE Effects

GCMRC utilized a network of field time-lapse cameras to evaluate the effects of the HFE on sandbars throughout the Colorado River ecosystem. Scientists were sent into the field in December 2013 and January 2014 to collect photographic data and recover gaging station data. Preliminary results indicate that there was favorable bar building in Marble Canyon caused by the HFE. The first presentation concerning the effects of the HFE was made to the Upper Colorado River Commission at its Las Vegas meeting in mid-December 2013 with additional data presented at the January 2014 annual reporting meeting described above and at a GCDAMP meeting in February 2014. In addition, rainbow trout populations and the aquatic food base in Glen Canyon were sampled before and after the HFE to evaluate any effects on the aquatic ecosystem of the event. Results and analysis to date indicate that HFEs do not trigger downstream movement of rainbow trout and suggest that the aquatic foodbase may respond positively in the form of increased abundance of some aquatic insects within weeks to months of these events.

Fisheries Information in Support of Nonnative Fish Control EA

GCMRC conducted monitoring of native and nonnative fish populations in support of Reclamation's nonnative fish control environmental assessment and its associated biological opinion for endangered humpback chub. This biological opinion identifies several triggers which if met require management actions to be taken to reduce nonnative fish populations in an effort to protect humpback chub. Information provided by GCMRC for specific triggers includes the abundance of nonnative rainbow trout and brown trout in the Colorado River near the Little Colorado River confluence. GCMRC and its cooperators also generated estimates of the abundance of several life stages of humpback chub in the Little Colorado River itself and near its confluence in the Colorado River, as well as survival rates of juvenile humpback chub in this

latter area. Although the trigger level for rainbow trout abundance was exceeded in 2013, no other trigger levels, including those for humpback chub, were reached so no nonnative fish control actions were required or implemented.

Other Science Activities and Findings

In the course of its regular and mandated science monitoring and research activities, GCMRC and its cooperators provided stakeholders and the GCDAMP with critical data concerning the status and trends of endangered humpback chub populations in the Colorado River downstream of Glen Canyon Dam as well as key tributaries; the status and trends of rainbow trout in Glen Canyon, Marble Canyon, and near the Little Colorado River confluence; the distribution and relative abundance of potentially harmful nonnative fish species between Glen Canyon Dam and Lake Mead reservoir; and the status and trends of the aquatic foodbase in the Colorado River ecosystem. Many GCMRC scientists also provided support to the ongoing LTEMP EIS process in the form of model development, data analysis, participation on subject matter expert panels, document review, peer review coordination, and other activities to help ensure a sound scientific foundation for the development of the EIS.

2014 OPERATIONS

Bureau of Indian Affairs

In 2014, the BIA will continue to take an active role in supporting stakeholder tribes related to the GCDAMP. The BIA will participate in meetings concerning the Tribal Consultation Plan, pre-meetings with tribal representatives prior to AMWG meetings, attend TWG meetings, and continue to participate in various ad hoc groups regarding tribal, cultural, and natural resource issues and concerns. The BIA is also a cooperating agency on the LTEMP EIS and will be actively involved in that process. The BIA will also continue to be involved with any future HFE releases from Glen Canyon Dam.

Bureau of Reclamation

Water Operations

As in 2010 through 2013, a 2014 hydrograph was jointly developed by the Interior AMWG agencies and Western. The recommended hydrograph is consistent with the Law of the River (including the GCPA) and is designed to enhance the protection of downstream resources. This approach to operations is consistent with the Interim Guidelines, operating criteria, or 2007 ROD, and falls within the parameters of the MLFF alternative adopted in the 1996 ROD. The recommended hydrograph received broad support from members of the AMWG and was approved by the Secretary on December 12, 2013.

Releases from Lake Powell in WY 2014 reflect consideration of the uses and purposes identified in the authorizing legislation for Glen Canyon Dam and were consistent with the 1996 ROD; the 2012 EA/FONSI for Development and Implementation of a Protocol for High-flow Experimental Releases from Glen Canyon Dam, Arizona, 2011-2020; and the 2014 hydrograph. The observed

and projected monthly release volumes for WY 2014 are displayed in Table 2. The end of water year 2014 elevation for Lake Powell is projected to be 3,605 feet.

Table 2. Lake Powell Monthly Release Volumes
Water Year 2014

Month	Monthly Release Volumes (maf*)
October 2013	0.481
November 2013	0.696
December 2013	0.601
January 2014	0.800
February 2014	0.599
March 2014	0.504
April 2014	0.502
May 2014	0.493
June 2014	0.598
July 2014	0.800
August 2014**	0. 800
September 2014**	0.606
Total Releases**	7.480

* maf = million acre-feet
** = projected release

Reclamation will continue planning for high-flow experimental releases from Glen Canyon Dam in November 2014 in accordance with the High-Flow Experimental Protocol and Reclamation's May 12, 2012, FONSI.

LTEMP EIS

In 2014, Reclamation and the NPS will continue development of the LTEMP EIS leading to publication of a draft document for public release in the winter of 2014/2015.

Conservation Measures for Humpback Chub and Tribal Activities

Many of the 2013 activities described above will continue in 2014. Reclamation will continue to provide funding to the NPS and other agencies for fish studies and other activities in Grand Canyon National Park and for the participation of five American Indian Tribes in the GCDAMP (as described above for 2013), and will continue efforts to update the 1994 Programmatic Agreement for operation of Glen Canyon Dam pursuant to the GCPA.

National Park Service

LTEMP EIS

In 2014, the NPS and Reclamation plan to continue development of the LTEMP EIS using the Department of Energy's Argonne National Laboratory as the third-party contractor, funded by Reclamation. Staff from the Intermountain Regional Office, Washington Office, Grand Canyon, Glen Canyon, and Lake Mead all participated in various LTEMP activities.

Archaeological/Cultural Resources

Grand Canyon National Park: 2014 work will include a field session devoted specifically to monitoring site conditions at archaeological sites. The NPS anticipates that approximately 100 sites will be assessed with current conditions noted. One stabilization project is also planned in conjunction with the Pueblo of Zuni to document and protect ethnographic resources of concern. Staff archaeologists will also participate in interdisciplinary mitigation along the river in the spring of 2014.

Glen Canyon National Recreation Area: NPS Submerged Resources Center will be assisting with documentation and development of monitoring protocols to evaluate potential effects to the Spencer Steamboat. Staff will also continue resource monitoring and expect delivery of summary results from GCMRC's monitoring of dam-related topographic change at cultural sites.

Tribal Consultation

In 2014, the NPS anticipates continued participation in consultation meetings with the various tribes who are directly involved in the GCDAMP and other Colorado River related programs. Grand Canyon National Park and Glen Canyon National Recreation Area staff will continue discussions with tribes to incorporate tribal perspectives into implementation of the NPS Comprehensive Fish Management Plan. Tribal advisors will continue to be consulted on specific monitoring and mitigation protocols relative to the Colorado River Management Plan implementation. Grand Canyon National Park staff anticipates working with the Pueblo of Zuni and external partners on projects to better protect important resources along the Colorado River.

The NPS will continue to work with Reclamation to consult with interested tribes involved in the LTEMP. Consultation is government-to-government and includes all tribes who are interested in the planning effort regardless of their role as a cooperating agency for the EIS.

Humpback Chub Translocation and Fisheries Management

In Grand Canyon, implementation of the fisheries management plan will continue into 2014. These efforts will include an evaluation of the status and habitat use of newly rediscovered endangered razorback sucker, translocations and monitoring of endangered humpback chub to Havasu and Shinumo creeks, and the removal of nonnative fishes threatening endangered and native fish in Shinumo and Bright Angel creeks and the Bright Angel Creek inflow area of the

Colorado River. Collaboration with Reclamation, FWS, GCMRC and others will continue on all fisheries projects leading to well integrated projects.

Wildlife Surveys and Monitoring

Grand Canyon National Park: In 2014, Grand Canyon staff will continue work on bighorn sheep including distribution and potential disease pathogen identification. Biologists will continue to monitor condors and Mexican spotted owls. Additionally, ground truthing the northern leopard frog habitat model will be completed.

Glen Canyon National Recreation Area: In 2014, Glen Canyon National Recreation Area staff plan to work on desert bighorn sheep, aquatic/riparian invertebrates and terrestrial vertebrate populations, and northern leopard frog and ambersnail habitat enhancements.

Vegetation Management/Exotic Species Removal

In fiscal year 2014, staff will expand the Adopt-a-Camp program by adding more camps and encouraging the participation of more commercial guides. Nursery staff will continue to propagate riparian plant species for future restoration projects along the river corridor. Funding for the restoration of two more riparian restoration sites was pushed to fiscal year 2015, but vegetation program staff will work with wildlife staff and compliance staff to continue strategic planning efforts for that project.

In fiscal year 2014, NPS staff, partners, and volunteers will continue invasive plant management, native plant restoration, and vegetation monitoring activities along the Colorado and Paria rivers below Glen Canyon Dam.

Research Review and Permitting

NPS staff anticipates continuation of research and permitting activities in 2014 at similar levels as 2013. For each of the research projects in support of the GCPA, peer review of the proposals, evaluation of need for NEPA, and completion of minimum requirement analysis will be completed. Updating of annual investigator reports will be done for each research permit and coordination with Reclamation will continue.

Resource Monitoring and Mitigation

Grand Canyon staff will continue integrated campsite monitoring in 2014, including deploying improved monitoring and mitigation protocols. The NPS will continue to conduct campsite use surveys and attraction site monitoring. Two mitigation trips are currently planned to concentrate on campsite impacts in areas above the 25,000 cfs flow line and pre-dam high-water areas in Grand Canyon.

Greater Grand Canyon Landscape Assessment

In 2014, an interdisciplinary team of NPS experts, agency partners, scientists, and other groups and individuals will continue to conduct the Greater Grand Canyon Landscape Assessment in an effort to identify resource conditions and trends and prioritize conservation needs to facilitate ecosystem-based stewardship. The NPS will continue to work on a pilot riparian rehabilitation project at Granite Camp, including the removal of nonnative tamarisk and revegetation with native plants

U.S. Fish and Wildlife Service

In 2014, the FWS will conduct up to five monitoring trips on the Little Colorado River to generate population estimates for humpback chub and other native fishes, and to also monitor the success of upstream translocations. The FWS will continue to work cooperatively with the NPS and the Havasupai Tribe on monitoring Havasu Creek and completing additional translocations of humpback chub in summer 2014. Fish will be collected for translocations from the Little Colorado River and held at the Southwest Native Aquatic Resources and Recovery Center until they are large enough to be marked with a small tag. The FWS will continue to take the lead on developing a monitoring protocol for effectively sampling the mainstem aggregations of humpback chub and will conduct two sampling trips in 2014.

U.S. Geological Survey

The major focus of GCMRC's activities in 2014 is to continue to serve in its role as the primary science provider to the GCDAMP by conducting the field and laboratory studies described in the fiscal year 2013/2014 Budget and Work Plan. Additionally, GCMRC plans to continue providing real-time scientific data needed to implement the High-Flow Experimental Protocol. Specifically, GCMRC will maintain its internet-based real-time reporting of stream flow and sediment storage and transport in Marble and Grand canyons as well as continue providing estimates of the mass of fine sediment supplied to the Colorado River by the Paria and Little Colorado rivers and the mass of fine sediment stored in various parts of Marble and Grand canyons. GCMRC will continue monitoring and reporting on resource conditions following HFEs and working with Reclamation in refining HFE planning protocols. Native and nonnative fish population data will continue to be collected and reported on in support of management decisions regarding nonnative fish control. GCMRC will also provide science support in planning and developing the LTEMP EIS.