RECLAMATION
Managing Water in the West

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

2014-2015

U.S. Department of the Interior
Bureau of Reclamation

August 2015

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 on August 29, 2014**, by Interior for 2013-2014, and covers activities for 2014 and 2015.

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

> in accordance with the additional criteria and operating plans specified in section 1804 and exercise other authorities under existing law in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National 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 Principal Deputy Assistant Secretary for Water and Science Jennifer Gimbel, 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). Collectively these five agencies fund five American Indian Tribes (Hopi, Hualapai, Pueblo of Zuni, Kaibab Paiute, and the Navajo Nation) to participate in the GCDAMP and two Tribal Liaison positions within Interior that assist in coordination between Interior and the tribes. 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 the 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, the 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.

2014 OPERATIONS

Bureau of Indian Affairs

In 2014, the BIA continued to consult with stakeholder tribes on formulating funding requests for various projects related to the GCDAMP. The BIA additionally participated in consultation meetings with the tribes regarding the Tribal Consultation Plan, attended a Section 7 consultation "working lunch" with stakeholder tribes and the FWS, conducted pre-meetings with tribal representatives prior to the AMWG meetings, and participated in meetings regarding cultural and natural resources issues and concerns. Principal among tribal concerns for 2014 remains 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 continue to work to find a way to quantify such values such that they can 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, particularly as it relates to monitoring impacts on cultural resources. The BIA continued to provide its portion of funding to tribes for their participation in the GCDAMP. Other activities included continued coordination of efforts for tribal participation in the GCDAMP and working with the Interior Tribal Liaisons to maximize tribal consultation and involvement.

Bureau of Reclamation

Water Operations

As in 2010 through 2013, a water year (WY) 2014 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, and 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 consensus support from members of the AMWG and was approved by the Secretary on December 9, 2013.

Releases from Lake Powell in WY 2014 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 2014 hydrograph. The monthly release volumes for WY 2014 are displayed in Table 1. The end of water year 2014 elevation for Lake Powell was 3,606 feet.

Table 1. Lake Powell Monthly Release Volumes
Water Year 2014

Month	Monthly Release Volumes (maf*)
October 2013	0.481
November 2013	0.696
December 2013	0.600
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	0.801
September 2014	0.604
Total Releases	7.480

*maf = million acre-feet

The third experimental release under the High-Flow Experimental Protocol was successfully conducted during November 2014. Reclamation released the maximum available capacity (38,000 cubic feet per second [cfs]) during the experiment, which began on November 10 and ended on November 15, 2014. Preliminary findings suggest that the first three high-flow experimental releases have been very successful in transporting sediment accumulated near the confluence of the Colorado and Paria rivers to beaches and sandbars where sediment replenishment was needed. Reports from the Grand Canyon white water rafting community have been extremely positive on the improvement of beaches in Grand Canyon over this 3-year period. Fisheries researchers have also indicated that these releases have temporarily rebuilt important backwater habitats where sandbars are adequately enhanced throughout Grand Canyon.

In 2014, Reclamation continued to fund and support Grand Canyon National Park with several projects including humpback chub translocations in Havasu and Shinumo creeks, non-native 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 Comprehensive Fisheries Management Plan.

LTEMP EIS

In 2014, 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 second structured decision analysis workshop 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 LTEMP EIS Team is continuing to work on analysis of alternatives based on alternatives and analysis methods discussed at the structured decision analysis workshops. A review of the most recent results and extended hydropower analysis was provided at the February 26, 2015, AMWG meeting. The goal of Reclamation and the NPS is to release a public draft EIS in late fall of 2015.

Conservation Measures for Humpback Chub and Razorback Sucker

From fiscal years 2009 through 2015, Reclamation has funded NPS to remove non-native rainbow trout and translocate humpback chub into Shinumo Creek, Havasu Creek, and if non-native removal is successful, Bright Angel Creek in order to fulfill conservation measures from two biological opinions on the operations of Glen Canyon Dam. These actions will provide additional refuge populations that minimize the effects of predation and competition from non-native fish, may establish new spawning populations, and also contribute to the mainstem populations of humpback chub.

Approximately 300 tagged humpback chub were introduced per year from 2009 to 2013 in Shinumo Creek. Passive integrated transponder (PIT) tag antennae indicate that high emigration rates occur shortly after a translocation. However, fish leaving the creek appear to contribute to the mainstem aggregations. Some have remained in the creek for 3½ 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. 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. In May 2014, a lightning-caused fire burned 6,100 acres in the drainage and was followed by monsoon flood events in July and August. These events greatly altered

habitat conditions for fish and destroyed the PIT tag antennae. Biologists hiked into the drainage in September and observed severe flood disturbance in the translocation reach, below Shinumo falls, and the only fish that could be located were speckled dace. As a result, no translocations occurred in 2014.

As of June 5, 2014, a total of 1,350 PIT-tagged humpback chub had been translocated to Havasu Creek. Prior to the first translocations in 2012, baseline fish surveys were conducted. These surveys turned up a surprising 13 wild humpback chub considered to be resident fish and fortunately, very few non-natives were present in the system. Surveys have relocated many of the tagged fish each year including multiple male humpback chub in spawning condition and ripe females, as well as immature untagged humpback chub, and very small untagged juveniles, all indicating that natural reproduction is occurring in Havasu Creek.

Translocations of humpback chub cannot currently be accomplished in Bright Angel Creek due to the large numbers of brown and rainbow trout that inhabit the creek. Consequently, trout removal efforts were increased beginning in 2012 that include a fish weir to trap spawning brown trout near the confluence and electrofishing trips in Bright Angel Creek from Roaring Springs to the mouth of the creek. Reduction efforts to date have yielded 12,456 and 10,545 brown trout and 1,735 and 1,400 rainbow trout in 2012-2013 and 2013-2014, respectively. In addition, from November through December 2013, the NPS (in cooperation with the GCMRC) initiated the Bright Angel Creek inflow reduction project as a pilot study within a defined 5.5-mile section of river at the confluence of Bright Angel Creek with the mainstem of the Colorado. Researchers removed 1,370 rainbow trout and 336 brown trout during the pilot study.

Monitoring has shown that abundance of adult chub in the mainstem has increased or remained stable at all aggregations since sampling began in the 1990s. Humpback chub translocated to Shinumo Creek and to Havasu Creek from 2009-2014 have contributed to the mainstem aggregations that are located at the tributary mouths. Two chub translocated to Shinumo were re-located almost 40 miles upstream at the mouth of the Little Colorado River where they were spawned. Preliminary data analysis from 2014 mainstem aggregation sampling indicate that humpback chub translocated into Shinumo and Havasu tributaries are approximately 70 percent and 35 percent of the total aggregation, respectively. In addition, a large number of adult humpback chub recently located at River Mile (RM) 35 suggests the possibility of a new aggregation or expansion of the 30-mile aggregation. Other areas not associated with known aggregations were sampled in 2013 and 2014, and results indicate that chub are more widely distributed in the mainstem than had been detected previously.

Grand Canyon National Park employs a permitting specialist and staff who review all proposals for projects to be completed in the park. Reclamation funds these positions to offset the park's administrative burden from the GCDAMP activities. In 2014, Grand Canyon National Park's Research Office issued 26 river trip permits, which fulfilled obligations under the GCDAMP. Although the GCMRC has been working to consolidate research trips, this was an increase 2 applications, up from the 24 filed in 2013. The GCMRC was issued 10 research and collection permits and 16 river launch permits, totaling 4,326 river user days. In addition to science trips, the GCMRC permits included logistics for 5 tribal monitoring trips and sponsors 2 trips each year for Grand Canyon Youth. Due to the sensitivity of the Little Colorado River area to tribes

and others, efforts have been made to reduce, combine, and eliminate river trips and helicopter flights into the area wherever possible.

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. 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, and long-distance movement of adult razorback suckers throughout Lake Mead and western Grand Canyon. Because the capture of larval fishes helps to identify where spawning takes place, the duration of spawning activities, habitat use, and availability and fish community dynamics, Reclamation funded additional research for larval fish surveys in the lower reaches of Grand Canyon.

In 2013, two razorbacks were captured downstream of Diamond Creek (RM 225), more than 50 miles upstream from Pearce Ferry. In an attempt to track movements and possibly locate spawning aggregations, in March 2014, nine sonic-tagged adult razorback suckers were released downstream of Lava Falls (RM 180). During the subsequent April monitoring trip, biologists located several of the newly released sonic-tagged fish as well as previously tagged fish that had migrated upstream from Lake Mead. They also located larval razorback suckers at 9 of 47 locations, all upstream from Lake Mead, with the furthest upstream location being Lava Falls (RM 179.2). The detection of these larvae fish indicates that razorback suckers may be naturally reproducing in an area where the species has not been seen in more than 20 years.

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 non-native 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 develop a new Programmatic Agreement (PA) for operation of Glen Canyon Dam pursuant to the GCPA that is consistent with the LTEMP, and anticipates completing the new PA in conjunction with the LTEMP ROD.

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 2014 high-flow experiment (HFE). The park units established individual response 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, the Glen Canyon National Recreation Area successfully worked with the three concessionaires on Lake Powell to minimize impacts to their marina operations.

LTEMP EIS

In 2014, 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. The NPS's Intermountain Regional Office, Washington Office, Grand Canyon, Glen Canyon, and Lake Mead all participated in various LTEMP activities including writing, reviewing, and editing sections of draft documents. The NPS also participated in numerous meetings between Interior representatives and tribal and state representatives.

Archaeological/Cultural Resources

Grand Canyon National Park: Field work in 2014 consisted of condition assessments at 122 river corridor archaeological sites as part of ongoing Colorado River Management Plan implementation. The NPS participated on two tribal monitoring river trips visiting ethnographic resources to determine condition and threats from a tribal perspective. The NPS accompanied a cultural resources assessment river trip with GCMRC and USGS scientists documenting geomorphic setting, impacts, and the potential for HFE-derived sediment to be transported into site boundaries.

The NPS worked with the Pueblo of Zuni to stabilize one site impacted by trailing and potential for inadvertent damage to rock writings from visitors. Zuni Cultural Resource Advisors documented tribal values and assisted in determining appropriate stabilization techniques. The Tribe and the NPS will continue to monitor the success of stabilization at this location.

Glen Canyon National Recreation Area: In 2014, the NPS Submerged Resources Center assisted with documentation and development of monitoring protocols to evaluate potential effects to the Spencer Steamboat. Additional field observations were conducted prior to, during, and following the November HFE to assess changes in resource condition at specific locations. The

NPS also continued to support the GCMRC's monitoring of dam-related topographic changes at select cultural sites.

Tribal Consultation

In 2014, 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. The NPS's Grand Canyon National Park and Glen Canyon National Recreation Area continued discussions with tribes and incorporated tribal perspectives into implementation of the NPS's Comprehensive Fisheries 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 participated in on-river monitoring with the Pueblo of Zuni and continue to work closely with tribal staff on monitoring and mitigation protocols and 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 2014, the Grand Canyon National Park continued implementation of the Comprehensive Fisheries Management Plan for native fish within the Grand Canyon National Park and sport fish in the Lees Ferry area of the Glen Canyon National Recreation Area. These efforts included 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 non-native fishes threatening endangered and native fish in Shinumo and Bright Angel creeks and the Bright Angel Creek inflow area of the Colorado River. A large flash flood and debris flow was recorded in Shinumo Creek during the summer monsoon season. Impacts to native fish were immediately identified and initial assessments suggested little or no survival.

Wildlife Surveys and Monitoring

Grand Canyon National Park: In 2014, 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 2014, Glen Canyon National Recreation Area staff and partners worked on great blue heron, waterfowl, and raptor surveys along the 16-mile reach below the dam. The great blue heron colony has expanded to >40 nests. Work continued on monitoring aquatic/riparian invertebrates and terrestrial vertebrate populations creating open water habitat at Leopard Frog Marsh for potential reintroduction of extirpated northern leopard frogs. The first frog breeding pool was created. In early 2015, a native adult tiger salamander was discovered in this pond and is the first record of this species along the river corridor.

Vegetation Management/Exotic Species Removal

Grand Canyon National Park: In 2014, the NPS 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. The NPS also maintained 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.
- Continued the first riparian restoration project in the river corridor at Granite Camp (RM 94) through site maintenance and outreach to project partners.
- Continued propagation of riparian plant species for supplemental planting at Granite Camp or other future riparian restoration projects.
- Removed the following exotic plant species:

    - ✓ Camelthorn - 1,535 (from camps and attraction sites)
    - ✓ Pampas grass - 1 (from along the river corridor)
    - ✓ Ravenna grass - 1 (from along the river corridor)
    - ✓ Russian olive - 1 (from along the river corridor)
    - ✓ Sahara mustard - 692 (from along the river corridor and at Lees Ferry)
    - ✓ Silverleaf nightshade - 1,082 (from camps and along the river corridor)
    - ✓ Tamarisk - 1,025 (from Granite Camp and attraction sites)

Glen Canyon National Recreation Area: In 2014, the NPS, 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:

- Grand Canyon Wildlands Council staff and Vanderbilt University Alternative Spring Break students improved fencing around planted cottonwoods and willows to protect from beaver herbivory at the Lees Ferry 10-acre restoration site.
- Grand Canyon Wildlands Council (under cooperative agreement with the NPS) continued monitoring native plant restoration success at Hidden Slough.
- Grand Canyon Wildlands Council, Prescott College students, and the NPS began re-establishing open water habitat at Leopard Frog Marsh and Hidden Slough for potential reintroduction of extirpated northern leopard frogs.
- 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 non-native species infestations:

    - ✓ Russian olive - 5 treated between the Glen Canyon Dam and Glen Canyon/Grand Canyon boundary and 16 treated 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, Leopard Frog Marsh, and Lees Ferry.
- ✓ Ravenna grass - 4 treated between the Glen Canyon Dam and Glen Canyon/Grand Canyon boundary.

Research Review and Permitting

The 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 2014, the Grand Canyon's Research Office received 26 river trip applications to fulfill obligations under the GCDAMP. The GCMRC was issued 10 research and collection permits and 16 stand-alone river permits, totaling 4,326 user days. Five tribal research permits with corresponding river trips were permitted for the Hopi, Hualapai, Navajo, Paiute, and Zuni tribes, totaling 861 user days. Overall, 5,187 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 2014, 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 NPS 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 2014. An additional 39 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.

The Glen Canyon National Recreation Area continued administration of 10 research permits associated with the GCDAMP between Glen Canyon Dam and the Paria River. The NPS anticipates continuation of research and permitting activities in 2015 at similar levels as 2014. For each of the research projects in support of the GCPA, evaluation of need for NEPA compliance 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

In 2014, the Grand Canyon National Park continued the integrated campsite monitoring and mitigation program. The trip conducted in February included photographic documentation of

campsites, and campsite rehabilitation projects in areas above the 25,000 cfs flow line and pre-dam high water areas. The Grand Canyon National Park is continuing to evaluate and refine their monitoring and mitigation protocols to ensure applicability to changing field conditions and management needs. A revised draft monitoring plan was completed in September 2014 and monitoring is scheduled for April 2015.

The Glen Canyon National Recreation Area continued 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.

The Glen Canyon National Recreation Area also employed the use of cameras at several localities to monitor terrace erosion and changes related to dam operations and HFEs. This work will continue in 2015.

Greater Grand Canyon Landscape Assessment

In 2014 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), continued working on 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 2014, the efforts of the previous year's technical work groups, comprised of subject matter experts and interested stakeholders, helped to 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 was convened to garner feedback on draft products and provide an opportunity for input into the prioritization process. The remainder of 2014 involved 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 continued to provide technical assistance to support the NPS's Comprehensive Fisheries Management Plan, which guides NPS activities for native and non-native fish in Grand Canyon National Park and Glen Canyon National Recreation Area. The FWS 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 2014, 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. In 2014, the FWS continued this translocation effort, moving an additional 305 humpback chub upstream of Chute Falls.

The FWS has continued to work collaboratively with the GCMRC and the Grand Canyon National Park in the collection and transport of young humpback chub for translocation into Havasu Creek. A total of 660 humpback chub were collected in 2014, transported to the Southwest Native Aquatic Resources and Recovery Center in Dexter, New Mexico, and will be held there until they are large enough to be marked with a small tag and translocated in 2015.

The FWS has taken the lead, and continues to work collaboratively with the GCMRC and the NPS, to develop and refine a monitoring program to effectively sample mainstem aggregations of humpback chub in the Colorado River in Grand Canyon. In 2014, the FWS and the GCMRC 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 2014, the GCMRC continued to serve in its role as the primary science provider to the GCDAMP. The GCMRC's primary activities during 2014 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) developing a 3-year Budget and Work Plan encompassing fiscal years 2015-2017, (3) maintaining a stream flow and sediment transport measurement and internet-based real-time reporting program that was the foundation for planning a November HFE, (4) analysis of those data so as to inform dam and river management activities in the months immediately before the HFE, (5) collection and reporting of data describing resource condition immediately following the HFE, and (6) collection and reporting of native and non-native fish population data in support of management decisions regarding non-native fish control. Additionally, the GCMRC conducted numerous field and laboratory studies and provided logistics support for river trips and other field activities as outlined in the fiscal year 2013/2014 Budget and Work Plan, and provided scientific support for development of the LTEMP EIS.

Knowledge Synthesis

In January 2014, the 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 the GCMRC and cooperating agencies were presented. All materials presented at the workshops were made available in electronic postings at the GCMRC and Reclamation websites.

Development of a 3-Year Budget and Work Plan for Fiscal Years 2015-2017

In close cooperation with the GCDAMP stakeholders, the GCMRC developed a 3-year Budget and Work Plan for fiscal years 2015-2017. Similar to the 2013/2014 Budget and Work Plan, the new plan was organized into a relatively small number of focused projects. Key topics of study include hydrology, sediment transport, geomorphology, fisheries, aquatic ecology, riparian vegetation, cultural resources, and socioeconomics.

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

The period July 1 to November 30, 2014, marked the third "sediment accumulation period" as defined under the High-Flow Experimental Protocol that was adopted by the Secretary in 2012. This HFE 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. The 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. The GCMRC staff estimated that between 900,000 and 1,300,000 metric tons of fine sediment was delivered from the Paria River to the Colorado River during the period between July 1 and November 9, 2014. The HFE began on November 10 and ended on November 15, 2014.

Analyses of Sediment Transport Data to Inform HFE Planning and Design

The 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 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

The 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 2014 and January 2015 to collect photographic data and recover gaging station data. Preliminary results indicate that there was favorable bar building in Marble and Grand canyons caused by the fall 2014 high-flow experiment. The most recent topographic surveys of long-term monitoring sites from fall 2013 indicate sandbars increased in size during the first 2-years of implementation of the HFE Protocol. 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 2014 with additional data presented at the January 2015 annual reporting meeting described above. Additional information about the effects of the HFE were presented at a GCDAMP meeting and HFE workshop in late February 2015. 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 only responds weakly to fall HFEs as shown by slight increases in abundance of some aquatic insects and an invasive snail species and slight decreases in abundance of other non-insect invertebrates (tubificid worms and amphipods) within weeks to months of these events.

Fisheries Information in Support of Non-Native Fish Control EA

The GCMRC conducted monitoring of native and non-native fish populations in support of Reclamation's non-native 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 non-native fish populations in an effort to protect humpback chub. Information provided by the GCMRC for specific triggers includes the abundance of non-native rainbow trout and brown trout in the Colorado River near the Little Colorado River confluence. The 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 2014, no other trigger levels, including those for humpback chub, were reached so no non-native fish control actions were required or implemented. As of April 2015, it appears that, due to declining rainbow trout abundance system wide, the trigger for rainbow trout abundance has no longer been exceeded based on surveys in January and April of 2015.

Other Science Activities and Findings

In the course of its regular and mandated science monitoring and research activities, the GCMRC and its cooperators provided stakeholders and the GCDAMP with other information including (1) 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; (2) status and trends of rainbow trout in Glen Canyon, Marble Canyon, and near the Little Colorado River confluence; (3) distribution and relative abundance of potentially harmful non-native fish species between Glen Canyon Dam and Lake Mead reservoir; (4) status and trends of the aquatic foodbase in the Colorado River ecosystem; and (5) status of archaeological and other cultural sites and monitoring the transport of HFE derived sand by wind into these sites.

The GCMRC was permitted for and provided logistics support for 26 mainstem river trips in 2014, two more trips than in 2013. Trips in 2014 included 16 GCDAMP approved research and monitoring trips led by GCMRC or cooperating agency scientists that launched from Lees Ferry; 1 HFE monitoring trip that launched from Lees Ferry; 1 fisheries monitoring trip that launched from Diamond Creek; 1 project to replace the Diamond Creek cableway, which included daily launches from Diamond Creek; and 5 tribal-led monitoring trips. Logistics support, including

helicopter support, was also provided for GCDAMP funded projects in the Little Colorado River conducted by the FWS, Arizona Game and Fish Department, and GCRMC. Five Little Colorado River trips were conducted in 2014 (two fewer than 2013) with each trip requiring two flight days, one to take crews into field camps along the river and one to retrieve them. One additional flight day (one less than in 2013) was required to accommodate crew exchanges for the Arizona Game and Fish Department.

Many GCMRC scientists also provided support to the ongoing LTEMP EIS process. Support included 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.

2015 OPERATIONS

Bureau of Indian Affairs

In 2015, 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, 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. The BIA will coordinate with, and if necessary meet with, Interior's Tribal Liaisons to facilitate stakeholder tribe participation in various aspects of the GCDAMP.

Bureau of Reclamation

Water Operations

As in 2010 through 2014, a WY 2015 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, and 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 September 29, 2014.

Releases from Lake Powell in WY 2015 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 2015 hydrograph. As of August 13, 2015, the observed and projected monthly release volumes for WY 2015 are displayed in Table 2. The end of water year 2015 elevation for Lake Powell is projected to be 3,608 feet.

Table 2. Lake Powell Monthly Release Volumes
Water Year 2015

Month	Monthly Release Volumes (maf*)
October 2014	0.598
November 2014	0.777
December 2014	0.864
January 2015	0.862
February 2015	0.589
March 2015	0.649
April 2015	0.600
May 2015	0.699
June 2015	0.800
July 2015	1.048
August 2015**	0.800
September 2015**	0.713
Total Releases**	9.000

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

Reclamation will continue planning for high-flow experimental releases from Glen Canyon Dam in November 2015 in accordance with the High-Flow Experimental Protocol and Reclamation's May 12, 2012, FONSI.

LTEMP EIS

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

Conservation Measures for Humpback Chub and Tribal Activities

Many of the activities described above will continue in 2015, but may be modified depending on the completion of the LTEMP EIS and the biological opinion that will follow. Reclamation will continue to provide funding to the GCMRC and the NPS for cultural, aquatic, and sediment research and for the participation of five American Indian Tribes in the GCDAMP (as described above for 2014). Reclamation will continue efforts to develop a new Programmatic Agreement for operation of Glen Canyon Dam pursuant to the GCPA and consistent with the LTEMP.

National Park Service

LTEMP EIS

In 2015, 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. The NPS's Intermountain Regional Office, Washington Office, Grand Canyon, Glen Canyon, and Lake Mead all participated in various LTEMP activities. The NPS will participate with Reclamation and Interior in the public meetings and review and comment on the draft EIS, anticipated to be released in the late fall of 2015.

Archaeological/Cultural Resources

Grand Canyon National Park: In 2015, work will include participating in tribal monitoring field sessions along the river. One field session devoted specifically to testing monitoring protocols for visitor use will also document visitor impacts to a selection of archaeological sites.

The NPS and tribal consultants continue working collaboratively on an interpretive brochure for the Unkar Delta sites. One river trip will include the NPS and tribes to review the work to date on site.

Glen Canyon National Recreation Area: In 2015, work will include progress in the development and evaluation of monitoring protocols for terrestrial resources to evaluate potential effects resulting from dam operations. Staff will continue opportunistic monitoring around planned high-flow experiments.

Tribal Consultation

In 2015, 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. The Grand Canyon National Park and the Glen Canyon National Recreation Area will continue discussions with tribes to incorporate tribal perspectives into implementation of the NPS's Comprehensive Fisheries Management Plan. Tribal advisors will continue to be consulted on specific monitoring and mitigation protocols relative to the Colorado River Management Plan implementation. The Grand Canyon National Park anticipates working with the Pueblo of Zuni and external partners on projects to better protect important resources along the Colorado River. Specific efforts will be made with the Pueblo of Zuni relative to creating a "buffer" zone near the confluence of Bright Angel Creek and Ribbon Falls Creek. This zone will incorporate specific removal techniques including use of nets and elimination of electrofishing in that area. Additional crew training will occur with representatives from Zuni to discuss specific concerns. Park staff anticipates working with representatives from traditionally associated tribes to gather information on the Salt Mines located along the river downstream of the Little Colorado River confluence.

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 Comprehensive Fisheries Management Plan will continue into 2015. 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 non-native 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 2015, the Grand Canyon National Park 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 2015, the Glen Canyon National Recreation Area plans to continue programs related to desert bighorn sheep, aquatic/riparian invertebrates and terrestrial vertebrate populations, and northern leopard frog and ambersnail habitat enhancements.

Vegetation Management/Exotic Species Removal

In FY 2015, the NPS will attempt to continue the Adopt-a-Camp program through work with 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 2016, but vegetation program staff will work with wildlife staff and compliance staff to continue strategic planning efforts for that project.

In 2015, the NPS, 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

The NPS anticipates continuation of research and permitting activities in 2015 at similar levels as 2014. For each of the research projects in support of the GCPA, peer review of the proposals, evaluation of need for NEPA compliance, 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

The Grand Canyon National Park will continue integrated campsite monitoring in 2015 based on the revised campsite monitoring protocols. The NPS will continue to conduct campsite use surveys. One trip for Lower Gorge campsites is planned to mitigate vegetation encroachment on campsites below Separation Canyon.

Greater Grand Canyon Landscape Assessment

In 2015, 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. Final reports are due in late 2015. The NPS will continue to work on a pilot riparian rehabilitation project at Granite Camp, including the removal of non-native tamarisk and revegetation with native plants.

U.S. Fish and Wildlife Service

In 2015, the FWS will conduct four 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 Havasupai Tribe on monitoring Havasu Creek and completing additional translocations of humpback chub in the summer of 2015. 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 1 sampling trip in 2015.

U.S. Geological Survey

The major focus of the GCMRC's activities in 2015 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 years 2015-2017 Budget and Work Plan. Additionally, the GCMRC plans to continue providing real-time scientific data needed to implement the High-Flow Experimental Protocol. Specifically, the 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. The GCMRC will continue monitoring and reporting on resource conditions following HFEs and working with Reclamation in refining HFE planning protocols. Native and non-native fish population data will continue to be collected and reported on in support of management decisions regarding non-native fish control. The GCMRC will also provide science support in planning and developing the LTEMP EIS.