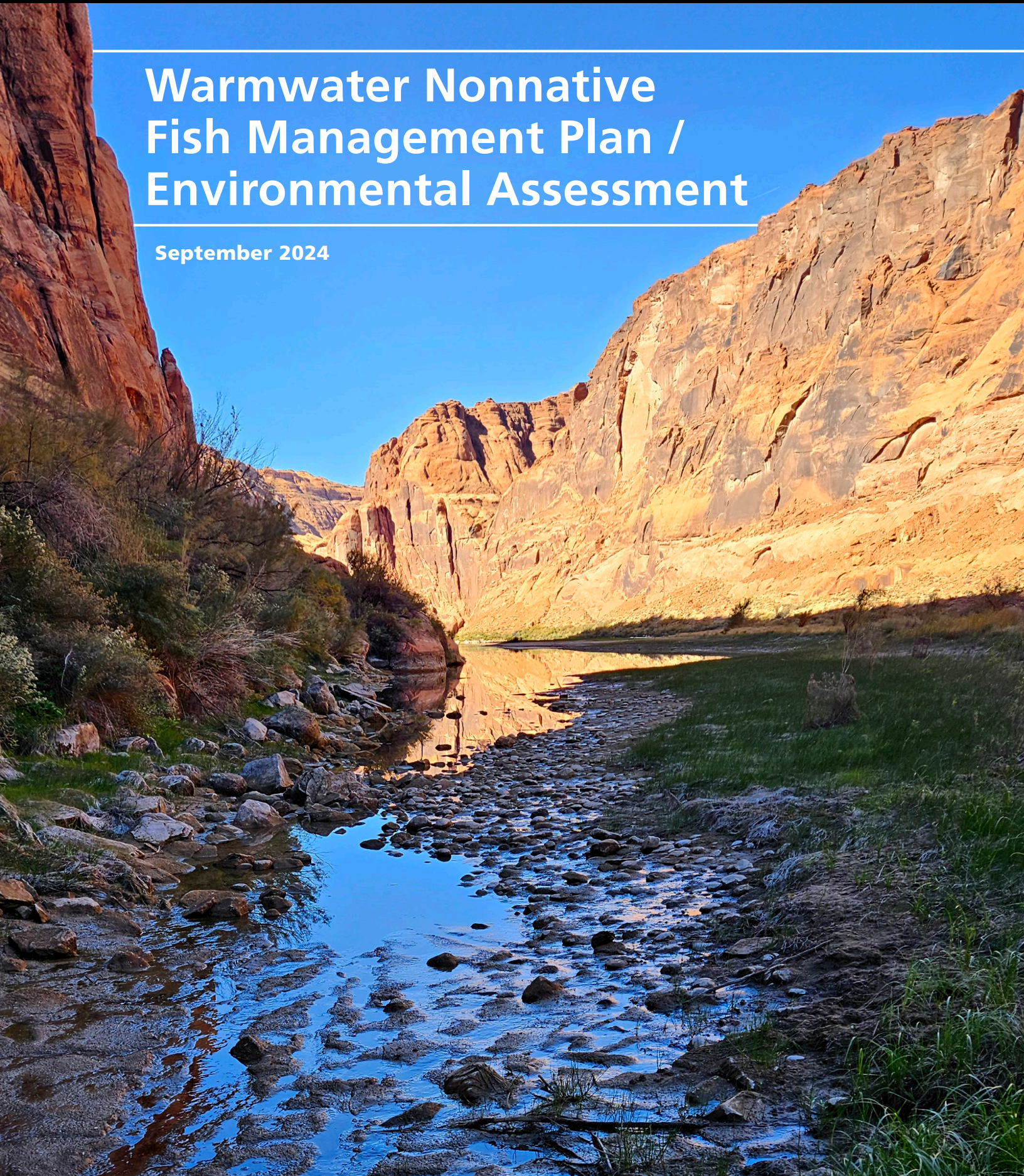




# Warmwater Nonnative Fish Management Plan / Environmental Assessment

September 2024







**National Park Service**

**US Department of the Interior**

**Glen Canyon National Recreation Area**

**Warmwater Nonnative Fish Management Plan /  
Environmental Assessment**

**Arizona and Utah**

**September 2024**

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# CHAPTER

# 1

## **OVERVIEW, PURPOSE, AND NEED**



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# CHAPTER 1: OVERVIEW, PURPOSE, AND NEED

## 1.1 ABOUT THIS ENVIRONMENTAL ASSESSMENT

This Environmental Assessment (EA) evaluates actions where physical modifications of a backwater slough complex are proposed in Glen Canyon National Recreation Area (Glen Canyon NRA) at the -12-mile marker on the Colorado River, located 3 miles below Glen Canyon Dam and 12 miles upriver from Lees Ferry. The proposed action is intended to disrupt warmwater non-native fish reproduction overall, with particular focus on reducing numbers of high risk (predatory) non-native warmwater fish. Predatory non-native warmwater fish threaten current populations of native fish in the Colorado River in Glen, Marble, and Grand Canyons. These threats are of great concern regarding long-term survival of the federally listed humpback chub (*Gila cypha*, threatened) and razorback sucker (*Xyrauchen texanus*, endangered) under the Endangered Species Act of 1973 (Public Law 93-205; 87 Stat 884), as amended.

For the purposes of this EA, the term slough is defined as a pond, a backwater, and a river inlet, all formed within a river side channel. Water in the sloughs is calm, with water flow rates low. The slough complex (hereafter called “the slough”) is currently composed of 6-acre lower slough backwater and a smaller roughly 0.3-acre upper slough pond.

This 2024 EA may be viewed on the National Park Service Planning, Environment and Public Comment (PEPC) web site using this link <https://parkplanning.nps.gov/projectHome.cfm?projectId=123839> on any computer. During the official EA public comment period, any person may use this PEPC web site to review this EA and contribute related comments to the National Park Service.

This 2024 EA incorporates by reference the considerations and management tools evaluated in the following two prior EA documents, along with one environmental impact statement (EIS).

*Expanded Nonnative Aquatic Species Management Plan* (NPS 2018), the *Glen Canyon Dam Long-Term Experimental and Management Plan* (LTEMP) *Environmental Impact Statement* (DOI 2016), and the *Comprehensive Fisheries Management Plan* (CFMP), *Environmental Assessment* (NPS 2013).

## 1.2 PURPOSE AND NEED FOR PROPOSED ACTION

**Purpose:** The purpose of taking action is to compliment collaborative, interagency management strategies being implemented to prevent the successful reproduction of high-risk (predatory) warmwater nonnative fish, particularly smallmouth bass and green sunfish in the upper and lower sloughs at river mile -12, which has conditions favorable for nonnative fish spawning. The approach would seek to minimize negative effects on native species, restore natural functions or dynamics, and mitigate impacts, as necessary.

**Need:** The need is driven by increased levels of entrainment of high-risk nonnative warmwater species surviving passage through the Glen Canyon Dam due to lower Lake Powell elevations, the increased dam outflow temperatures in 2022 and 2023, the expectation that these conditions will occur in the future, and the resulting reproduction of predatory smallmouth bass and green

sunfish, including in the river mile -12 upper and lower slough. Reducing nonnative fish reproduction at this site would help reduce the likelihood of their downstream expansion and establishment in Glen, Marble, and Grand Canyons.

Action is needed to disrupt or prevent the establishment of high-risk (predatory) warmwater nonnative fish in the proposed project area by limiting additional recruitment before the 2025 reproductive season and beyond. Warmwater nonnative fish threaten populations of the federally listed fish species humpback chub and razorback sucker and other native fish, amphibians, and invertebrates in Glen Canyon, Marble Canyon, and Grand Canyon.

### **1.3 GLEN CANYON NATIONAL RECREATION AREA AND THE -12-MILE SLOUGH**

Glen Canyon National Recreation Area was established as a unit of the National Park Service when the enabling legislation adopted by Congress was signed into law on October 27, 1972. Glen Canyon NRA, located at the center of the Colorado Plateau, provides for public enjoyment through diverse land- and water-based recreational opportunities. Glen Canyon NRA also protects scenic, scientific, natural, and cultural resources on Lake Powell, the Colorado River, its tributaries, and surrounding lands.

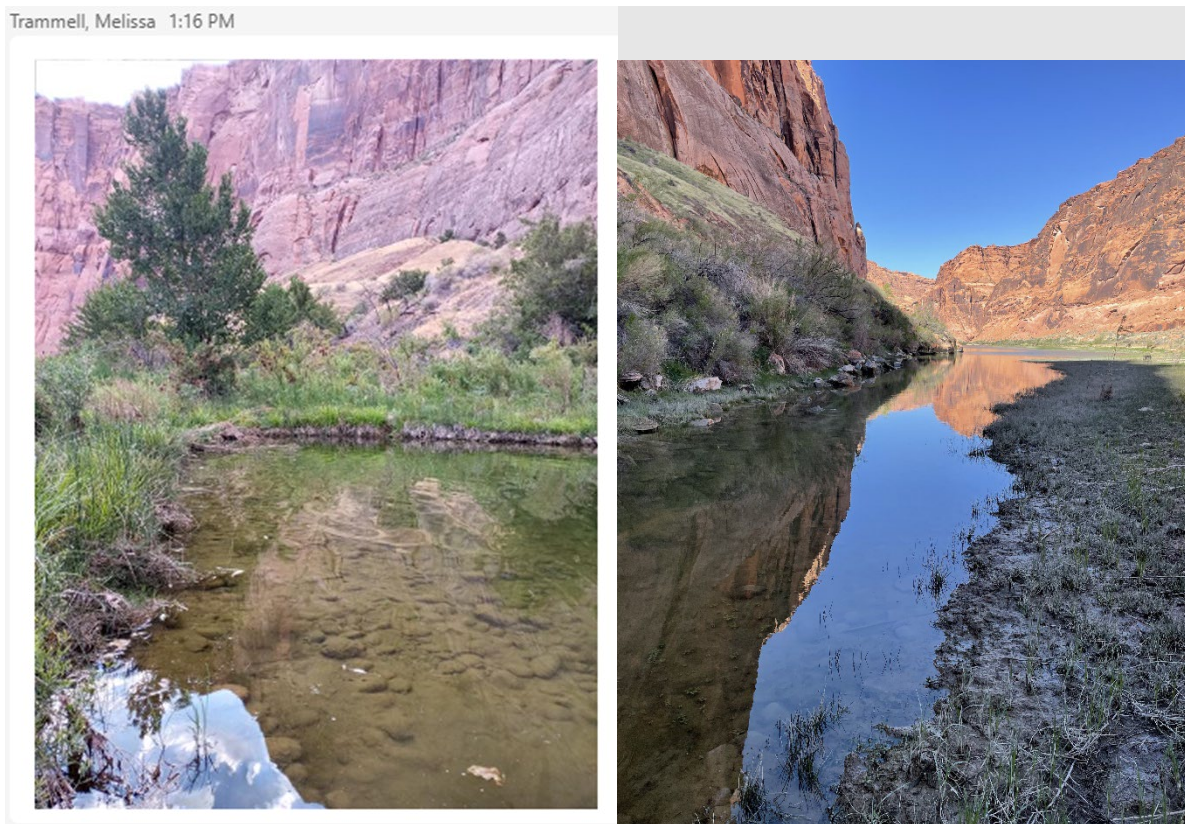
Glen Canyon National Recreation Area and Grand Canyon National Park are both protected under the Grand Canyon Protection Act of 1992 (Title XVII of Public Law 102-575). Section 1802 of the act directs the secretary to establish and implement long-term monitoring programs and activities to ensure the Glen Canyon Dam is operated in such a manner as to protect, mitigate adverse impacts, and improve the values for which both parks were established. This includes natural resources, cultural resources, and visitor use.

Significance statements, identified in the park's foundation document, express why a park's resources and values are important enough to merit designation as a unit of the national park system. Because the slough complex ("slough") is part of Glen Canyon, the proposed actions at the slough would potentially impact the resources and values identified in the following four significance statements for Glen Canyon NRA.

- The Colorado River and its many tributaries, including the Dirty Devil, Paria, Escalante, and San Juan rivers, carve through the Colorado Plateau to form a landscape of dynamic and complex desert and water environments.
- The vast, rugged landscapes of Glen Canyon NRA provide an unparalleled spectrum of diverse land- and water-based recreational opportunities for visitors of wide-ranging interests and abilities.
- Glen Canyon NRA preserves a record of more than 10,000 years of human presence, adaptation, and exploration. This place remains substantial for many descendant communities, providing opportunities for people to connect with cultural values and associations that are both ancient and contemporary.
- The deep, 15-mile-long, narrow gorge below the dam provides a glimpse of the high canyon walls, ancient rock art, and a vestige of the riparian and beach terrace

environments that were seen by John Wesley Powell's Colorado River expedition in 1869, providing a stark contrast to the impounded canyons of Lake Powell.

The slough is currently composed of a 6-acre lower slough backwater and a smaller roughly 0.3-acre upper slough pond, which measures 70 feet by 200 feet (figure 1-1). The lower slough has clear to turbid water and experiences daily and nightly tidal-like influence from the river mainstem via dam hydropower fluctuation operations. The upper slough is a clear water pond, which currently maintains steady pond levels independent of river flows, largely because of a spring inflow from the bottom of the upper end of the upper slough. Both the upper and lower slough are adjacent to a bar currently composed of sand and cobble.



**Figure 1-1. Upper slough (left) and lower slough (right)**

#### **1.4 LOCATION, BACKGROUND, AND HISTORY**

The two photos in figure 1-2 (below) show the slough site in the year 1889 compared to the year 2011. The 1889 photo, captured 74 years before 1963 dam completion, shows a sandbar and a distant backwater that have persisted in various forms during the past 135 years or longer. The bar is composed of sand with no vegetation, suggesting a more dynamic river with high spring season flows and summer monsoon flash floods, which at times flowed over the bar. The 2011 photo, captured 61 years after dam completion, shows the slough site with cobble and vegetation growth, suggesting a less dynamic river with less frequent flows of water over the bar. During the 135-year period, the general shape of the bar and lower slough backwater remain similar, even though river flows at times covered the entire slough and bar with high water flows.





**Figure 1-2. The slough site in the years 1889 (top) and 2011 (bottom)**

The slough site has many values and uses for many people, reflecting the park's significance statements. The slough is located within Glen Canyon alongside the Colorado River. The

Colorado River is a Traditional Cultural Property of interest to traditionally associated Tribes, seven of which are affiliated with the Glen Canyon portion of the river. Some Tribes speak of the canyons in their creation stories, including Glen Canyon. The slough site contains some plants of ceremonial or medicinal value to Tribes. The slough site and adjacent bar are currently visited for recreation opportunities, such as bow hunting for carp, angling for trout, winter duck hunting, and picnic rest stops during boating and kayaking. Other people visit the slough to experience its wildlife and aesthetic qualities, including birdwatchers and artists. Wildlife at the slough includes mammals, fish, waterfowl, amphibians, and invertebrates.

The orientation of the slough is shown in figure 1-3, with a view from directly above the slough site in 2023. Figure 1-4 shares a broader view of where the slough site is located near Page, Arizona, upriver from the famous Horseshoe Bend.

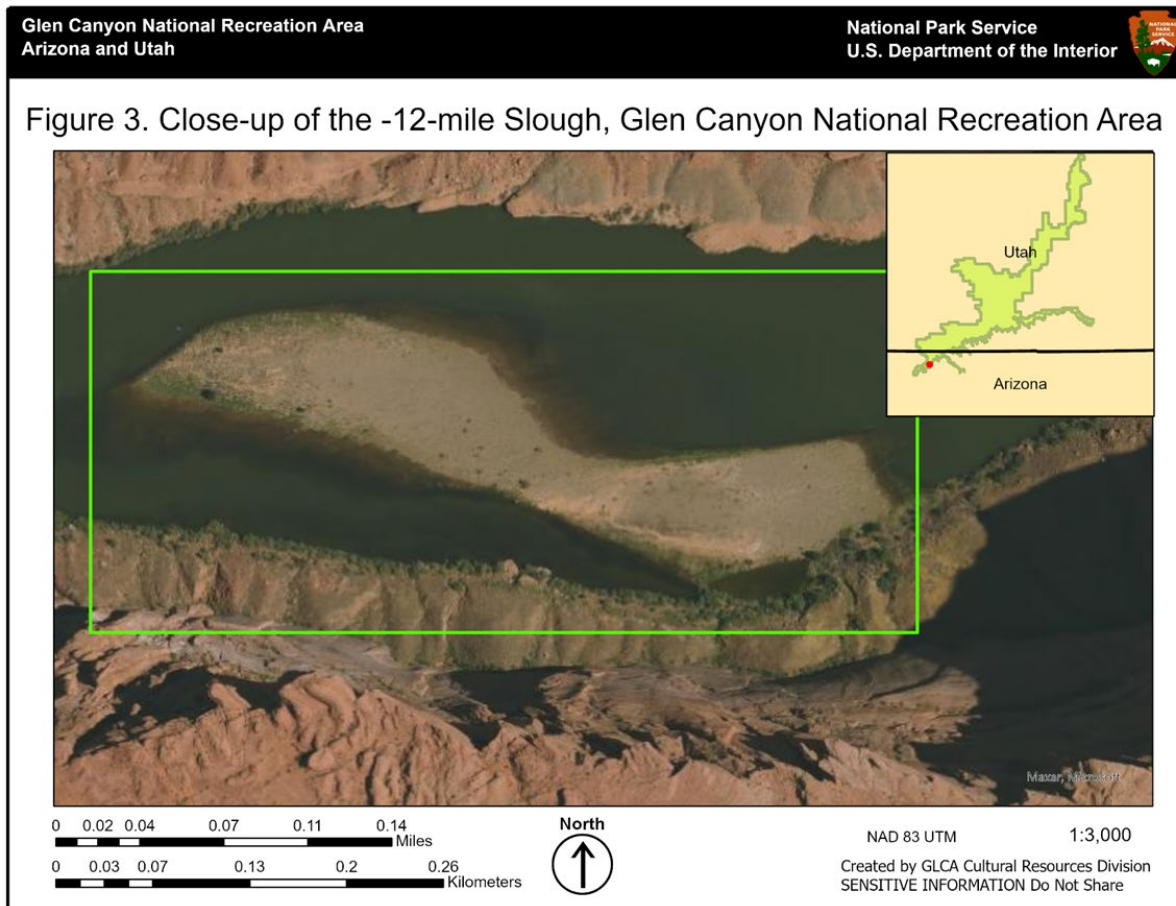


Figure 1-3. The slough site in the year 2023





**Figure 1-4. General project location for proposed -12-mile slough channelization**

Sixta and Randle (2023) note the completion of Glen Canyon Dam in 1963 resulted in trapping the sediment load of the Colorado River. This, in turn, resulted in clearwater releases, causing the river mainstem to incise, armor, and narrow. Near the slough site, the riverbed has lowered by 10 feet or more, while the water surface elevation has lowered 5 feet or more since 1959 (Grams et al. 2007). After many years, the river mainstem became deeper along the right side of the canyon while the left side of the canyon became more exposed as a sand and gravel bar. Over time, this isolated the upper end of the historic river side channel at the slough site from the mainstem of the river, restricting side channel flows. Depressions in the side channel continued to support what are now the upper and lower sloughs.

Data suggest that the side channel at the slough flowed intermittently with water from the river mainstem during the past 85 years. Sixta and Randle (2023) note in their modeling that the slough side channel will flow with river water when the river mainstem flows at 20,000 cubic feet per second (cfs) or greater. Table 1-1 below (USGS 2024) shows the percentage of time flows at Lees Ferry equaled or exceeded 22,000 cfs between 1940 and 2023, which is the level of dam discharge needed to create flow through the side channel based on current channel morphology (Wright et al. 2024). With less-frequent flows through the side channel, the lower slough currently remains a tidal backwater at its downstream interface with the river mainstem. Table 1-1 also notes scouring flows (1950 to 1963) and flooding (1983 and 1984), which may have contributed large cobble to armoring of the slough sandbar surface.

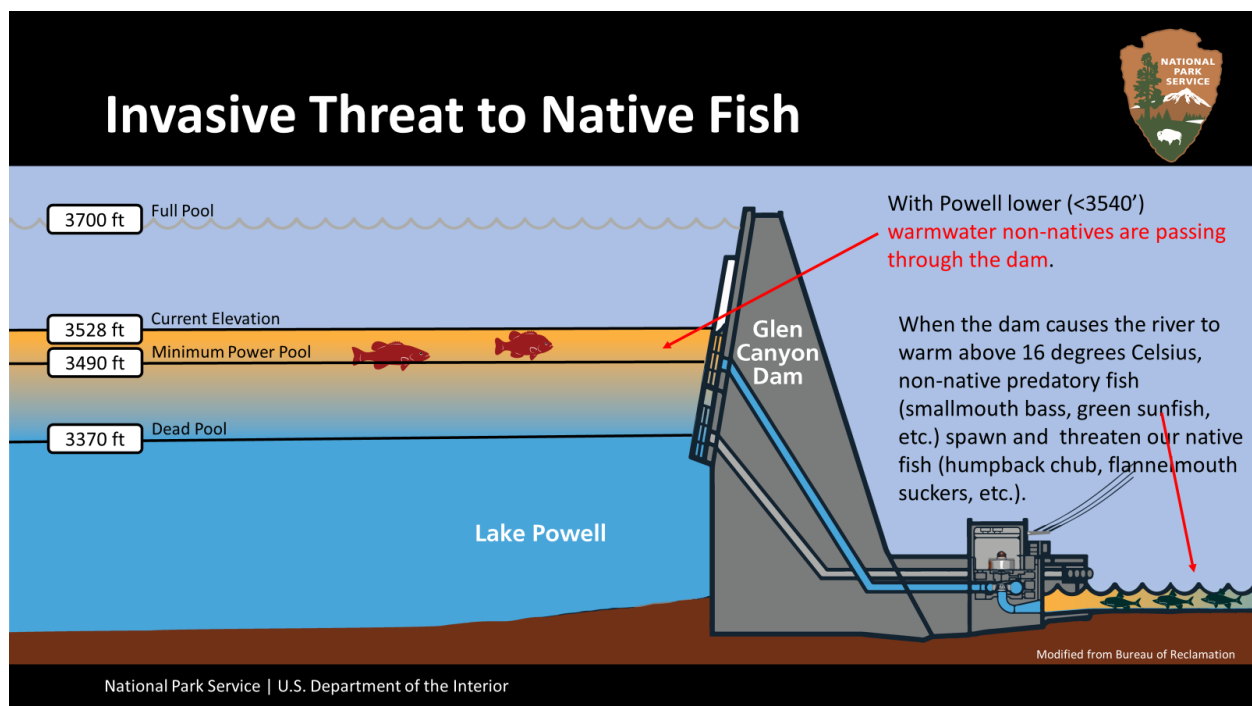


**Table 1-1. Percent of time flows at Lees Ferry equaled or exceeded 22,000 cfs\* (USGS 2024), the level needed to see flow through the slough side channel (Wright et al. 2024)**

Period	Percent of Time	Notes	Max of Annual Flow Avg (cfs)	Avg of Annual Flow Avg (cfs)
1940–1950	22	Peaked every spring season for extended periods > 45,000 cfs but no daily fluctuations.	23,490	17,431
1950–1963	18	Peaked every spring season > 45,000 cfs, but there were big scouring flows before the full dam closure that reduced channel elevation in Glen Canyon below the dam and washed away much of the sediment	24,740	14,718
1963–1970	3	Dam release flows were lowered to fill the dam, and there were no more spring season peak flows during this period.	14,950	9,574
1970–1980	10	Dam releases had large daily fluctuations for hydropeaking, and there were no more spring season peak flows during this period.	13,960	12,093
1980–1990	35	Dam releases had large daily fluctuations for hydropeaking and no spring season peaks until the 1983/1984 years, when there were large flooding/spillway releases when the reservoir was full.	28,240	18,079
1990–2000	5	Dam release fluctuations were reduced after the 1992 Grand Canyon Protection Act and further under modified low fluctuation flows after the 1996 EIS. Very few high flow events; only one high flow event in 1996. Summer steady flow experiment in 2000.	19,120	13,815
2000–2010	<0.6	Dam release fluctuations per modified low fluctuation flows. Very few high flow events, only one high low event in 2008.	13,120	11,829
2010–2020	3	More frequent high flow events start in 2014, and LTEMP reduces fluctuations further in 2016.	17,580	12,743
2020–2023	<0.8	Reductions in annual release levels and few high flow events—only one in 2023 during this time period.	12,060	11,218

\* Source: US Geological Survey Lees Ferry gage data

During 2022 and 2023, lower water levels in Lake Powell passed warmer water and predatory warmwater nonnative fish through the Glen Canyon Dam into the Colorado River below (figure 1-5) (Eppehimer et al. 2024). Bureau of Reclamation (Reclamation, hereafter) modeling shows that lake levels are likely to be at these lower levels in the future under most climate change scenarios. Their projections anticipate river temperatures below Glen Canyon Dam to exceed 15.5°C often in the future, unless other actions are taken to avoid this, such as a cool-mix of water from bypass tubes at the base of the dam (BOR 2024a). In 2022 and 2023, elevated river temperatures (>15.5°C) resulted in nonnative predatory fish spawning and growing in numbers within approximately the first 20 miles of the river below the dam. In particular, the predatory nonnative smallmouth bass (*Micropterus dolomieu*) and green sunfish (*Lepomis cyanellus*) have grown in numbers and threaten survival of native fish such as flannelmouth suckers (*Catostomus latipinnis*) and the federally threatened humpback chub (*Gila cypha*).



**Figure 1-5. Lower water levels in Lake Powell send warmer water with nonnative predatory fish into the Colorado River below**

Nonnative warmwater predatory fish threaten both native fish and rainbow trout (*Oncorhynchus mykiss*) sport fish in the Colorado River. Green sunfish spawning was first detected in both the upper and lower sloughs in 2015 (BOR 2022), and they have spawned frequently since then. Smallmouth bass spawning was first detected in the lower slough at the end of June 2022 by a Glen Canyon NRA fish biologist and again in July of 2023. Each year, water in the slough warms much earlier and for much longer than in the adjacent Colorado River mainstem. The calmer warmer waters of the slough create ideal spawning conditions for smallmouth bass, green sunfish, and other nonnative warmwater fish, raising the level of threat the predatory nonnative warmwater fish pose to native fish, sportfish, amphibians, and invertebrates in and along the river.

During 2024, Glen Canyon NRA fish crews were highly successful in using netting and other methods to prevent smallmouth bass from entering both the upper and lower sloughs, thus preventing breeding by these bass in the sloughs from April to the time of the writing of this 2024 EA in September. The Reclamation's cool-mix flows into the river from Glen Canyon Dam started on July 9, 2024 (BOR 2024a), and the cool-mix strategy so far has been highly successful in lowering water temperatures in both the river and in the lower slough to below the 15.5°C breeding threshold for nonnative warmwater fish. The upper slough water continues to remain warmer compared to the river and lower slough. Green sunfish were found in both the upper and lower sloughs during 2024 in numbers lower than in the prior two years.

## **1.5 ISSUES AND IMPACT TOPICS ADDRESSED IN THIS ENVIRONMENTAL ASSESSMENT**

Appendix A provides a summary of impact topics identified for or dismissed from detailed analysis in this EA for proposed slough channelization.

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## CHAPTER

# 2

## ALTERNATIVES

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## CHAPTER 2: ALTERNATIVES

The National Park Service proposes habitat modification in the form of a river side channel restoration at the slough site in Glen Canyon NRA. This proposed action converts still water slough habitat into a restored flowing river side channel that reconnects at both ends to the mainstem of the Colorado River. This restoration action would cool water temperatures and increase water flow rates to help prevent nesting and spawning by predatory warmwater nonnative fish. This action would help reduce the overall threats by predatory nonnative warmwater fish on native fish species, amphibians and invertebrates in Glen, Marble, and Grand Canyons. This proposed project would assist in overall conservation and recovery downstream for the federally threatened humpback chub and federally endangered razorback sucker, along with benefitting other native fish species such as flannelmouth and bluehead suckers.

Multiagency efforts to understand and control warmwater nonnative fish in Glen, Marble, and Grand Canyons were identified in the document, *Glen Canyon Dam Adaptive Management Program's Invasive Fish Species below Glen Canyon Dam: A Strategic Plan to Prevent, Detect, and Respond* (GCDAMP 2023). The proposed action in this 2024 EA supports these ongoing efforts by preventing nonnative warmwater fish spawning in both the river and the slough. This action would also improve the effectiveness of Reclamation's recently approved Long-term Experimental and Management and Program (LTEMP) Supplemental Environmental Impact Statement (SEIS) cool-mix water smallmouth bass flows (BOR 2024a). These flows are aimed at reducing temperature in the mainstem to prevent warmwater nonnative fish spawning. The proposed action would improve flow into the slough, which would allow slough temperatures to mirror river mainstem temperatures and eliminate the existing warmwater refuge in the slough.

The proposed action in this 2024 EA builds upon slough modification potential actions identified in the prior 2018 EA, which analyzed several tools that include channelizing and dewatering of the upper slough. The action in this 2024 EA differs from what was proposed in the 2018 EA by widening the proposed channel, extending the length of the channel into the lower slough, and connecting the upper end of the historic side channel to the river mainstem. This 2024 EA also proposes the use of fill material harvested from the adjacent sand/cobble bar to narrow the lower slough and cause an increase in water flow rate.

The actions considered in this 2024 EA would comply with the Law of the River and would not modify anything with respect to water allocation, uses, releases, appropriation, development, or exportation of water within or between the Upper and Lower Colorado River Basins. Accordingly, consistent with the Grand Canyon Protection Act, the proposed action is intended to remain fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in *Arizona v. California*, and the provisions of the Colorado River Storage Project Act of 1956 and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin and consistent with applicable determinations of annual water release volumes from Glen Canyon Dam made pursuant to the Long-Range Operating Criteria for Colorado River Basin Reservoirs, which are

currently implemented through the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead.

**Alternatives Considered but Dismissed:** Appendix A provides a summary of two additional proposed slough project alternatives considered, but dismissed, in this EA for proposed slough channelization. Alternative 3 and alternative 4 were dismissed due to concerns that these two alternatives would not be as effective in reducing warmwater nonnative fish compared to the preferred alternative below. However, alternatives 3 and 4 retain benefits to conservation of amphibian, invertebrate, and mammal species currently living at the slough site while still helping to reduce warmwater nonnative fish.

**Alternatives Carried Forward:** This 2024 EA carries forward two alternatives for further evaluation, the no-action alternative and the proposed action (NPS preferred alternative). Both alternatives continue the implementation of existing NPS policies and programs and consider tools identified in the NPS 2018 EA. Both alternatives consider prior NPS efforts to manage potentially harmful nonnative warmwater fish species in the Colorado River and its tributaries (NPS 2013). Nothing in this current EA would transfer, change, or interfere with the responsibilities of the National Park Service or Reclamation under past biological opinions and programmatic agreements. Under both alternatives, the National Park Service and the Arizona Game and Fish Department (AGFD) would continue to work cooperatively to manage fish and wildlife resources on NPS lands as articulated in the NPS 2013 *Comprehensive Fish Management Plan* (CFMP) and the 2013 “Master Memorandum of Understanding between United States Department of the Interior National Park Service Intermountain Regional Office and State of Arizona Game and Fish Commission.” Nothing in this 2024 EA would change the agencies’ understanding of the jurisdiction or cooperation related to the fishery.

## 2.1 NO-ACTION ALTERNATIVE

The Council on Environmental Quality requires the inclusion of an alternative of no action (Title 40, Code of Federal Regulations [CFR], Part 1502.14(d) [40 CFR 1502.14(d)]). For this 2024 EA, the no-action alternative represents a situation in which the National Park Service would not add any additional modification to the slough site beyond the modifications analyzed as tools in the prior 2018 EA. The 2018 tools are divided into four Tiers, where Tier 1 actions involve smaller efforts and impacts, while Tier 4 actions involve greater efforts and impacts. Some of these actions are also described in Greimann and Sixta (May 2018).

One Tier 4 option in the 2018 EA not yet implemented involves a small cut dredged to connect the upper and lower sloughs, installing a water-control structure in the cut, and using the structure to allow draining and refilling of the upper slough. This Tier 4 tool remains an option in helping to control and remove nonnative predatory fish in the upper slough. This Tier 4 option is like a Tier 1 tool currently practiced under the 2018 EA in which a Glen Canyon NRA fish biologist pumps water from the upper slough, removes green sunfish and other nonnative fish, and then refills the slough. There is some taking of life of nonnative fish associated with these Tier 1 and Tier 4 actions, since fish are removed for other beneficial uses in science, as fertilizer, or as food for aviaries.

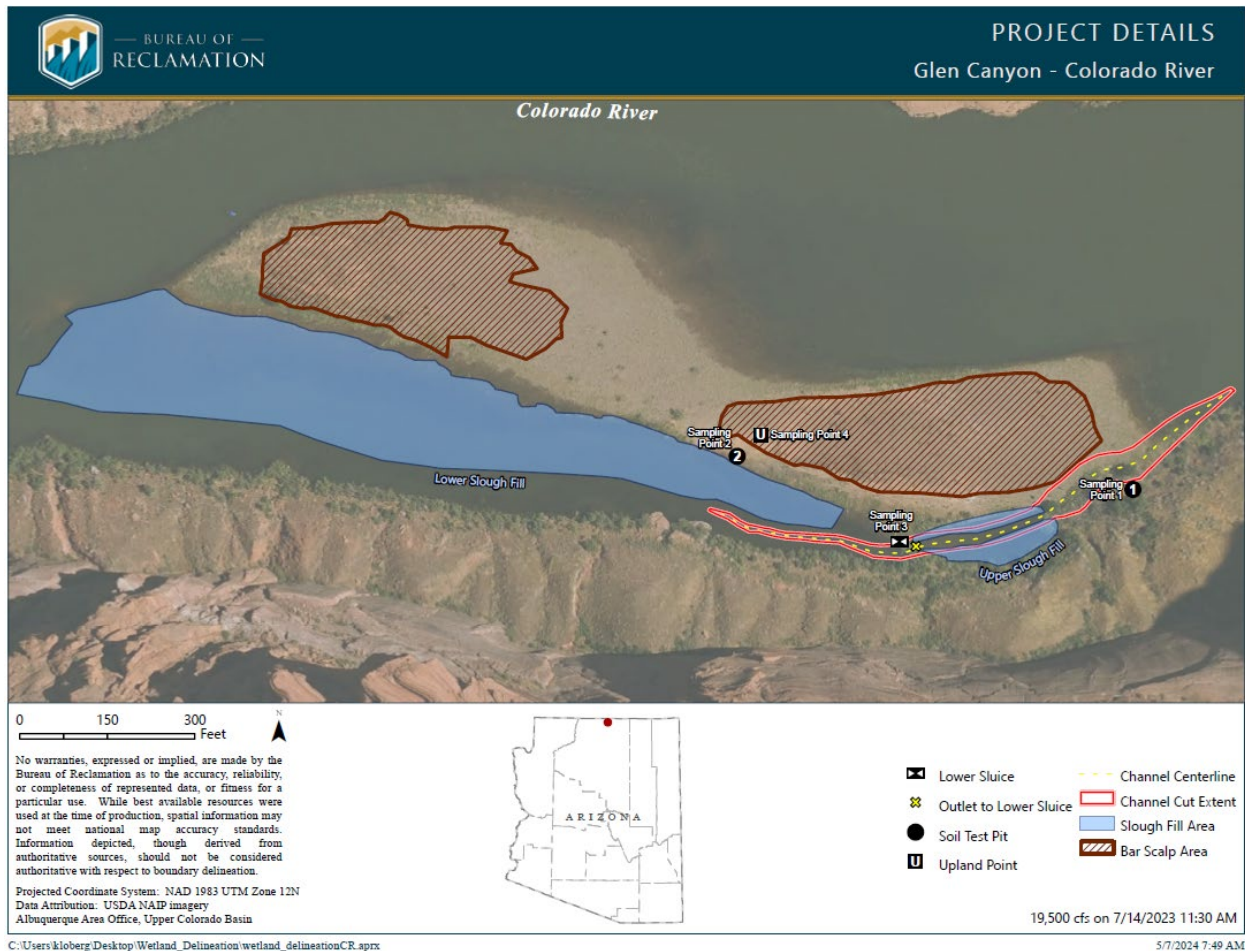


The 2018 EA upper slough Tier 1 and Tier 4 actions described above leave the lower slough largely intact. The lower slough would remain wide with calm water or tidal action due to its downriver connection to the river mainstem. During summer months, the lower slough water would warm earlier and longer than river temperatures. These warmer slough temperatures could continue to provide nonnative fish spawning habitat if slough water temperatures reach 16°C or higher. Current cooling of river mainstem water from Glen Canyon Dam cool-mix flows in summer 2024 are cooling the lower slough water below the 16°C nonnative fish spawning threshold via tidal action tied to dam water releases. However, the 2024 Reclamation LTEMP SEIS extends this cool-mix action only to 2027, since it was intended as a short-term action to prevent nonnative fish breeding until a longer-term solution is identified and used.

In the case where no actions are implemented from this 2024 EA or the 2018 EA, Glen Canyon NRA staff continue the use of other fishery management tools in the 2013 CFMP and the LTEMP. These tools include targeted and incidental nonnative fish removal and associated taking of life, along with a variety of methods involving monitoring and low, moderate, or higher intensity fish management actions. This means nonnative fish removal actions may continue to be used, such as chemical treatments (Rotenone), electrofishing, Fyke netting, and block netting. Some tools under the 2018 EA or 2013 CFMP assist in conservation or recovery of the federally listed fish species humpback chub and razorback sucker.

## **2.2 PROPOSED ACTION (PREFERRED ALTERNATIVE)**

The proposed action in this 2024 EA expands slough modification relative to what was considered in the 2018 EA. This proposed action constructs a longer (1,000 feet long) channel that is wider and deeper than considered in the 2018 EA and in the initial channelization proposal from Reclamation in 2023 (Sixta and Randle 2023). The channel is proposed to be constructed from the river above, through the historic side channel, through the middle of the spring and upper slough, and into the lower slough (figures 2-1 below). The upper slough would be filled with rock, cobble, and sand, eliminating the existing pond. Rock, cobble and sand would also be used to partially fill the lower slough to increase the velocity and flow rate of water to discourage nesting and spawning by smallmouth bass and other predatory nonnative species. This 2024 alternative was conceived through discussions with a number of partners and experts and related models that address water temperature, water velocities, and habitat drying as factors to use in reducing or eliminating nonnative fish spawning in the sloughs. If the proposed action is successful in both the upper and lower sloughs, certain recurring fish removal actions, and associated taking of life of nonnative fish, may no longer be needed, such as chemical treatments (Rotenone), electrofishing, Fyke netting, and block netting. Regular monitoring for nonnative fish would continue.



**Figure 2-1. Project details map: Channel excavation is indicated by the bright red polygon, fill material harvest by burgundy polygons, and fill areas by blue polygons**

### 2.2.1 Location Detail and Project Area

As shown earlier in figure 1-4, the slough project site is located on the Colorado River, 3 miles downriver from Glen Canyon Dam at river mile -12, which is 12 miles upriver from the Lees Ferry boat ramp. Construction equipment required for the project would be loaded onto a barge at Lees Ferry and transported 12 miles upstream to the slough site. Thus, the proposed project action area is defined as the segment of the Colorado River from Lees Ferry to the upstream end of the -12-mile slough site, with 0.25 miles on each side of the river to ensure this plan accounts for various potential impacts, including the effects of sound.

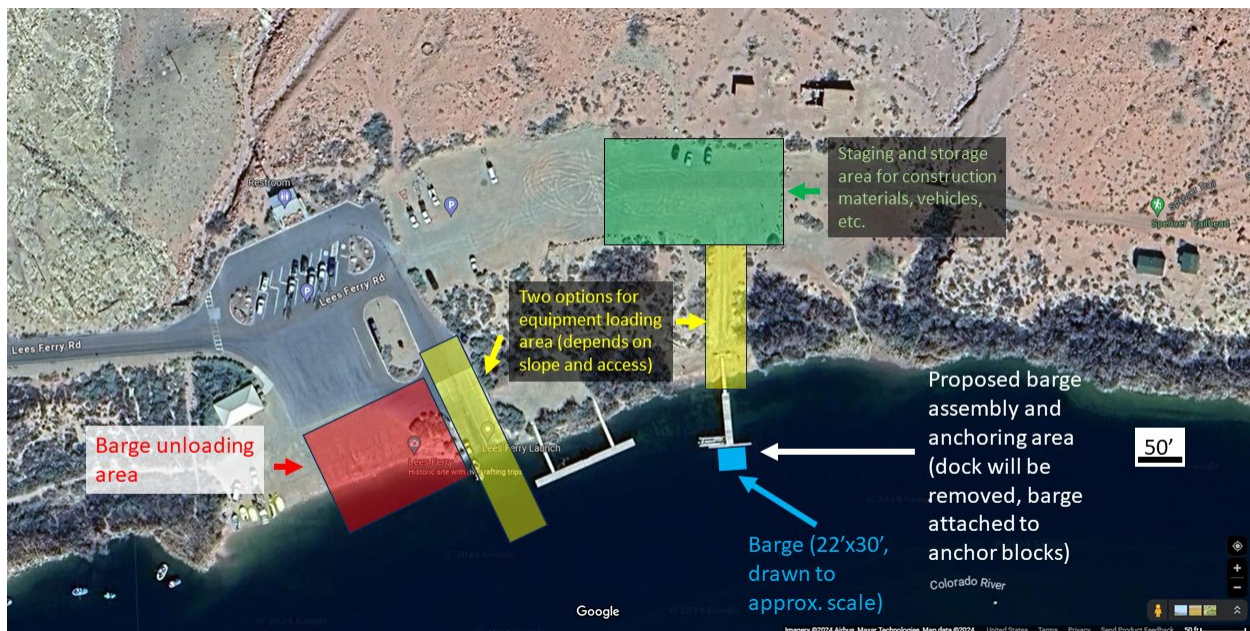
### 2.2.2 Implementation Approach for the Proposed Action

The implementation of slough project actions would occur in steps, with most of the work completed approximately from January 1 to March 15 in 2025. Work would start with channel construction in the upper and lower slough, filling the upper slough, and filling a portion of the lower slough (figure 2-1 above). Channel construction above the upper slough along the sand/cobble bar and historic river side channel would occur followed by leveling/shaping of the

sand/cobble bar. After construction is complete, Glen Canyon NRA staff would monitor for invasive plants and follow up with the planting of native vegetation where appropriate.

### 2.2.3 Mobilization, Staging, and Storage

Heavy construction equipment would be used for the earth moving work on the slough site. The equipment would be transported to the slough from Lees Ferry using a barge pushed by a tugboat. The barge would be assembled at Lees Ferry and stored on the river at Lees Ferry during the construction process. Equipment and fuel would be stored in the staging area at Lees Ferry, (figure 2-2, green box). Construction equipment would be stored on the slough for the duration of the project, which is expected to be approximately 2.5 months.



**Figure 2-2. Overhead view of Lees Ferry showing the barge unloading area (red box), assembly location (near the blue box, white text), equipment loading areas (yellow boxes), and storage area (green box). The blue box represents the barge and is drawn approximately to scale for this map.**

Mobilization would begin at Lees Ferry with the delivery of equipment on approximately eight tractor trailers. The equipment would include the barge on one or two trailers, a heavy construction crane on a trailer, a tugboat, two skid steer loaders and one or two mini-excavators on trailers, and possibly other equipment on a trailer. One or more of the tractor trailers may need to be stored in the local area but would not be needed until the end of the project, allowing its storage to be distant from the construction site if best. Storage locations would be coordinated by Reclamation and Glen Canyon NRA and may include a portion of the Lees Ferry dirt/gravel parking lot. There would also be a job trailer, a 600-gallon towed fuel tank, a truck towing a tender boat on a trailer, and small vehicles transporting workers. These vehicles would need to remain near the construction site and may also be stored at the east end of the dirt/gravel parking lot at Lees Ferry (figure 2-2, green box).

Equipment and vehicles stored at Lees Ferry may require security. This may include fencing around the stored equipment, security cameras, warning signs, and/or an overnight or 24-hour

security presence. If security is a concern, the tender can be trailered and stored off-site each night.

#### **2.2.4 Barge and Transportation Logistics**

The barge would be delivered as three 7.5-foot × 30-foot sections that would be assembled to form a 23-foot × 30-foot platform. A heavy construction crane would lift each barge section off the trailer and place them in the water. This work would occur at the Lees Ferry dirt/gravel boat launch (red box, figure 2-2) and would require closing at least a portion of the launch ramps while the barge is being unloaded by the crane. The tender boat would tow each barge section upstream to be attached to prepositioned anchor blocks (located near the blue box representing the barge, figure 2-2), and the barge sections would be assembled while floating. It is anticipated that this activity would take a full day. Once the barge pieces are in the water, the crane would leave the site and return to reload the barges onto trucks at the conclusion of the project.

The assembled barge would be moved close to shore to load equipment (yellow boxes, figure 2-2), either at the location of the old dock to the east of the main dock, near where the barge would be anchored and assembled (figure 2-2, right yellow box) or at the concrete boat ramp (figure 2-2, left yellow box), with the adjacent dirt/gravel ramp as a back-up option. Heavy equipment would be driven onto the barge using existing roads, a dirt path, and ramps from shore and secured for transportation upriver. Due to the barge's draft (the minimum water depth in which the barge can safely navigate) and barge weight constraints, it is likely that only one vehicle and some supporting equipment can be transported during each trip on the barge.

Once equipment is loaded and secured, the barge would be pushed or pulled by a shallow water tugboat up the Colorado River to the slough. Equipment would be walked off the barge using the ramps. It is expected that 1–2 trips per day over 3–5 days would be needed to deliver all the equipment to the slough.

Reclamation may need to alter water flow out of the dam to accommodate the tugboat and barge navigation over shallow water areas of the river. Any flow adjustments would be done within the parameters of Reclamation's 2016 Long-term Experimental Management Plan Record of Decision (DOI 2016). Reclamation would coordinate any changes in water flow with the construction crew and communicate with Glen Canyon NRA staff following normal protocols.

#### **2.2.5 Daily Operations and Logistics**

Personnel, fuel, and other materials would be transported to the slough daily via the tender boat. The tender would have a fuel transfer tank that would be filled on shore from slip and a towable fuel tank. The tank on the tender would be used to refuel the equipment on the slough. All fuel tanks would be double walled, and spill kits (55-gallon drum with absorbent material) would be stationed at each fuel transfer location (at Lees Ferry and at the slough site).

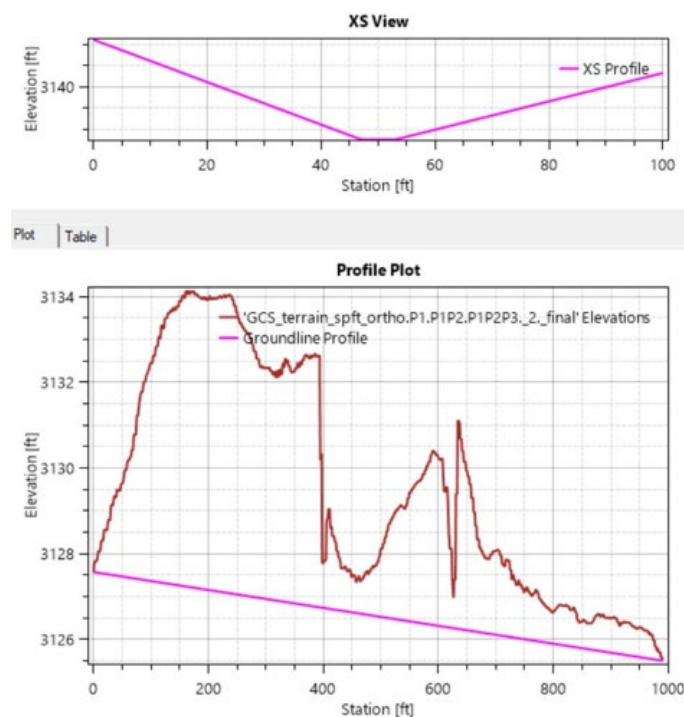
A river toilet (groover) or other portable toilet would be set up on the slough sand/cobble bar for the work crew's use. This toilet would likely be located in the brush on river left bank or at another nearby suitable location. Glen Canyon NRA pit toilets, a short distance downriver from the slough, may also be used.



## 2.2.6 Channel Excavation

**Equipment:** A Cat 306 Mini Excavator would be used to excavate the channel. Two Cat 299 skid steer loaders would transport fill from the channel and fill from the sand/cobble bar harvest sites to the lower slough. All vehicles would use rubber tracks to minimize surface disturbance. All equipment would be inspected and cleaned to remove any invasive plants or animals, including mollusks, tamarisks, and noxious weeds, before it arrives at Lees Ferry.

**Excavation:** The channel (figure 2-1, red polygon, above) would be excavated from upstream to downstream by digging several yards inland from the upstream water's edge to prevent flow of the mainstem entering the channel (though smaller amounts of water are expected to enter the channel during excavation via infiltration from the river). The channel would be approximately 1,000 feet long, up to 7 feet wide at the base, and have a 2:1 slope on the river left side, with a 3:1 slope on river right (figure 2-3, top panel). This results in an average width of 35 feet at the top of the channel and approximately 7 feet deep at the upstream end. The excavator would place material removed from the channel on the bank next to the channel, and the two loaders would move the material to the upper and lower sloughs to form channel edges there. Disturbance to vegetation on the river left bank of the upper slough would be minimized to protect native vegetation and burrowing animals, such as salamanders and small mammals. Dam releases may need to be restricted to ensure suitable water flows for safe equipment operation.



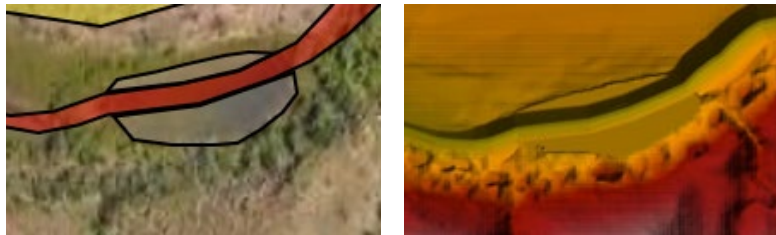
**Figure 2-3. Cross-section view of the channel side slopes (top panel) and longitudinal section of the channel cut relative to the existing terrain (lower panel)**

**Equipment Access Routes / Vegetation Protection:** The excavator would be staged alongside the river right side of the historic side channel so its bucket can reach to the far side. The excavator would work around existing vegetation whenever possible. Swamp mats (heavy

timbers cribbed together into 4-foot × 16-foot sections) would be used to protect any vegetation the excavator must travel over, particularly over the vegetation between the upper and lower sloughs. Swamp mats would also be used to protect vegetation on the areas the skid steers are using frequently. Most or all vegetation located on the left bank of the sloughs and old river side channel would be left in place and not disturbed by heavy equipment.

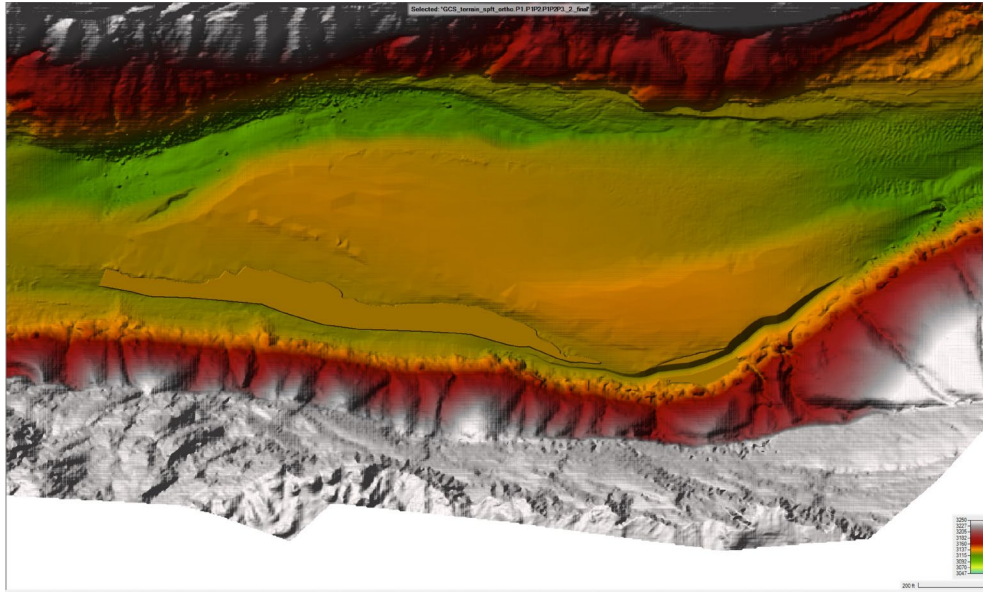
**Borrow Sites:** Fill material would be removed from two areas of the sandbar (figure 2-1 above, burgundy polygons) and transported to help place fill in the upper and lower sloughs. The skid steers would use their buckets to loosen and scoop material from the two high points, which would have approximately 4 feet of material removed.

**Upper Slough Fill:** The channel created through the upper slough would be 5–7 feet deep, as material excavated from the upper channel would be used as fill to create the steeper banks which help narrow the channel (figure 2-4). Fill in the upper slough would be at approximately the level of the existing water's edge and would be placed on both sides of the new channel bank, completely filling the upper slough with sand, mud, and cobble. This fill would require approximately 1,200 cubic yards of material, most or all of which can be sourced from the channel excavation. Swamp mats would protect vegetation around the upper slough's edge, and new vegetation is expected to establish along the new channel edge. Disturbance to vegetation on the river left bank of the upper slough would be avoided or minimized to protect the vegetation and burrowing animals.



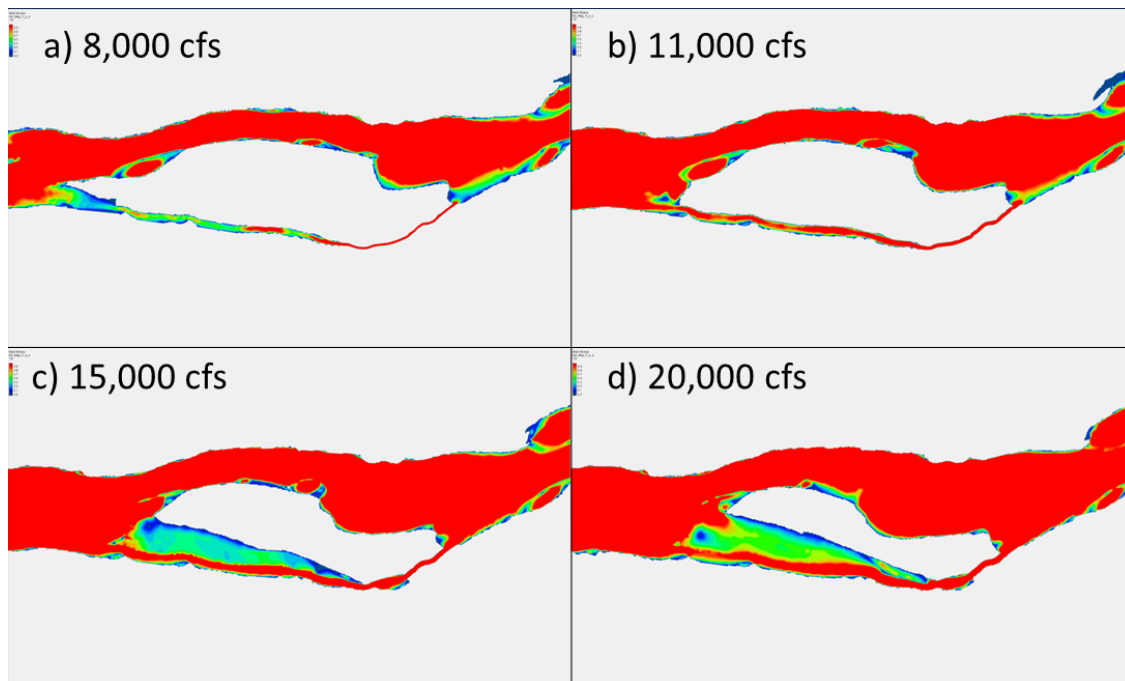
**Figure 2-4. Imagery (left) and elevation map (right) of the upper slough showing the location of the channel cut and fill areas**

**Lower Slough Fill:** Fill material would be placed in the lower slough beginning inland of the edge of the existing riparian vegetation (figure 2-1 above, blue shaded polygon). The existing vegetation at the water's edge would be covered by fill, and a new, straight channel edge would be established 50–100 feet from the current edge. Fill would be 5–6 feet deep in the deepest part of the lower slough, and the new channel would be approximately 50 feet wide through most of the lower slough (figure 2-5). Fill for the lower slough would come from both the upper historic side channel and from the adjacent sand/cobble bar.



**Figure 2-5. Elevation map of the channel excavation and fill area**

This process would result in a “bench” of roughly level land that would be inundated at river levels above 11,000 cubic feet per second (cfs), as shown in figure 2-6 below. Based on where hydric soil was found during the wetland delineation, the entire bench would likely become wetland-supporting soil and can be revegetated as such. Furthermore, hydric soil was detected in the test pit dug in clearly upland vegetation, so the material harvested as fill may already have an established anaerobic ecology and is expected to support riparian vegetation quickly. Potential mitigation, which includes vegetation, is described in appendix B.



**Figure 2-6. Model showing water velocities in four different flow conditions over the bench of fill material (blue, green, and yellow area below the sand/cobble bar)**

**Final Connection:** After the channel is excavated and fill in both sloughs complete, the final channel cut would be made at the upstream end of the sand/cobble bar and new side channel. This action would connect the mainstem river to the new side channel. This action would require timing with low river water flows from the Glen Canyon Dam to allow the excavator safe entry into and exit from the riverbed and constructed channel. The new side channel would be deep enough for river mainstem water to flow into it at a river flow rate of 5,000 cfs or greater. After the final cut, there would likely be a small sediment plume generated by water initially flowing through the new channel on its first day of flows.

**Demobilization:** Demobilization would essentially be the reverse of mobilization. Equipment would be transported from the slough back to Lees Ferry via the barge. The barge would be disassembled in the water and craned on to semitrucks. All equipment and fencing would be removed from Lees Ferry.

## 2.3 RELATED RESOURCE PROTECTION MEASURES AND PLANS

Resource protection measures would be in effect during and after project construction. These would include the following efforts:

- Best management practices would be implemented during construction, including erosion control measures, fuel and lubricant safety measures, spill kits and response plan, noise control, dust control, debris management, protective construction mats, storage practices, restroom facilities, and general housekeeping.
- Slopes and vegetation important to burrowing wildlife, such as on and above the left bank of the upper slough, would be conserved and avoided during construction activity. Vegetation along the left bank of the lower slough and old river side channel would also be preserved.
- Resident wildlife in the construction area would be relocated, if feasible. A badger (*Taxidea taxus*) currently lives at the slough site. If this badger continues to live within the construction site, Glen Canyon NRA staff may have to trap the badger before the project begins. In this case, the badger would be relocated to suitable habitat not directly affected by slough channel construction, which would help ensure its survival. Relocating salamanders to another location is under consideration to see if it is feasible.
- Mitigation measures to ensure safety of federally protected condors would be briefed to construction crews and federal employees. Mitigation measures are described below in chapter 3 in section 3.4.2.2.2.
- A Hazard Analysis and Critical Control Point Plan is currently under development by Glen Canyon NRA and Reclamation staff to ensure equipment practices help prevent transport of invasive species between water bodies. Practices include equipment cleaning and other actions ensuring against transport of invasive mollusks, tamarisk, noxious weeds, and nonnative aquatic plants. This plan applies to heavy equipment, construction matts, the barge, the tugboat, the tender boat, and even waders or boots worn at the slough construction site.



- Cautionary measures would be taken regarding sediment management and water quality. River mainstem water flows would be prevented from entering the newly constructed channel during construction. The final cut in the side channel, connecting it to the mainstem riverbed, would occur when river water levels are lowered via Glen Canyon Dam operations. A water treatment plant at Lees Ferry would be shut down during a brief initial period when a small plume of sediment may result from the first time mainstem river water enters the newly constructed channel.
- Both on-site and off-site mitigation measures would be practiced in efforts to restore balance to habitat, living things, cultural condition, and overall ecology within the 15-mile segment of the Colorado River below Glen Canyon Dam. A summary of potential mitigation actions is in appendix B. For example, mitigation measures at the project site would include immediate monitoring for invasive plants followed by establishing native plants annually within a post-project five-year period. During fall months in 2024, Glen Canyon NRA staff would harvest native seeds, cuttings, and plants to use in the revegetation work.

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CHAPTER

3

**AFFECTED  
ENVIROMENT AND  
ENVIRONMENTAL  
CONSEQUENCES**



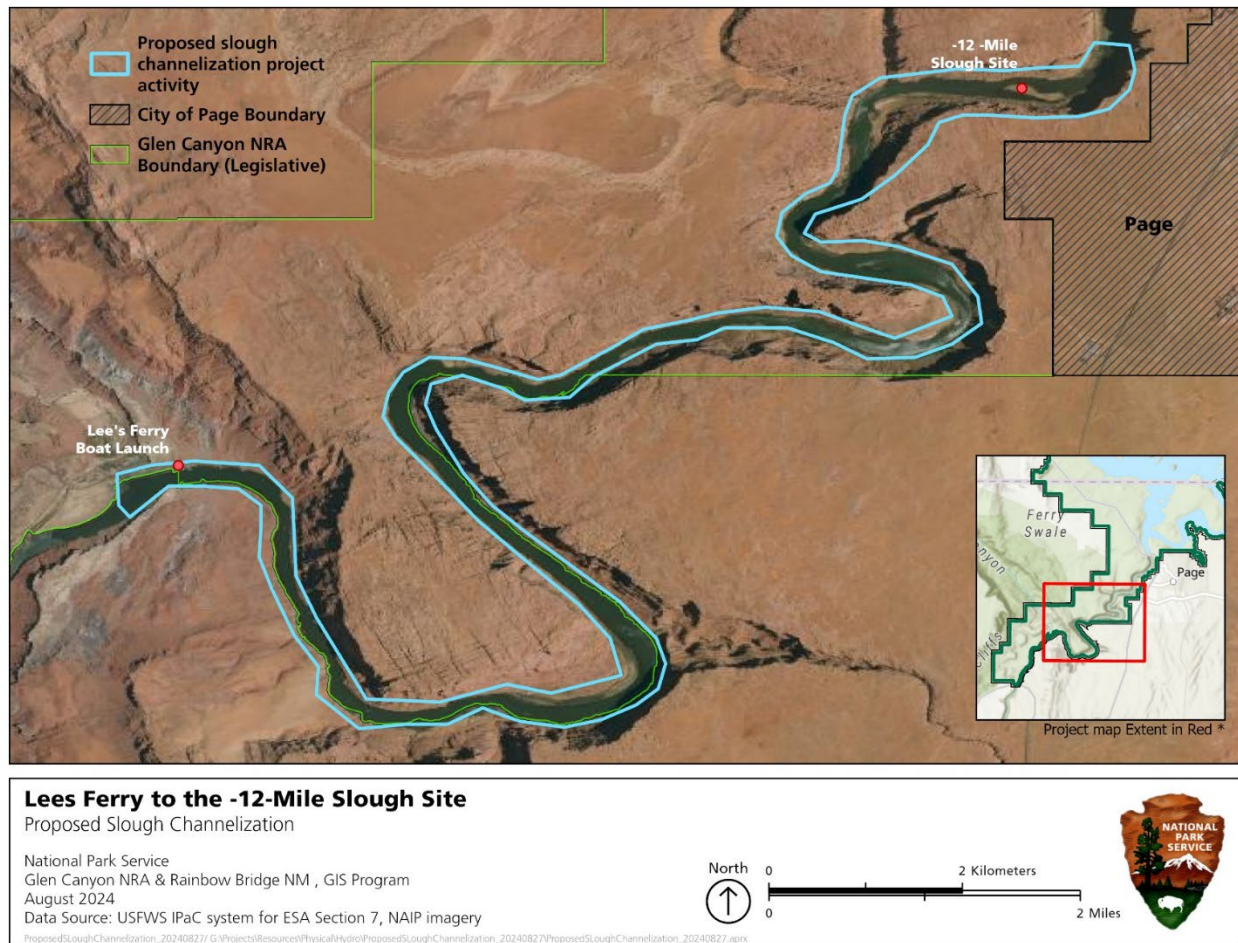
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## CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

### 3.1 ANALYSIS AREA

As described in chapter 2, the project area for this slough channelization EA includes the Colorado River from the upstream end of the -12-mile slough downstream to the Lees Ferry boat launch. This reach of the river is bounded by a 0.25-mile buffer to include the consideration of the land and other resources on either side of the river. The focus of this analysis is on impacts on the project activity area shown in figure 3-1. Where appropriate, impacts on resources downriver of the project area, such as for federally listed species, are also addressed to include considerations for the whole of Glen, Marble, and Grand Canyons.



**Figure 3-1. The oblong blue polygon shows the action area affected by the proposed slough channelization project activity and, hence, is the core area considered for compliance consultations**

Note: A 0.25-mile buffer extending away from the oblong blue polygon is included in consultations. The Glen Canyon NRA boundaries show as thin green lines. The Lees Ferry boat ramps are at the lower left end of the blue polygon. The slough site is at the upper right end of the blue polygon. Barge transportation up and down the Colorado River in Glen Canyon would occur between the two ends of the blue polygon.

A detailed description of resources in the project area is presented in the affected environment sections of the CFMP EA (NPS 2013) and the LTEMP EIS (DOI 2016). As described in the LTEMP EIS, virtually all the resources in the project area are associated with or dependent upon water and sediment. Glen Canyon Dam upstream of the project area collects and stores water for beneficial purposes, and, in the process, traps sediment and associated nutrients that previously traveled down the Colorado River. Regulated releases from Glen Canyon Dam and Lake Powell have resulted in an altered aquatic and terrestrial ecosystem compared to what existed before Glen Canyon Dam. Summary descriptions of the affected environment and the environmental consequences of the no-action alternative and the proposed action are provided below in sections of this chapter.

This chapter describes the affected environment consisting of the existing, or baseline, conditions and expected future conditions for resources carried forward for detailed analysis. This chapter also analyzes the potential beneficial and adverse environmental consequences (impacts or effects) that could occur when implementing the alternatives.

## **3.2 WATER QUALITY**

### **3.2.1 Water Quality – Affected Environment**

Glen Canyon Dam and water releases from Lake Powell affect the water quality of the Colorado River in the project area. Water temperatures in the Colorado River fluctuate annually, reflecting seasonal variations in the temperature of Lake Powell water at the depth of the large pipes (penstocks), which bring water to power turbines located inside Glen Canyon Dam (DOI 2016). From 1973 to 2002, Glen Canyon Dam tailwater temperatures ranged from about 12°C (45 to 54°F) as measured at Lees Ferry (DOI 2016). During the ongoing drought in the 2000s, Lake Powell water levels generally declined, and water release temperatures began to warm, ranging from 8°C to 16°C (46°F to 61°F). Water temperatures increase slowly downstream from the dam, at a rate of about 1°C (1.8°F) for every 30 miles; mean annual downstream river water temperatures range from 9 to 18°C (48 to 64°F). Tributaries, backwaters, and off-channel areas tend to have higher temperatures than the Colorado River mainstem. Tributaries, especially the Paria River and Little Colorado River, carry large amounts of fine sediments and organic matter to the mainstem during flood events. The Little Colorado River contributes more salinity to the Colorado River than do other tributaries in the project area (DOI 2016).

Turbidity of the Colorado River has been reduced by the presence of Glen Canyon Dam because it reduces the supply of river-borne sediment (DOI 2016). Suspended sediment concentrations at Lees Ferry range from about 1 to 150 mg/L, compared to a pre-dam range from 1,450 to 6,140 mg/L. Suspended sediment concentration increases further downstream of the dam, and depends primarily on tributary runoff into the Colorado River.

Releases from Glen Canyon Dam and downstream Colorado River waters are relatively low in nutrients (DOI 2016). Tributaries below the dam have somewhat higher nutrient contents than the river mainstem, but they contribute little to overall mainstem nutrient concentrations (DOI 2016), at least during base-flow conditions. Dissolved oxygen concentrations at Lees Ferry

typically range from a low of 6 mg/L in the fall (October–November) to a high between 9 and 11 mg/L in the spring season (April–May), and concentrations increase further downstream because of aeration (Hall et al. 2012).

Reclamation’s LTEMP SEIS cool-mix water smallmouth bass flows (BOR 2024a) from Glen Canyon Dam are successful in lowering river water temperatures to 15.5°C, or below, in both the river mainstem and lower -12-mile slough. These cool-mix flows help to prevent spawning by warmwater nonnative fish. Cool-mix flows also help to deliver dissolved oxygen into the river through bypass tubes at the base of the dam. Cool-mix flows are thus extremely helpful at this time when climate change is trending toward lower water quality influenced by lower water levels, lower water volumes, higher water temperatures, and lower dissolved oxygen. However, using cool-mix as a tool is currently only authorized for use through 2027.

### **3.2.2 Water Quality – Environmental Consequences**

#### **3.2.2.1 Impacts of the No-Action Alternative on Water Quality**

**Current Conditions:** Under the no-action alternative, the proposed slough modification in this 2024 EA would not occur, and water quality would be like conditions described in the affected environment section. Slough modification tools in the 2018 EA could still be used, including a Tier 1 pumping option, a Tier 4 water-control structure option, or an upper slough smaller channelization option. The 2018 EA discusses associated water quality effects of each of these smaller tools (NPS 2018). Generally, with no action, water quality would be unchanged from that described above in section 3.2.1, but water temperature might vary with annual weather and climate conditions. Dissolved oxygen levels in the river and slough would continue to depend upon the quality of water passing through Glen Canyon Dam.

**Cumulative Impacts:** Under the no-action alternative, water conditions at the -12-mile slough site remain the same and are subject to more broad influences. Cumulative impacts of past, present, and reasonably foreseeable future actions on water quality are substantial and adverse (appendix B and table B-1 in DOI 2016). Past and present actions have reduced flow and resulted in alterations of water temperature, declines in dissolved oxygen, changes in sediment patterns, and increases in salinity in the Colorado River. These effects would continue from future actions at Glen Canyon Dam and along the Colorado River. Climate change would continue to have the most substantial effect on future conditions in water volume, temperature, and quality.

#### **3.2.2.2 Impacts of the Proposed Action on Water Quality**

**Conditions Under the Proposed Action:** The proposed action could affect water quality in several ways. Sediment disturbance during or shortly after construction would produce localized turbidity plume in the immediate area and downstream of the slough. This disturbance includes channel excavation in the upper and lower sloughs, channel excavation between the river mainstem and upper slough, and the addition of excavated material to the upper and lower sloughs. This plume would be episodic, localized, and occur periodically during the action itself, depending on where equipment is working. The plume could potentially continue for a few days after project completion, but it would not increase overall turbidity conditions in receiving

waters downstream of Lees Ferry, some of which are normally quite turbid, especially during high flow events.

Connecting the slough to the mainstem river above would cool water in the slough and side channel to match river mainstem water temperatures. The overall thermal regime in the slough/channel is expected to be generally cooler. This would result in less warmwater influence on the channel, such as cooler overall flows, less rapid warming during spring season, and less rapid cooling during fall season. Dissolved oxygen levels in the river and slough depend upon water quality passing through Glen Canyon Dam, but faster-moving water through the new channel could raise dissolved oxygen levels slightly.

Construction equipment could possibly release small amounts of grease or oil to the slough/channel work site. Heavy equipment is lubricated with grease, which might create a sheen on the water's surface at times. Best practice measures would help avoid or minimize this possibility. Fluids and grease more friendly to the environment would be used whenever possible.

**Cumulative Impacts:** The proposed slough channelization project will locally improve water quality conditions at the -12-mile slough site. More broadly, the cumulative impacts of past, present, and reasonably foreseeable future actions on water quality are substantial and adverse (appendix B and table B-1 in DOI 2016). Past and present actions have reduced flow and resulted in alterations of water temperature, declines in dissolved oxygen, changes in sediment patterns, and increases in salinity in the Colorado River. These effects would continue from future actions at Glen Canyon Dam and along the Colorado River. Climate change would continue to have the most substantial effect on future conditions in water volume, temperature, and quality. Future decisions by Reclamation to activate annual cool-mix flows (BOR 2024a) or not would result in substantial positive or negative impacts on river and lower slough water temperatures through 2027, directly affecting the ability of agencies to manage warmwater nonnative fish.

### **3.3 AQUATIC RESOURCES**

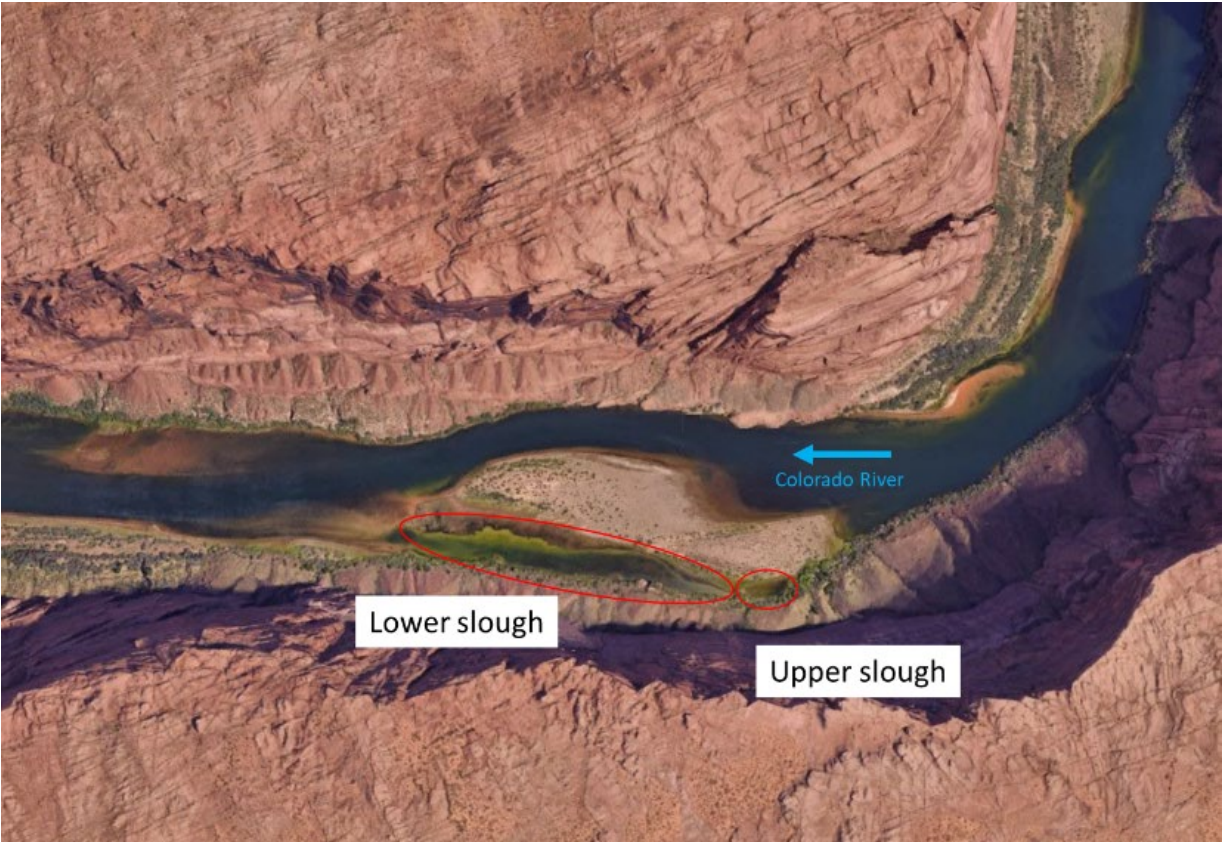
#### **3.3.1 Aquatic Resources – Affected Environment**

This section describes the aquatic habitat and related biological resources in the slough project area that could be affected by proposed slough channelization. This section includes descriptions of a spring, fish, amphibians, macroinvertebrates, plants and the habitat in which they occur.

##### **3.3.1.1 Aquatic Habitat – General Description**

The upper slough (figure 3-2 and figure 3-3) is disconnected from the mainstem at the upstream end, and it drains through a small channel approximately 10 feet long and 2 feet wide into the lower slough (figure 3-4). The upper slough is less than 2.5 feet deep, on average, except for a groundwater inflow from the bottom of the upper slough that is 4–6 feet deep. The lower slough averages 6 feet deep, and it is 9 feet deep or more at its downstream end near where it joins the river mainstem.





**Figure 3-2. Location of the upper and lower sloughs in the Colorado River**

The upper slough maintains a constant water level that is independent of fluctuations in the level of the nearby river mainstem. Sixta and Randle (August 2023) calculate an estimate of groundwater inflow into the upper slough to be up to 12 gallons per minute. The depth of the lower slough fluctuates dramatically from tidal flows from dam operations.



**Figure 3-3. Upper slough (left) and lower slough (right)**

The existing aquatic habitat in the slough site is generally slow-moving water with aquatic algae and macrophytes. Slow-water habitat is typically found in backwaters and off-channel ponds, and these habitats are relatively rare in Glen Canyon when compared to river mainstem habitat.



**Figure 3-4. The narrow, 2-foot wide channel draining the upper slough into the lower slough. The image is facing the upper slough while standing at the upstream end of the lower slough. (The upper slough is not visible behind a seine net and tall vegetation.)**

#### **3.3.1.2. Aquatic Habitat – A Spring Maintaining the Upper Slough**

A study in 2024 initially indicates the upper slough is fed by a spring. Spring data analyses will continue for six parameters through the remainder of 2024. Initial findings are reported in this EA based on two initial comparative parameters, specific conductance, and water levels. Figure 3-5 below shows the upper slough sample site located in between the lower slough and river mainstem.

Glen Canyon NRA and the US Geological Survey (USGS) Arizona Water Science Center initiated a 2024 study to evaluate the water chemistry of collected water samples from three locations. These locations are the upper slough at the -12-mile mark, the Colorado River at Lees Ferry, Arizona (USGS site ID 09380000), and a spring located in Leopard Frog Marsh, near Horseshoe Bend, that is known to be a regional spring source. The set of six parameters undergoing analyses are as follows:

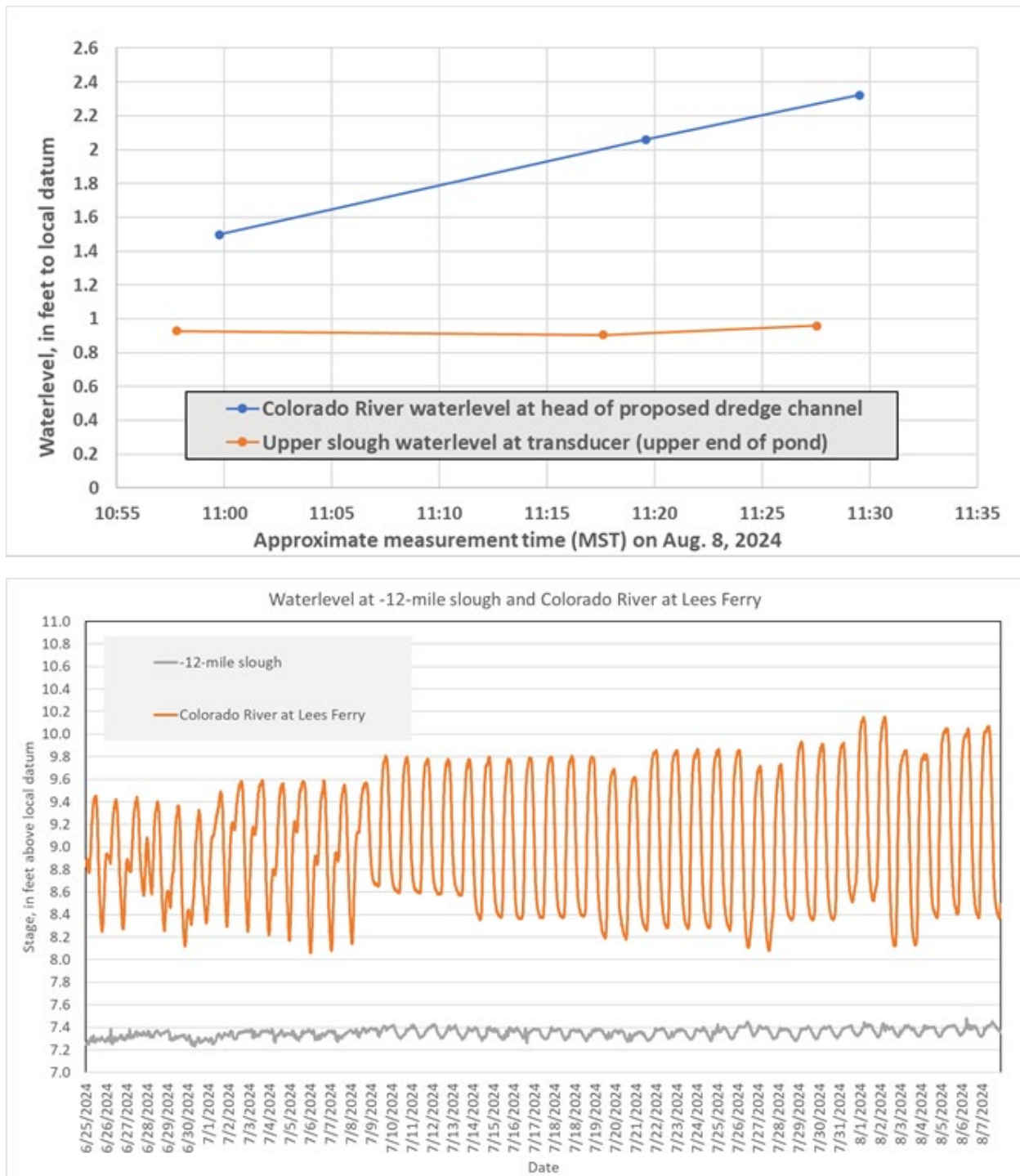
- Comparative water levels (figure 3-6)
- Specific conductance
- Major ions
- Nutrients



- Stable isotopes
- Tritium



Figure 3-5. Upper slough (top middle), lower slough (lower right), and river mainstem (left)



**Figure 3-6. The upper plot shows a brief snapshot in time (30 minutes, top diagram) illustrating how water levels in the upper slough remain relatively steady while water levels in the river mainstem change more rapidly. The lower plot shows water levels in the upper slough compared to water levels in the Colorado River mainstem at Lees Ferry between June 25, 2024 and August 8, 2024.**



The initial evaluation of transducer data suggests there is minimal fluctuation in the water level of the upper slough from June 25 to August 8 in 2024 (figure 3-6). During the same period, the water level of the Colorado River fluctuated daily by approximately 1.5 feet at the Lees Ferry gage with similar fluctuations expected at the -12-mile slough location. Transducer data thus support daily and weekly observations of Glen Canyon NRA employees who observe the upper slough maintaining itself at relatively steady levels despite fluctuations in levels of the adjacent river mainstem.

Based on 2024 specific conductance results alone, the water source feeding the upper slough is most likely from a spring and not from the Colorado River mainstem. Measured in microsiemens per centimeter ( $\mu\text{S}/\text{cm}$ ), specific conductance was 222.7 at the upper slough inflow, compared to 222.4 at the Leopard Frog Marsh seep, and compared to 767.6 at the Lees Ferry river mainstem. The specific conductance measured at the upper slough indicates its bottom groundwater inflow is likely a spring or seep located at the deepest point in the pond.

### 3.3.1.3. Amphibians

Amphibians have complex life cycles with distinct larval and adult life stages and ecologies. In the Colorado River corridor, aquatic life stages (eggs and larval stages) are dependent on calm, quiet backwaters and fringe marshes. In the Glen Canyon National Recreation Area reach of the Colorado River, distinct wetland habitats occur in the form of backwater sloughs, fringe marshes, off-channel wetland habitats, and springs. During recent surveys, three native amphibian species were detected in or near one or more of the backwater habitats in Glen Canyon. These are the Woodhouse's toad (*Anaxyrus woodhousii*), the red-spotted toad (*Anaxyrus punctatus*), and the western tiger salamander (*Ambystoma mavortium*) shown in figure 3-7.

All three species use the upper and lower sloughs (figures 1-1 and 3-3 above) for multiple life stages, including breeding, egg deposition, and larval development and as basking and foraging sites to varying degrees. Western tiger salamanders are long-lived species that use backwater habitats, including sloughs, during breeding and larval development periods. These salamanders can also use an alternate form (phenotype) to exploit permanent water and persist year-round, where the alternate form is a reproductive adult that has external gills and looks like a younger (larval) life stage (paedomorphosis).



**Figure 3-7. Woodhouse's toad (left), red spotted toad (center) and a slough salamander (right) (NPS photos by Randy Williams [left], Robb Hannawacker [center], and Jeff Arnold [right])**

Glen Canyon NRA staff are currently working with colleagues from the National Park Service, the US Geological Survey, and Washington State University to complete an inventory of amphibians within backwater sloughs and fringe wetlands along the 15-mile reach of the

Colorado River extending from Glen Canyon Dam to Lees Ferry. Surveys of all suitable amphibian habitat were carried out in 2024 during late April and mid-summer, following the onset of monsoon rains, at Hidden Slough, Leopard Frog Marsh, the lower slough, the upper slough, and the Dam Slough. This work included a combination of live trapping (with baited minnow traps), visual encounter surveys (VES), and environmental DNA surveys designed to detect the native amphibians described above, as well as for other native species of conservation concern, such as the northern leopard frog (*Lithobates pipiens*). Visual surveys were conducted during daylight hours and included sweeping vegetated areas with a dip net; VES surveys also looked for the presence of nonnative American bullfrogs (*Lithobates catesbeianus*). Water samples (1 to 5 liters in total volume) were also collected and filtered for eDNA analysis. The eDNA results are still pending at the time of writing this EA.

Glen Canyon NRA staff also submitted tissue samples from nine individual salamanders, captured at the upper slough, to Washington State University to help identify the salamanders to the subspecies level. Staff hope these tissue samples will provide information on whether tiger salamanders in the slough are the native Arizona salamander genotype (*Ambystoma mavortium nebulosum*) or are more consistent with genotypes that were introduced as part of the bait trade in many areas of the western United States (*Ambystoma mavortium mavortium*), including in Arizona and Utah (Shaffer and McKnight 1996). At the time of writing this EA, results are still pending, but staff know the upper slough is the only currently documented location along the Colorado River corridor, across Glen Canyon NRA (NPS unpublished data) and Grand Canyon National Park (B. Holton, pers. comm.), where western tiger salamanders have been detected along the river in recent surveys. In 2015, at Leopard Frog Marsh, and in 2016, near the upper slough, one native Arizona salamander was found at each Glen Canyon location by an NPS employee (NPS unpublished data).

#### **3.3.1.4. Aquatic Food Base and Macroinvertebrates**

Aquatic invertebrates, algae, rooted plants, and organic matter serve as the aquatic food base for fishes in the Colorado River ecosystem (Gloss et al. 2005). Although most of this food base is produced within the aquatic system, terrestrial inputs of organic matter (e.g., leaf litter) and terrestrial invertebrates also contribute. The composition and abundance of the aquatic food base in the mainstem are primarily driven by effects of the presence and operation of Glen Canyon Dam on flow patterns, temperature regimes, sediment transport and deposition, turbidity, and nutrient concentrations (DOI 2016; Hall et al. 2015; Sabo et al. 2018). The diversity of aquatic macroinvertebrates in the Glen Canyon reach is relatively low and dominated by nonnative species (Kennedy et al. 2013). Compared to other western rivers, the structure of the food web in Glen Canyon is simple and energy transfer from the base (e.g., algae and diatoms) to the top of the web (e.g., rainbow trout) is relatively inefficient (Kennedy et al. 2013).

The Colorado River immediately downstream of Glen Canyon Dam generally has low numbers and low diversity of aquatic invertebrate species. The Glen Canyon reach is dominated by non-insect taxa, including New Zealand mudsnails (*Potamopyrgus antipodarum*), scuds (*Gammarus lacustris*), flat worms (planarians, sub-phylum Turbellaria), sludge worms (family Tubificidae), earthworms (Lumbricidae), and bladder snails (Physidae) (Cross et al. 2011; Carothers and Brown 1991). The two most common aquatic insect taxa in the mainstem Colorado River in

Glen Canyon are generalist taxa including non-biting midges in the family Chironomidae and black flies in the family Simuliidae, while sensitive mayflies (Order Ephemeroptera), stoneflies (Order Plecoptera), caddisflies (Order Trichoptera) are absent from the tailwater (Kennedy et al. 2016; Abernethy et al. 2021).

There are no rare aquatic invertebrates known to be present in the sloughs. Invasive nonnative aquatic invertebrate species that are known to occur within the project area include the northern crayfish (*Orconectes virilis*) (Trammell 2015), the New Zealand mudsnail (Benson et al. 2018a), and the quagga mussel (Benson et al. 2018b). These species are believed to pose low-to-medium levels of threat due to their potential to alter ecosystem conditions, compete with native aquatic species, or affect operation of infrastructure and recreational opportunities (appendix F in NPS 2018).

### 3.3.1.5. Odonates – Dragonflies and Damselflies

Glen Canyon NRA employees observe an abundance of odonates at the slough each year, comprising multiple species. Glen Canyon NRA staff are not aware of published accounts of odonate survey data specifically focused on the slough site. However, odonates at the slough may be species already identified in publications in the general Grand Canyon region (Stevens and Bailowitz 2009 or Stevens, Bailowitz, and Danforth 2020). While numerous adult dragonflies and damselflies representing 10 distinct families are frequently observed flying throughout Glen and Grand Canyons, aquatic larvae of dragonflies and damselflies are most abundant in tributaries, springs, and backwaters, such as the -12 mile slough. Larval dragonflies and damselflies are extremely rare in the mainstem river (Cross et al. 2011). Figure 3-8 shows two examples of odonates.



**Figure 3-8. Odonates (left: NPS photo by Robb Hannawacker; right: photo by Duplaga)**

Concerns for holistic ecological impacts from removing rare and novel habitat (Hobbs et al 2009) from the Glen Canyon tailwater were raised by Tribal stakeholders during the 2024 Glen Canyon Dam Adaptive Management Work Group meeting in Phoenix, Arizona. Glen Canyon NRA staff and the US Geological Survey Southwest Biological Science Center are collaborating in a 2024 pilot study that allows an initial assessment of the slough site as odonate habitat relative to other nearby microhabitats within the Glen Canyon reach of the Colorado River. This pilot study allows comparison of odonate habitat suitability at two novel warmwater sites versus two river mainstem sites. This study will help inform the National Park Service about the value of the slough to odonates and possibly how best to mitigate for odonate impacts if slough channelization occurs.

### 3.3.1.6. Native Fish and Special Status Fish Species

Eight species of native fish have historically occurred within the project area (figure 3-9). The flannelmouth sucker (*Catostomus latipinnis*) occurs in the area and is frequently captured in the lower slough in recent years. The bonytail chub (*Gila elegans*, endangered) is considered extirpated from Glen and Grand Canyons but occurs in Lake Powell due to hatchery stocking. In 2023, two individual hatchery bonytail chub passed through Glen Canyon Dam and were captured in the river below, including one in the lower slough. The humpback chub (*Gila cypha*, federally threatened), razorback sucker (*Xyrauchen texanus*, federally endangered), bluehead sucker (*Catostomus discobolus*), and speckled dace (*Rhinichthys osculus*) occur in most of the 277 miles of river downstream in Grand Canyon but are absent in Glen Canyon. The Colorado pikeminnow (*Ptychocheilus Lucius*, federally endangered) is extirpated from the mainstem between Glen Canyon Dam and Hoover Dam. Of all these native fish, only the flannelmouth sucker normally occurs in the slough project area.

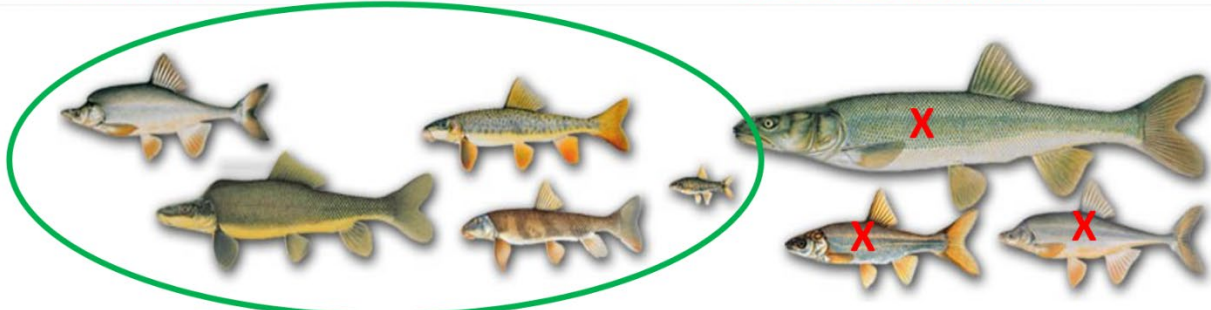
# Native Fish in the Colorado River Between Glen Canyon Dam and Hoover Dam



## Grand Canyon's Native Fish

What we protect now through conservation...

What we have already lost...



Fish native to Grand Canyon, from left to right: humpback chub, razorback sucker, bluehead sucker, flannemouth sucker, speckled dace, and the three extirpated species: Colorado pikeminnow, roundtail chub and bonytail.

Illustrations by Joe Tomelleri

National Park Service | U.S. Department of the Interior



**Figure 3-9. Native fish that occurred historically in the segment of Colorado River, currently located between Glen Canyon Dam and Hoover Dam**

Note: The flannemouth sucker occurs in the slough project area within Glen Canyon NRA, while the flannemouth and four other native species (humpback chub, razorback sucker, bluehead sucker, and speckled dace) occur in Grand Canyon. Three other species (Colorado pikeminnow, roundtail chub, and bonytail chub) have already been lost in this segment of the Colorado River. The NPS photo on the bottom shows a close-up of the federally endangered humpback chub.



### 3.3.1.7. Nonnative Fish

Two nonnative trout species currently occur in the 15 miles of the Colorado River below Glen Canyon Dam (figure 3-10). Rainbow trout (*Oncorhynchus mykiss*) were introduced in 1964, are managed by the Arizona Game and Fish Department, and are supported by multiple agencies as a sport fish for anglers. Brown trout (*Salmo trutta*) are invasive and grew in numbers in Glen Canyon from 2014 to 2016, raising concerns regarding potential impacts on native fish such as flannelmouth suckers and the federally listed humpback chub (Runge et al. 2018). Due to their highly predatory nature in adversely affecting native fish species (Budy and Gaeta 2018), brown trout are subject to an incentivized harvest fishing program using various fund sources and comanaged by Glen Canyon NRA, The Glen Canyon Conservancy, and the US Geological Survey.

Both brown trout and rainbow trout eat a variety of prey. However, warmwater nonnative predatory fish are considered a much greater concern for native fish species (Johnson et al. 2008). In many southwestern desert streams, native fish and warmwater nonnative fish species simply cannot coexist, since the nonnatives prey upon and compete with natives (Marsh et al. 2024).



**Figure 3-10. Brown trout (left, NPS photo by Aristidis Harris), and rainbow trout (right, NPS photo)**

Where feasible, the National Park Service restores ecosystems and manages for native species with complete suppression or the eradication of nonnative species. Whereas the Colorado River between Glen Canyon Dam and Hoover Dam was relatively free of nonnative fish during earlier decades, nonnative fish species became introduced over time into Lake Powell, Lake Mead, and tributaries of Glen and Grand Canyons. Many of those nonnative species moved through Glen Canyon Dam into the Colorado River in Glen Canyon, Marble Canyon, and Grand Canyon. Currently, approximately 22 species or of nonnative fish occur in the river and slough general vicinity (NPS unpublished data).

The 2018 Expanded Nonnative Fish EA assessed the threats posed by nonnative species based on their potential for competition and predation with native species, and the risk of each nonnative species was evaluated and ranked from low to very high (NPS 2018). Higher-risk species require more intensive management to support native species conservation. The

National Park Service concluded that smallmouth bass and brown trout are a very high risk to native species, while green sunfish are a medium-high risk (figure 3-11).



**Figure 3-11. Smallmouth bass (left), and Green Sunfish (right) (public domain photos)**

Prior to 2015, warmwater nonnative fish species were mostly contained behind Glen Canyon Dam in Lake Powell, though they were collected in low numbers below the dam from sporadic entries through the dam into the Colorado River below. Species collected included the common carp, channel catfish, and fathead minnow (Johnstone and Laurretta 2007; Ackerman 2008). Other uncommon species collected from this reach included green sunfish, smallmouth bass, striped bass, redbreast shiner, golden shiner, and walleye (USFWS 2008).

With the water in Lake Powell warming and falling to lower levels during drought and aridification, warmer lake water was released through the dam into the river below. In July 2015, a reproducing population of green sunfish was discovered in the upper slough. Green sunfish are prolific in reproduction, and they are predators of small native fish and native fish eggs and larvae (Ward 2015).

A multiagency effort was initiated in 2016 to control the spread of green sunfish (NPS 2018; Hyde et al. 2016, 2017; Fry 2021), including the consideration of a variety of approaches to eliminate or control green sunfish, or otherwise make modifications to the slough site. Green sunfish control efforts in the slough and elsewhere in the river were not fully successful. Continued fish passage through the dam, concurrently with increasing river water temperatures in 2022 and 2023, resulted in the further spread of green sunfish downstream in the Colorado River. Green sunfish are now common in Glen Canyon and are starting to be found at some locations within Grand Canyon.

Smallmouth bass were initially found breeding in the lower slough on June 30, 2022; they have since continued to pass through the dam and have shown nesting behavior at the base of the dam. With warmer water temperatures in the river and sloughs in 2022 and 2023, smallmouth bass spawned in the lower slough in both years, and immature juveniles were found in the upper slough in 2023. Smallmouth bass numbers grew within the first 20 miles of the river below the dam in 2022 and 2023 (Shollenberger 2024), largely because of low lake levels, warmwater nonnative fish passing through the dam, and warmer river and slough temperatures supporting spawning by nonnative fish.

Smallmouth bass have a much larger adult body size, larger gape, and are generally much more piscivorous (i.e., predatory fish eaters) than green sunfish and are known to reduce or eliminate native fish populations (Marks et al. 2010, 2024; Johnson et al. 2008; Bestgen and Hill 2016). In

response to the detection of smallmouth bass amid a growing number of green sunfish in Glen Canyon, a larger multiagency effort was initiated in 2022 using multiple fund sources for the National Park Service to target and remove nonnative fish in Glen and Grand Canyons. Funding continues for the Grand Canyon Monitoring and Research Center to gather and analyze pertinent data, while funding continues for the National Park Service and the Arizona Game and Fish Department to monitor, gather and analyze data, and remove nonnative fish.

Electrofishing and netting in Glen Canyon by multiple agencies in 2022, 2023, and 2024 in the river mainstem resulted in removal of warmwater nonnative fish that Tribes consider to be the taking of life. Removals (taking of life of nonnative fish) continued in the form of chemical treatments (Rotenone) in 2022 and 2023, complemented by slough netting and electrofishing in 2022, 2023, and 2024. Beneficial use practices (supporting life) occurred in the form of using the removed (netted or electrofishing) fish for fertilizer, as food for Tribes or aviaries, or in research.

Counts of green sunfish and smallmouth bass removed in 2022, 2023, and 2024 from the -12-mile slough site and from the first 23 miles of the Colorado River mainstem below Glen Canyon Dam are shown below in tables 3-1, 3-2 and 3-3. In 2022, most green sunfish and smallmouth bass captures were from fish that passed through the Glen Canyon Dam during very low lake levels, with smaller amounts of smallmouth bass and green sunfish passing through the dam in 2023 and 2024. In 2022 and 2023, green sunfish spawned in the upper slough, lower slough, and river mainstem, while smallmouth bass spawned in the lower slough and river mainstem. In 2024, cool-mix flows (BOR 2024a) were implemented and suppressed reproduction in the lower slough, while lake levels were high enough to limit entrainment.

In 2024, cool-mix flows were implemented and successfully suppressed warmwater nonnative fish spawning in the lower slough and river mainstem, while lake levels were high enough to limit nonnative fish from passing through Glen Canyon Dam. Green sunfish captures increased, possibly because of increased capture effort, increased spawning, or growing large enough to be captured by equipment. Smallmouth bass did not breed in the slough or river mainstem in 2024, thanks to cool-mix flows and efforts to net and electrofish. All smallmouth bass, except for two, caught in 2024 were from the earlier years 2022 or 2023. However, this cool-mix tool is currently only authorized for use through 2027.

**Table 3-1. Counts of green sunfish captured in the -12-mile slough and in the first 23 miles of the Colorado River mainstem below Glen Canyon Dam from 2021 through September 2024**

GSF	GSF in Mainstem	GSF in Slough
2021	17	0
2022	3864	1998
2023	8339	5698
2024	10492	132

**Table 3-2. Counts of smallmouth bass captured in the -12-mile slough and in the first 23 miles of the Colorado River mainstem below Glen Canyon Dam from 2021 through September 2024**

Year	SMB in Mainstem	SMB in Slough
2021	0	0
2022	345	19
2023	448	835
2024	177	6

**Table 3-3. Counts broken down into adult and juvenile smallmouth bass captured in the -12-mile slough and in the first 23 miles of the Colorado River mainstem below Glen Canyon Dam from 2022 through September 2024**

Year	SMB in Mainstem		Slough	Slough Treatment	Total
	juvenile	adult	YOY +1	YOY	
2022	343	2	19	0	364
2023	435	13	687	148	1283
2024	176	1	6	x	183

Note: Chemical treatment of the slough in 2023 removed 148 smallmouth bass. Most of the smallmouth bass removed each year were juvenile fish.

The principal concern related to the presence of smallmouth bass and green sunfish in Glen Canyon is the potential for these predatory fish to move downriver to areas in Grand Canyon, where they could start eating larger numbers of young native fish in the Colorado River, including the federally threatened humpback chub. However, smallmouth bass and green sunfish may negatively impact native flannelmouth and bluehead suckers in Glen and Marble Canyons, along with the rainbow trout sport fishery (BOR 2022) in Glen Canyon. Smallmouth bass also alter the food web (Marks et al. 2010) and thus are expected to prey upon other aquatic organisms, including salamanders, tadpoles, and aquatic invertebrates.

The regulated water flow through Glen Canyon Dam combined with the narrow canyon creates habitat conditions generally unsuitable for smallmouth bass reproduction. Smallmouth bass prefer gravel substrate to dig nests, and spawning is triggered when water temperatures rise above 16°C. Smallmouth bass are thought to not spawn in water velocities greater than 0.1 m/s (approximately 1 foot/second), and they will abandon nests when water velocities are above 0.3 m/s (Winemiller and Taylor 1982; Lukas and Orth 1995; Knotek and Orth 1998; Miller and Brewer 2021). The US Geological Survey recently identified locations in Glen Canyon that meet the conditions for smallmouth bass nesting. The -12-mile slough site is one of those locations, with optimal conditions for reproduction by smallmouth bass, green sunfish, and other warmwater nonnative fish.

### 3.3.2 Aquatic Resources – Environmental Consequences

#### 3.3.2.1 Impacts of the No-Action Alternative on Aquatic Resources

**Slough Habitat Conditions:** Under the no-action alternative, conditions described in the affected environment section would continue. Tools described in the 2018 EA remain available. The lower slough would not be physically modified to remove smallmouth bass spawning habitat. There would also be no new upriver channel connecting the upper slough to the river mainstem. Glen Canyon NRA management of green sunfish would continue in the upper slough. If implemented by Reclamation each year through 2027, cool-mix flows (BOR 2024a) could continue to cool the lower slough via tidal action to below the 16°C breeding threshold for nonnative fish; in 2024, this proved cool-mix flows work well. If cool-mix flows do not continue, the slough site would continue to warm earlier, higher, and later in water temperatures compared to the river mainstem. Thus, with no cool-mix flows, the slough site would continue to provide still, warm water as optimal spawning habitat for smallmouth bass and green sunfish.

**The Spring in the Upper Slough:** The no-action alternative leaves the spring and upper slough intact and in current form, function, and condition, as described in this EA in section 3.3.1.2.

The spring would continue to flow into the upper slough from its bottom deepest point. Upper slough water levels would remain relatively constant. Water temperatures would warm from April through September each year.

**Amphibians/Aquatic Food Base and Macroinvertebrates/Odonates:** Slough, wetland, and riparian habitat would remain intact for amphibians, the aquatic food base, and macroinvertebrates, including the odonates known as dragonflies and damselflies. Calm waters and suitable habitat would continue to allow conditions for feeding, breeding, and sheltering by these species at the upper and lower sloughs. Life cycle patterns would continue for salamanders, toads, and macroinvertebrates, including dragonflies and damselflies.

Warmwater nonnative predatory fish could continue to pose considerable threats to the survival and life cycle of amphibians and macroinvertebrates at the slough site, including odonates and the general aquatic food base. Continuing the management of smallmouth bass and green sunfish would be important to allow amphibians and invertebrates to complete their aquatic life stages. Nonnative fish predators are known to decimate populations of the Sonoran tiger salamander (USFWS 2019). If nonnative fish are not prevented from entering the sloughs or are not removed when found, the nonnative fish will eat egg masses, larval stages such as tadpoles, and possibly small juvenile or adult forms of salamanders, toads, dragonflies, damselflies, and other macroinvertebrates.

Toads could be impacted less by bass, since tadpoles and adults may be targeted less by smallmouth bass, but food web changes (Marks et al. 2010) caused by bass may also adversely impact the toad populations. Many toad larvae are unpalatable to fish and may, therefore, have some resistance to the impacts from nonnative fish. Kruse and Stone (1984) found that largemouth bass (*Micropterus salmoides*) learned to avoid feeding on Woodhouse's toad tadpoles because of their unpalatability and aggregative behavior. However, bass did still prey on some tadpoles, and the indirect effects of fish may still have considerable consequences. For



example, Lawler (1989) found Woodhouse's toad tadpoles to greatly reduce activity levels in the presence of a fish predator. This decreases their foraging efficiency and increases their larval period, which exposes them to other predators for a longer period.

**Native Fish and Special Status Fish Species/Nonnative Fish:** With conditions described in the affected environment section continuing under the no-action alternative, native flannelmouth suckers may continue to use the slough site. Warmwater nonnative predatory fish, such as smallmouth bass and green sunfish, could continue to try to enter the slough site to spawn, along with other nonnative fish such as rainbow trout and common carp (*Cyprinus carpio*).

If the level of Lake Powell falls below 3,570 feet elevation, then analysis shows increasing risks for entrainment passing nonnative fish through the dam into the river, along with increased river water temperatures (Eppehimer et al. 2024). This would likely produce related increases in the river of warmwater nonnative fish, such as smallmouth bass and green sunfish, some of which could breed in the river or slough, adversely affecting native fish, such as flannelmouth suckers or humpback chub, through predation and competition. These effects might be somewhat mitigated by the LTEMP SEIS cool-mix flows from the base of Glen Canyon Dam (BOR 2024a), since cool-mix flows are effective in reducing water temperature in the river and lower slough in 2024. However, the cool-mix flows cannot cool the more isolated upper slough in which green sunfish like to breed. Note that Reclamation decides each year if cool-mix flows should be implemented, and compliance for cool-mix flows expires in 2027, unless extended.

With the no-action alternative in this 2024 EA, in the scenario where Reclamation decides to not implement cool-mix flows in a future year, both the river and sloughs could present favorable breeding conditions for smallmouth bass or green sunfish. This would likely produce related increases in the river of warmwater nonnative fish, adversely affecting native fish, such as flannelmouth suckers or humpback chub, through predation and competition. This would make 2018 EA tools necessary, such as netting, electrofishing, or chemical treatments, each of which causes loss of fish life of concern to Tribes.

Under the no-action alternative in this 2024 EA, smaller tools in the prior 2018 EA would still be available to help reduce green sunfish and smallmouth bass in the upper and lower sloughs, providing some downstream benefits to native fish like flannelmouth suckers, the humpback chub, and razorback suckers. The 2018 EA tools are helpful but less effective in controlling breeding and expansion of nonnative predatory fish when compared to the 2024 EA proposed alternative. If 2018 EA tools are used, only temporary and short-term disturbance at the local slough site might occur. If no action to reduce spawning by warmwater nonnative fish is implemented by the National Park Service under the proposed action in this 2024 EA, by the National Park Service under the 2018 EA (NPS 2018), or by Reclamation implementing the cool-mix flows (LTEMP SEIS; BOR 2024a), the humpback chub, razorback sucker, flannelmouth sucker, and rainbow trout sportfish could be adversely affected from increased spawning and dispersal of warmwater nonnative fish down through Glen, Marble, and Grand Canyons. Actions described by these three documents each could help avoid or reduce negative downstream effects.

In 2024, combined agency efforts resulted in no smallmouth bass spawning in the upper and lower sloughs; however, green sunfish and carp were still able to breed in the warmer upper slough. Glen Canyon NRA fisheries management field efforts were complemented by cool-mix flows implemented by Reclamation and the Western Area Power Administration. Netting, electrofishing and installation of a block net in the lower slough were effective in preventing spawning by smallmouth bass in the lower slough until cool-mix flows were initiated on July 9, 2024. These prevention and control methods are labor intensive, and they would be required each year in the upper slough but would not be required in the lower slough if cool-mix flows occur.

Under the no-action alternative of this 2024 EA, Glen Canyon NRA would continue to use 2018 EA tools, such as a block net to prevent nonnative fish from moving into the lower slough from the river mainstem. Netting and electrofishing would continue to remove nonnative fish from the slough site. Whether there are cool-mix flows or not, the upper slough would be suitable habitat for warmwater nonnative species, so pumping or draining the upper slough to remove green sunfish or other nonnatives would be necessary in most years. These prevention and control methods could involve some lower levels of taking of life or beneficial use unless the green sunfish are released elsewhere alive.

**Rotenone:** Because efforts in 2024 were successful in preventing smallmouth bass from spawning in the lower slough, a Rotenone treatment in the sloughs was not needed in 2024. Under the no-action alternative in this 2024 EA, the tool in the 2018 EA in which Rotenone is applied remains a future treatment option against warmwater nonnative fish. Glen Canyon NRA strives to not use Rotenone in favor of other field measures to control nonnative fish. When a Rotenone treatment is conducted, it is timed for when amphibians are not in their gilled stage to help protect them at the slough site from harm (Farringer 1972; Burress 1982; Fontenot et al. 1994; Grisak et al. 2007; Ultsch et al. 1999).

**The Colorado River Mainstem:** Under the 2024 EA no-action alternative, efforts to manage and monitor nonnative fish would continue in the river mainstem in the form of field actions such as netting, seining, and electrofishing. Multiagency efforts to gather and analyze data, monitor, and remove nonnative fish would continue in the river mainstem. Funding would continue to be needed each year to address nonnative fish species in the Colorado River. The rainbow trout sport fishery would remain vulnerable to decline due to nonnative fish predation and competition. If implemented, cool-mix flows might help rainbow trout survival.

**Cumulative Impacts:** Under the no-action alternative of this 2024 EA, no additional cumulative effects would occur because climate change and nonnative fish impacts are already happening. However, substantial, mostly adverse cumulative impacts on aquatic resources in the project area result primarily from changes in seasonal and annual water flow patterns that drive Glen Canyon Dam release volumes and water temperatures. Past, present, and reasonably foreseeable future actions and trends have or are expected to produce increased water demand (resulting from population growth and development); decreased water supply (resulting from drought and increased water temperature attributed to climate change); and other foreseeable actions (DOI 2016). Decreases in runoff, reservoir volume, and river flow caused by drought and increased demand would result in lower reservoir elevations and warmer release temperatures, which could make conditions more favorable for warmwater nonnative aquatic species that prey on or

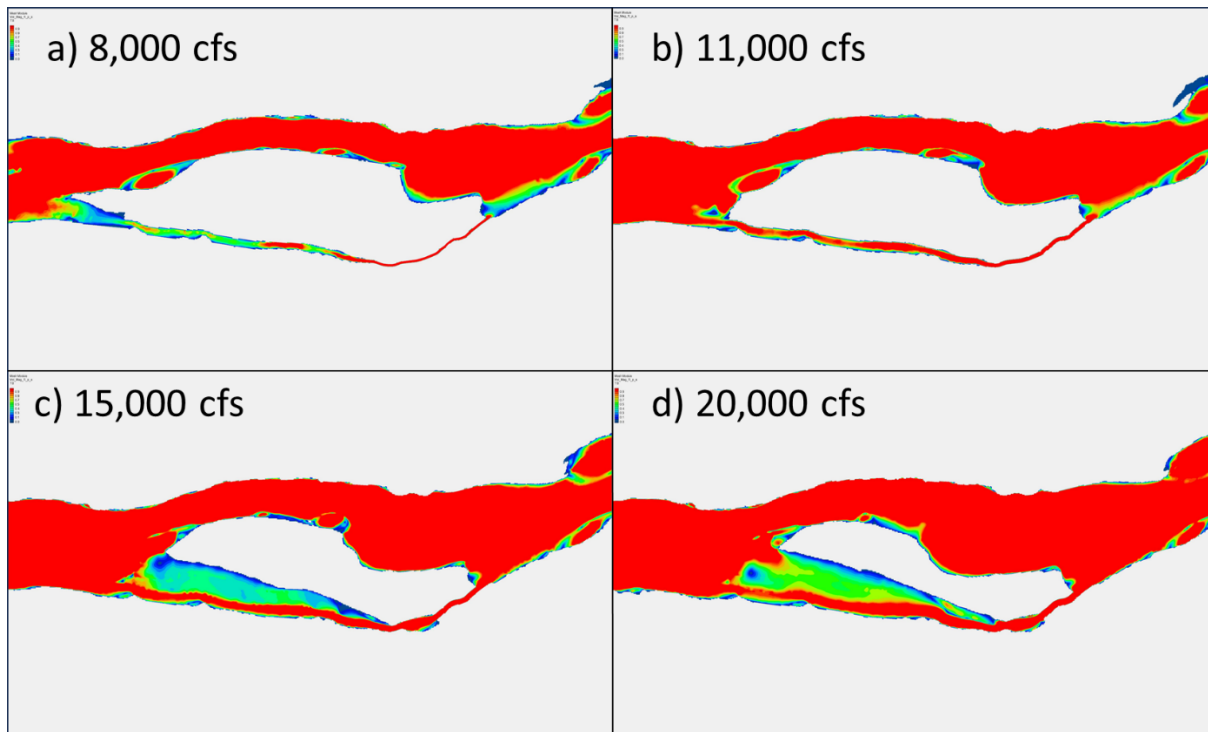
compete with native species. Without cool-mix or 2024, 2018, or 2013 EA tools, it is anticipated there could be unaddressed increases in the abundance and distribution of some warmwater nonnative fish species under the no-action alternative. This would result in negative cumulative impacts on native species within the slough site and along the Colorado River throughout Glen, Marble, and Grand Canyons.

### 3.3.2.2 Impacts of the Proposed Action on Aquatic Resources

**Slough Habitat Conditions:** The proposed action alternative in this 2024 EA would convert two low-velocity pool habitats (the upper slough and lower slough) into a higher-velocity restored river side channel with water temperatures more like the river mainstem. This would eliminate the upper slough pond and would narrow the lower slough by two-thirds and thus eliminate the largest potential breeding habitat for warmwater nonnative fish in the 15-mile Glen Canyon reach. Some of the wetland, riparian, and submerged habitat lost would be restored using mitigation described in appendix B. Success of the proposed action is highly dependent on cool-mix flows occurring each year. In years without cool-mix flows, the channel is less successful against nonnative fish but is designed to flow fast enough (with a velocity of 1 foot per second (equivalent to 0.1 m/s) or higher to disrupt smallmouth bass nesting.

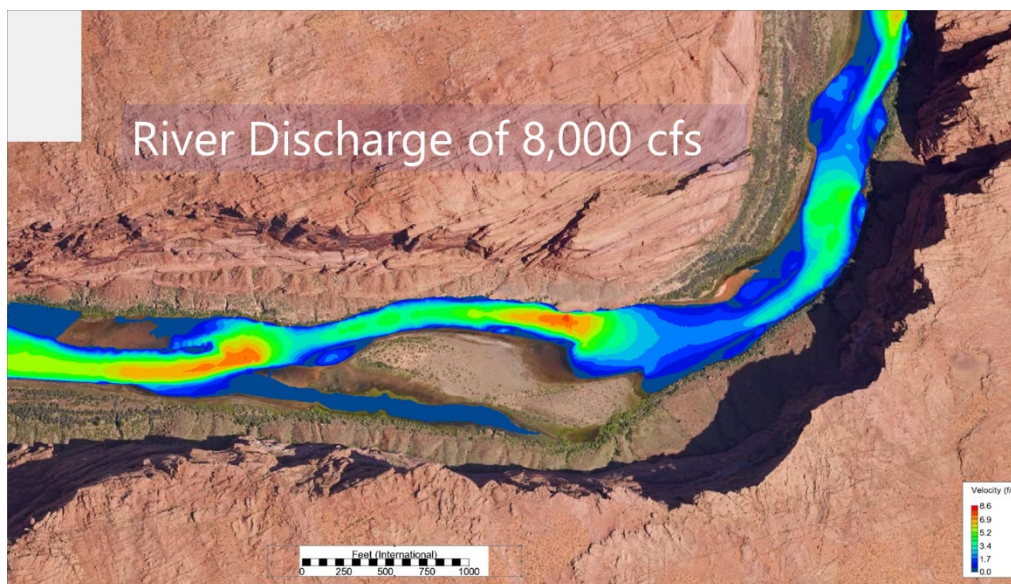
Under the proposed action, the slough would be connected to the river mainstem above the upper slough and channelized to cool the water and increase water velocity. The lower slough width would be reduced from about 200 feet to a 50-foot wide channel. The fill area of the upper slough is approximately 0.66 of an acre, and fill area of the lower slough is approximately 4 acres. The fill area would be dry at water flows below 11,000 cfs and thus would no longer be aquatic habitat for portions of each day because hydropower fluctuations go below 11,000 cfs for part of each day.

The channelization would change water velocity from 0 m/s in the sloughs (pre-project) to between 0.1 m/s and approximately 0.5 m/s for river flow rates between 8,000 and 11,000 cfs (figure 3-12, panels a and b). For river flows above 11,000 cfs, the main channel would flow greater than 0.3 m/s, but the berm would be over topped, allowing for reduced water velocities over the berm (figure 3-12, panels c and d). Although water velocity is increased to a bass-detering velocity, this velocity is slower than the mainstem. For example, in the mainstem adjacent to the slough, water velocities at 8,000 cfs range from approximately 0.1 to 2 m/s (figure 3-13). This amount of water flow would ensure that the temperatures in the slough matched the mainstem temperature.



**Figure 3-12. Post-modification modeled water velocity in the slough for four different river flow rates. The colored sections are the water velocities, with red indicating velocity above 0.3 m/s.**

Note: The sandbar is the open (unshaded) area in the center, and the thin channel of color in panels a and b are the modified channel. This shows that water velocities in the new slough channel would be above 0.1 m/s for any flow rate above 8,000 cfs and above 0.3 cfs for most areas of the slough channel around 11,000 cfs. The green and blue areas above the thin channel in panels c and d show the low water velocities where the fill area overtops.



**Figure 3-13. Water velocity at 8,000 cfs under existing conditions (pre-modification), with channel velocities between approximately 0.1 and 2 m/s**

**The Spring in the Upper Slough:** Under the proposed action, the upper slough in its current form would no longer exist. The upper slough would be filled with sand, cobble, and larger rock, leaving a channel 6 feet wide at the bottom and 30 feet wide at the top. The channel would cut directly through the spring and upper slough to a depth of approximately 5–7 feet. The bottom of the newly cut channel would be roughly even with the current pre-project depth of the substrate at the bottom of the spring inflow. The spring might continue to flow into the new channel and on to the river mainstem. The spring would no longer maintain a pond at the upper slough. Cooler and faster water would flow through the channel over the spring, possibly making the spring less attractive to green sunfish seeking it for shelter or spawning. Most of the surrounding riparian vegetation would remain on the left bank of the channel, but some of the wetland and riparian vegetation would be removed. Some riparian vegetation would be replanted along the channel edge and on the cobble bar, as described in appendix B.

**Amphibians/Aquatic Food Base and Macroinvertebrates/Odonates:** As described above for the spring, the upper slough habitat in its current form would no longer exist under the proposed action alternative in this 2024 EA. The upper slough's calm water would also not exist, impacting the life cycles of the salamanders, toads, dragonflies, damselflies, and other macroinvertebrates currently living in and around the upper slough. The bank of rock, mud, and vegetation that separates the upper and lower sloughs would be breached, possibly causing the direct loss of burrow sites and the loss of the amphibians and invertebrates within or near those sites.

This conversion in habitat conditions from a calm-water spring-supported upper slough pond into a faster-flowing river side channel would directly impact assemblages of amphibians and macroinvertebrates. Channelization would reduce or eliminate the amphibian populations, while assemblages of aquatic macroinvertebrates might change to those seen more on the river mainstem. The new channel would be much less hospitable to amphibian larvae and to juvenile dragonflies and damselflies ( GCMRC pers. comm., 2024; Cross et al. 2011; Carothers and Brown 1991).

After channel construction is complete, toads and salamanders would emerge from remaining burrows and shelters in spring or summer seasons of 2025 to find their breeding and feeding habitat is greatly altered and diminished. This would interrupt their life cycles and threaten their local survival. In both the upper and lower sloughs, salamanders and toads would emerge and discover faster cooler water, with some individuals becoming swept downstream or else laying egg masses that suffer slow or no development into larvae due to cooler waters. The higher water velocity might also deter some amphibians from laying eggs altogether in the same way as it discourages smallmouth bass spawning. Predation pressure from warmwater nonnative fish may decline, but predation by cool water nonnative fish, such as trout, may rise locally.

Channel construction means calm waters would be gone and there would be less total surface area for primary production supporting local aquatic macroinvertebrates. This may cause a corresponding decrease in macroinvertebrate population size on a local scale. There may also be a temporal shift in primary macroinvertebrate productivity to later in the year since water temperatures would be cooler and would require more time to warm in the spring or summer seasons. For these reasons, the numbers and diversity of odonates (dragonflies and damselflies)



at the channelized slough site would be smaller. Macroinvertebrates would continue to serve as an aquatic food base, though in a proportionally reduced manner.

The proposed action could cause the salamanders at the slough to become locally lost, causing a broader extirpation in Glen and Grand Canyons, as this is the only currently known location along the Colorado River corridor, in both Glen Canyon NRA and Grand Canyon National Park (B. Holton, pers. comm.), where tiger salamanders were detected in recent surveys. Moving salamanders to a new location before project construction is very difficult, and their rate of survival at a new location might be low to none.

The proposed action would cause the two toad species currently at the slough to be locally lost or highly reduced. This would not be a larger regional impact on these toad species because they are widely distributed in Glen, Marble, and Grand Canyons. In general, amphibians in off-channel ponds and sloughs in Glen, Marble, and Grand Canyon could benefit from the slough channelization if it is successful in reducing warmwater nonnative predatory fish in the Colorado River system.

**Native Fish and Special Status Fish Species/Nonnative Fish:** The proposed alternative in this 2024 EA would eliminate the largest potential breeding habitat for warmwater nonnative fish in the 15-mile Glen Canyon reach. This is a substantial contribution to reducing warmwater nonnative predatory fish, such as smallmouth bass and green sunfish, in the Colorado River system below Glen Canyon Dam. The numbers of smallmouth bass and green sunfish seen in tables 3-1, 3-2, and 3-3 above would not be produced each year in the new river side channel at the -12-mile marker. This means there would be fewer nonnative fish moving down into Grand Canyon where they could threaten survival of the federally threatened humpback chub, the federally endangered razorback sucker, and other native fish such as flannemouth suckers. However, warmwater nonnative predatory fish would persist in the river mainstem and river side habitats in Glen and Marble Canyons, so cool-mix flows remain important each year, along with efforts to remove nonnative fish from the river mainstem when cool-mix flows are not occurring.

Native flannemouth suckers have been found more frequently in the slough and in Glen Canyon during the past four years in response to warmer river temperatures. Because slough channelization is expected to result in cooler and faster flowing water, a small number of flannemouth suckers may use the new channel less frequently, and, depending on river mainstem temperatures (affected by reservoir level or using cool-mix flows), may retreat farther down the Colorado River into portions of the river with desired temperature and substrate conditions outside Glen Canyon NRA. The effects on the overall flannemouth sucker population from this project area would be negligible, whereas the benefits from reducing warmwater nonnative predatory fish species using channelization would be expected to benefit populations of flannemouth sucker, bluehead sucker, speckled dace, humpback chub and razorback sucker living in the 277 miles of river through Marble and Grand Canyons. Rainbow trout and brown trout might use the new channel more often due to cooler water and better aeration; however, changes to the population levels of these trout species would be negligible. The increased water velocity in the new channel would make the habitat less suitable for larval and juvenile warmwater nonnative predatory fish.

**Rotenone:** If the proposed slough channelization is effective in reducing or eliminating nonnative predatory fish spawning from the new channel, the use of Rotenone to remove nonnative fish would no longer be needed in this project area, reducing the loss of aquatic life, and would promote both life and ecological balance in the corridor.

**The Colorado River Mainstem:** Under the proposed action alternative in this 2024 EA, slough channelization would be completed. Field actions at the slough would not be needed if channelization is effective. However, field efforts to manage nonnative fish in the river mainstem would have to continue at some level in the form of netting, using seines, or electrofishing in the river mainstem. Multiagency efforts to gather and analyze data, monitor, and remove nonnative fish would continue in the river mainstem and cause loss of life. Funding would still be needed each year to address nonnative fish species in the river mainstem. The rainbow trout sport fishery would remain vulnerable to decline due to nonnative fish predation and competition in the mainstem, but the completed slough project and cool-mix flows might help rainbow trout survival longer term by reducing the abundance and reproduction of nonnative predatory fish.

**Mitigation:** The proposed alternative is a channel restoration project that would result in habitat conversion causing both positive and negative impacts. Mitigation would be necessary to offset adverse impacts and restore ecological and life balance to the 15 miles of Colorado River reach below Glen Canyon Dam. Both on-site and off-site mitigation measures would be practiced and are summarized in appendix B.

**Cumulative Impacts:** Amphibians located within the proposed slough channelization project boundary are subject to local, regional, and broader pressures, including multiple effects from climate change. Current pressures from nonnative predatory fish and potential impacts from slough channelization both threaten to cause the loss of the small riverside tiger salamander populations in Glen, Marble, and Grand Canyons. These pressures would also cause toad species at the slough site to largely decline or possibly disappear locally. Amphibian declines or loss at the slough site thus exacerbate the well-documented ongoing declines of amphibian species overall on regional, national and worldwide scales (Luedtke et al. 2023; Re:wild et al. 2023; Blaustein et al. 2011).

Substantial, mostly adverse cumulative impacts on aquatic resources in the project area primarily result from changes in seasonal and annual water flow patterns that drive dam release volumes and temperatures. Past, present, and reasonably foreseeable future actions, and trends have or are expected to produce increased water demand (resulting from population growth and development); decreased water supply (resulting from drought and increased water temperature attributed to climate change); and other foreseeable actions (DOI 2016). Decreases in runoff, reservoir volume, and river flow caused by drought and increased demand would result in lower reservoir elevations and warmer release temperatures, which could benefit native aquatic species, but which could also make conditions more favorable for warmwater nonnative aquatic species that prey on or compete with native species. The proposed action is expected to benefit aquatic resources overall and decrease the magnitude of cumulative impacts by reducing potential for population growth of extremely harmful nonnative species.

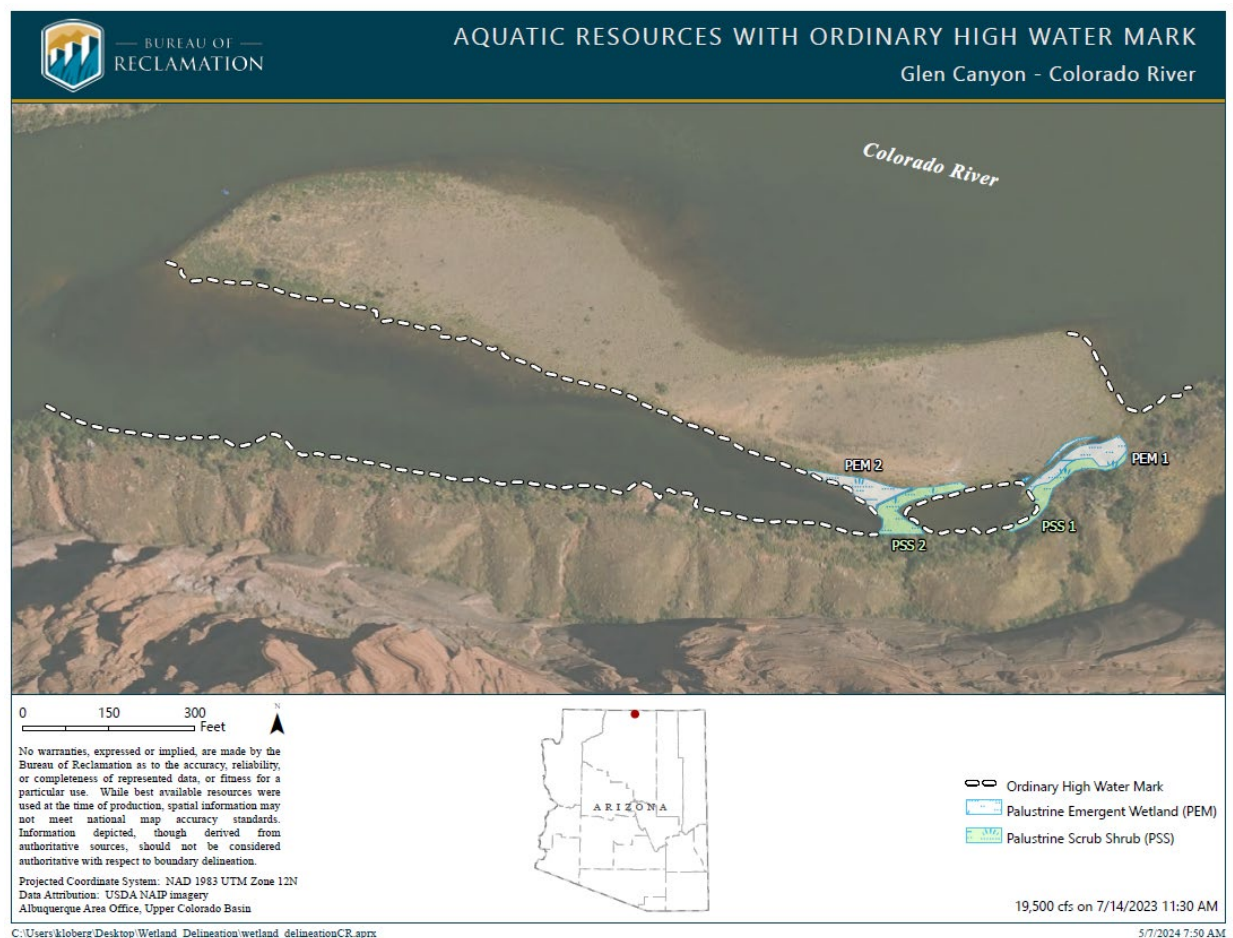
## 3.4 TERRESTRIAL RESOURCES

### 3.4.1 Terrestrial and Wetland Vegetation

#### 3.4.1.1 Terrestrial and Wetland Vegetation – Affected Environment

As shown in figure 3-5, the upper slough is disconnected from the river mainstem at the upstream end at flows below 22,000 cfs. A spring feeds the upper slough, as described in section 3.3.1.2 in this 2024 EA. The upper slough drains through a small channel approximately 10 feet long and 2 feet wide into the lower slough (figure 3-5).

The slough site configuration described above provides habitat for wetland vegetation along the edge of each slough, between the sloughs, and in the original channel upstream of the upper slough. During wetland field visits, wetland indicators, including hydric soils, hydrophytic vegetation, and wetland hydrology, were found at three out of four sampling points. Figure 3-14 shows the delineated wetlands in the project area that would be affected during the modification.



**Figure 3-14. Wetland habitat identified during the wetland delineation overlaid with the channel excavation and fill polygons**

The vegetation overstory (large tree) component is very limited on the bank formation and mainly occurs at slightly higher elevations above and adjacent to the wetland and riparian area boundary at the sloughs. Tree species observed in this overstory fringe and noted adjacent to the sloughs include a few large common hackberry trees (*Celtis occidentalis*), a Siberian elm (*Ulmus pumila*), and one red mulberry (*Ulmus pumila*). Additionally, Glen Canyon NRA employees and partners completed cottonwood (*Populus deltoides*) plantings for restoration in several areas on the bank formation. The midstory component primarily comprises coyote willow (*Salix exigua*), with a few salt cedar (*Tamarix ramosissima*) and Emory's baccharis (*Baccharis salicina*) present. Emory's sedge (*Carex emoryi*), tall fescue (*Schedonorus arundinaceus*), Ferriss' horsetail (*Equisetum X ferrissii*), and other various grasses, sedges, and rushes are located throughout the project site. No plant species protected under the Endangered Species Act of 1973 occurs in the vicinity of the sloughs within the proposed project boundary.

### 3.4.1.2 Terrestrial and Wetland Vegetation – Environmental Consequences

#### 3.4.1.2.1 Impacts of the No-Action Alternative on Terrestrial and Wetland Vegetation

**Current Conditions:** Under the no-action alternative, conditions and activities described above in section 3.3.2.1. of this 2024 EA would continue. Tools described in the 2018 EA remain available. The channel excavation and fill actions proposed in this 2024 EA would not occur. Options exist under the 2018 EA, such as installing a water-control structure between the sloughs to help block travel of nonnative fish and allow Glen Canyon NRA employees to reduce upper slough water levels long enough to remove nonnative fish. Riparian vegetation could be removed where needed. In using tools from the 2018 EA, options exist to allow the removal of a small amount of wetlands, up to 0.3 acres in size, at the location of the upper slough and its barrier separating it from the lower slough.

**Cumulative Impacts:** Under the no-action alternative, conditions described in the affected environment section would continue. No loss of wetland or riparian or submerged aquatic vegetation habitat would occur, so no action would not contribute to cumulative effects. Note however, that federal agencies are assessing which additional portions of river side habitat are contributing to the spawning of warmwater nonnative fish and looking to identify which additional river side habitat locations could be altered or eliminated within the Glen Canyon reach, potentially causing additional losses of wetland, riparian and submerged aquatic vegetation habitat.

The slough site would continue to be subject to other cumulative influences. Ongoing cumulative influences relate to changes in riparian vegetation resulting from the construction of Glen Canyon Dam (NPS 2018). Future increased water demand and lower flows downstream of Glen Canyon Dam, which are expected with climate change, could stress and reduce riparian and wetland vegetation. Warmer discharges of water through the dam (attributed to climate change) could increase algae, causing both positive and negative food chain effects. If cool-mix flows continue from the dam, it is possible algae response and food chain effects may calm.

#### 3.4.1.2.2 Impacts of the Proposed Action Alternative on Terrestrial and Wetland Vegetation

**Project Conditions:** The proposed action alternative converts two low-velocity pool habitats (the upper slough and lower slough) into a higher velocity channel with water temperatures

more like the river mainstem (figures 3-12 and 3-13). The proposed action causes loss of 0.14 acre of jurisdictional wetlands and eliminates up to 4.66 acres of riverine submerged (underwater) aquatic vegetation in the lower slough. The proposed action also reduces or eliminates additional winter waterfowl feeding and resting habitat, such as mudflats, at the slough site. Submerged aquatic vegetation in the lower slough would be eliminated in favor of upland sand/cobble fill. Some wetland or riparian substrate containing hydric soils or portions of root or seed banks could be saved by construction crews to add on top of a small portion of the sand/cobble fill. During the year after channel construction, the National Park Service would evaluate restoration potential of the 4.66 acres of sand/cobble fill for both wetland and riparian vegetation potential. Native vegetation would then be planted to restore an appropriate portion of the project site, as described in appendix B.

Reclamation worked with Glen Canyon NRA staff to assess jurisdictional wetlands at the proposed slough channelization site and draft a report with pertinent details (appendix D). The report describes 0.14 acres of jurisdictional wetlands impacted, with the potential to restore approximately 0.04 acres, expressing a net loss of 0.1 acres of jurisdictional wetlands. Some adjacent portions of wetland could also be temporarily affected by heavy equipment or other machines during project construction. After channel construction is complete, the National Park Service would initiate a five-year revegetation plan (appendix B) to restore native vegetation within the project footprint and possibly at one or more mitigation sites located outside of the slough project boundary. Vegetation restoration would include repair to temporarily impacted wetland vegetation along the banks of the new channel and at fill locations on the slough sand/cobble bar. Mitigation would also emphasize removing nonnative plants that take advantage of the disturbed areas, such as tamarisk.

Wetland habitat surrounding the upper slough would be converted into a restored river side channel with a loss of 0.1 to 0.14 acres of wetland. Riparian vegetation would be replanted, as needed, along the channel edge to restore a portion of the lost wetland habitat. Fill would be shaped at the same elevation as the existing wetland, and it could potentially grow wetland vegetation depending upon the amount of hydric soils, root bank, or seed bank that is deposited by construction action along the channel bank. The fill could become colonized by native riparian and wetland vegetation or else must be replanted as part of mitigation (appendix B) restoration efforts.

**Cumulative Impacts:** With the wetland alterations described above, the proposed action contributes to the overall national and global decline of such habitat from human activity and climate change. Some of this habitat could be restored through mitigation (see appendix B) after the initial assessment of restoration capacity, including some portion of the 4.66 acres of sand/cobble fill placed on the right bank of the upper and lower sloughs. However, these considerations occur at a time when federal agencies are assessing which additional portions of river side habitat are contributing to spawning of warmwater nonnative fish and looking to identify which additional river side habitat locations could be altered or eliminated within the Glen Canyon reach, potentially causing additional losses of wetland, riparian and submerged aquatic vegetation habitat.

Under the action alternative, the slough site would continue to be subject to other cumulative influences. Ongoing cumulative influences relate to changes in riparian vegetation resulting



from the construction of Glen Canyon Dam (NPS 2018). Future increased water demand and lower flows downstream of Glen Canyon Dam, which are expected with climate change, could stress and reduce riparian and wetland vegetation. Warmer discharges of water through the dam (attributed to climate change) could increase algae, causing both positive and negative food chain effects. If cool-mix flows continue from the dam, it is possible algae response and food chain effects may calm.

### **3.4.2 Wildlife Resources**

#### **3.4.2.1 Wildlife – Affected Environment**

Sections 3.3.1 and 3.4.1.1 above in this 2024 EA describe overall aquatic and wetland habitat and associated features and species. These sections also provide photos that help explain the current value of the slough site and the Glen Canyon corridor to wildlife in their habitat. A wide variety of wildlife species are associated with terrestrial and riparian habitat along the Colorado River. Many of these species are habitat generalists, occurring in ecosystems from both the riparian zones and upland communities. Some species require specific vegetation composition and structural components and thus may only occur within specific habitats in the river corridor (DOI 2016).

The slough site supports a variety of mammals, birds, fish, amphibians, and invertebrates. The fish, amphibians and invertebrates are discussed above in this 2024 EA in section 3.3.1. Mammals, birds and species with federal or state status are also described below. A robust description of bird species found in Glen Canyon NRA is presented by Morris et al. 2022.

##### *3.4.2.1.1 Common Mammals*

A variety of mammals occur along the Colorado River within the 15-mile reach of Glen Canyon NRA. These include bighorn sheep (*Ovis canadensis*), ringtail cats (*Bassariscus astutus*), rock squirrels (*Spermophilus variegatus*), antelope ground squirrels (*Ammospermophilus leucurus*), beavers (*Castor canadensis*), and badgers (*Taxidea taxus*). Other small mammals occur in the corridor, where their abundance and richness are greatest in higher elevation portions of riparian habitats where talus piles, steeper slopes, rock falls, and canyon wall crevices provide a wider variety of habitats (NPS 2005).

Beavers, ringtail cats, badgers, and squirrels occur at or near the slough site. Photos of a beaver and badger are shown in figure 3-15 below. Glen Canyon NRA employees confirmed a badger is currently living within the slough project boundary, including recent dens dug by the badger into the sand/cobble bar along the slough. Beavers are growing in number along the river in the Glen Canyon reach. Beavers may have possible dens at both the upper and lower slough since they have been observed entering each slough from the adjacent left bank. Beavers and ringtail cats are otherwise visitors to the slough site from the surrounding area.



**Figure 3-15. A badger (left; NPS photo by Jane Gamble) and a beaver (right; NPS photo)**

#### *3.4.2.1.2 Migratory Birds – Waterfowl, Marsh Birds, and Shorebirds*

The river mainstem, calm water side habitats, riparian habitat, rock piles, and canyon walls provide a variety of habitat used by migratory birds in the 15-mile Colorado River corridor below Glen Canyon Dam. This Glen Canyon corridor provides habitat for birds year-round, including seasonal breeding habitat, migratory bird stopover sites, and wintering areas (Spence 2006; Spence et al. 2011; Gatlin 2013). Several species of birds that breed along the river corridor are obligate riparian species (DOI 2016).

A variety of waterfowl and shorebirds occur in the Glen Canyon corridor, and they visit the slough site for feeding and resting during winter. An active great blue heron (*Ardea herodias*) rookery is located just below Glen Canyon Dam and had 22 active nests during May in 2013. Annual Christmas bird counts are conducted by Glen Canyon NRA with partners within this 15-mile river corridor every year, and the 2024 count identified 43 species of birds, 22 of which were species of waterfowl and shorebirds. The slough site itself is a survey point during these annual Christmas bird counts. Figures 3-16 and 3-17 show some of the bird species seen at the slough project area during winter resting and feeding.



**Figure 3-16. American wigeon and redhead duck (top left, USFWS photo); common merganser (top right, NPS photo by Jake Frank); and great blue heron (bottom, NPS photo)**





**Figure 3-17. White-faced ibis (top left, USFWS photo by Tom Koerner); black-necked stilt (top right, USFWS photo by Lane Wintermute); and Virginia rail (bottom, USFWS photo by Katie Theule)**

Within the slough site, the lower slough serves as important winter resting and feeding habitat for waterfowl and shorebirds. It is common to see rafts or scattered groups of duck species numbering a few hundred individuals resting and feeding in the lower slough daily and weekly during winter months. These water birds are attracted to the lower slough for its calm waters supporting aquatic plants, invertebrates, small fish, and other food sources.

Large mixed groups of mergansers (*Mergus merganser*), northern pintails (*Anas acuta*), redhead ducks (*Aythya americana*), American wigeons (*Mareca americana*), and mallards (*Anas platyrhynchos*) are commonly seen feeding and resting in the lower slough. Some marsh birds or shorebirds observed by Glen Canyon NRA employees or partners at the lower slough include great blue herons (*Ardea herodias*), white-faced ibis (*Plegadis chihi*), black-necked stilt (*Himantopus mexicanus*), lesser yellowlegs (*Tringa flavipes*), and Virginia rail (*Rallus limicola*).

#### **3.4.2.1.3 Migratory Birds – Raptors**

A variety of raptors occur in Glen Canyon NRA during all seasons of each year, where some migrate, some stop to rest, and some build nests. A pair of ospreys (*Pandion haliaetus*) successfully nested at the base of Glen Canyon Dam in 2014 (DOI 2016), and ospreys frequent

the river corridor to forage. Peregrine falcons (*Falco peregrinus*) are a state special status species for the state of Arizona, and they frequent the canyon corridor. Peregrines are known to nest on cliff ledges above the slough site, and a nesting pair was found initially in 2012 during statewide monitoring activities.

The Bald and Golden Eagle Protection Act of 1940 protects these two eagle species across the United States. Bald eagles winter in Marble Canyon and in the upper half of Grand Canyon, where wintering individuals occur at tributary confluences (DOI 2016). Golden eagles prefer rugged terrain with cliffs and mesas and nest on cliff ledges. Migrant eagles use the sheer cliffs of the Glen Canyon NRA to hunt (DOI 2016). Both bald eagles and golden eagles occur across Glen Canyon NRA, but these two eagle species do not nest within or near the proposed slough channelization project boundary.

#### *3.4.2.1.4 Species with Federal Status Near the Proposed Slough Project Area*

Species with federal status under the Endangered Species Act of 1973, as amended, occur in or near the general vicinity of the 15-mile corridor below Glen Canyon Dam. Their status is explained below in relation to the proposed slough channelization project area. No federally designated critical habitat for any species is located at the proposed slough channelization.

**California Condor (*Gymnogyps californianus*):** The Arizona/Utah-based condor population is a 10j nonessential experimental population under the Endangered Species Act. Experimental populations have a federally threatened status within national park and national wildlife refuge boundaries. Local condors are shown in figure 3-18.



**Figure 3-18. California condors (NPS photos by Gerry Nealon)**

Condors prefer mountains, gorges, canyons, and hillsides, which create updrafts, thus providing favorable soaring conditions (USFWS 2024). Condors nest in a shallow cave or on a ledge or cleft or crevice among boulders on a cliff or hillside where there is minimal disturbance. High perches for roosting provide updrafts, allowing condors to uplift into flight. If available, condors may sometimes use rivers or ponds for bathing and cooling.

Condors eat small-to-medium to large-size dead animals (USFWS 2024; DOI 2016). Examples are fish carcasses or dead squirrels, coyotes, deer, elk, pronghorn, sheep, goats, cattle, or horses



found across the landscape. The carrion can be in any condition, including various stages of decay.

Lees Ferry boat ramps in Glen Canyon NRA are at Colorado River mile marker 0. Condors are often seen downriver in the vicinity of Marble Canyon, where they roost during spring season on or near Navajo Bridge (river mile marker +4.5). In recent years, a pair of condors nested and attempted to raise young in Marble Canyon. In 2012, 2018, and 2019, a condor pair attempted to nest upriver in Glen Canyon NRA near the -4-mile river mark, but they were not able to hatch young and have not attempted to nest at this location recently. The Marble Canyon condors range widely in flight over land managed by Navajo Nation, the National Park Service, the Bureau of Land Management, and the US Forest Service.

Inspection of Peregrine Fund telemetry tracking data to date clearly show that condors soar above or rest on the rim of Glen Canyon as far upriver as the -7-mile mark. To date, there are no known data or observations showing condors down at river level at the base of Glen Canyon walls. For these reasons, the site of proposed channelization (i.e., the slough complex upriver at the -12-mile river mark) does not experience condor presence.

In a 2008 environmental assessment (NPS 2008) for habitat improvements at Hidden Slough (river mile marker -6.5), Glen Canyon NRA recognized that condors were potentially attracted to human activities, including construction projects. In recent years and currently in 2024, Glen Canyon NRA has not experienced condor attraction to human activity of any kind in Glen Canyon, including during activities involving rafting, fishing, camping, picnics, boating, and park employee resource work involving monitoring, maintenance, and data collection.

Condors are vulnerable to avian flu and other forms of avian illness. Both Glen Canyon NRA and Grand Canyon National Park cooperate with the Peregrine Fund and the US Fish and Wildlife Service in condor recovery, which includes monitoring condors, ravens, and other bird species for illness.

### **3.4.2.2 Wildlife – Environmental Consequences**

#### *3.4.2.2.1 Impacts of the No-Action Alternative on Wildlife*

**Current Conditions Continue for Wildlife:** Under the no-action alternative, conditions and activities described above in sections 3.3.1, 3.3.2.1, and 3.4.1.1 of this 2024 EA would remain the same. Wildlife and plants currently living at the slough site would continue to have habitat features they need to survive. Nonnative fish would still try to enter the slough site to breed and to eat local native fish, amphibians, and invertebrates. Cool-mix flows from the Glen Canyon Dam and field netting efforts by Glen Canyon NRA may continue to be successful in preventing nonnative fish from entering or breeding in the lower slough. Under the 2018 EA, the option remains to install a water-control structure between the sloughs to help block travel of nonnative fish and allow Glen Canyon NRA employees to reduce upper slough water levels long enough to remove nonnative fish. This water-control structure option would allow wildlife and their habitat to remain as they currently exist.

**Cumulative Impacts:** Under the no-action alternative, current habitat and fauna continue as they exist today but are subject to the following cumulative influences. Cumulative impacts on wildlife in the corridor relate to the changes in riparian vegetation resulting from the

construction of Glen Canyon Dam (NPS 2018). Future increased water demand and lower flows downstream of Glen Canyon Dam, which are expected with climate change, could stress riparian and wetland vegetation, resulting in adverse impacts on wildlife, their habitats, and their base. Warmer discharges of water through the dam (attributed to climate change) could increase algae and invertebrates, increasing the food base for some wildlife species but reducing the food base if supporting larger numbers of nonnative aquatic species. If cool-mix flows continue from the dam, it is possible some of these stresses on wildlife habitat and food base may calm. Note however, that these considerations occur at a time when federal agencies are assessing which additional portions of river side habitat are contributing to spawning of warmwater nonnative fish, looking to identify which additional river side habitat locations could be altered or eliminated within the Glen Canyon reach, potentially causing additional losses of wetland, riparian, and submerged aquatic vegetation habitat that would otherwise be used by wildlife.

#### *3.4.2.2.2 Impacts of the Proposed Action on Wildlife*

**Conditions for Wildlife Under Proposed Action:** Adverse impacts on wildlife from slough channelization would result from noise, human disturbance, and abrupt habitat conversion from slough habitat to restored river side channel habitat. Riparian habitat vegetation would be retained on the left bank of the channel and sloughs. The upper slough would be eliminated by filling it with rock, mud, sand, and cobble from the side channel and sand/cobble bar. The lower slough would be narrowed by two-thirds using similar fill material. Larger, mobile wildlife species are expected to temporarily avoid the area during construction. Loss of small amounts of wetland (0.1 acres net loss) and riparian habitat would result in fewer wildlife using the new channel, but some wildlife may return after vegetation is restored to disturbed surfaces by mitigation measures (appendix B). Overall, the proposed action is not expected to result in population-level impacts on wildlife described in this EA section.

**Common Mammals Impacted:** A badger living within the proposed slough project area would be directly impacted by the proposed alternative. Glen Canyon NRA employees recently confirmed a single badger is living at the slough site during all of 2024 to date. The badger is living in dens it dug in the sand/cobble bar near the lower slough. Glen Canyon NRA is currently trying to confirm if the badger is a male or a female or if the badger has young. If this badger continues to live within the proposed construction site, Glen Canyon NRA may have to trap the badger before the project begins. In that case, the badger would be relocated to suitable habitat not directly affected by slough channel construction. This action would help ensure the badger's survival since heavy equipment would destroy its dens while moving fill material.

During project construction, beavers may be disturbed by human presence, heavy equipment activity, noise, and associated visual cues. If beavers have dens at each slough, the construction project would disturb them, possibly causing them to shelter in their dens on the undisturbed left bank or otherwise leave the area. Visiting beavers would move away from the slough site during construction but may return to visit after construction is completed. If beavers return, they would find faster-moving, cooler water in the new channel, which may affect beaver food choices or else cause displacement to more suitable habitat.

**Migratory Birds – Raptors:** Peregrine falcons normally nest during warm months on the high cliffs and ledges of Glen Canyon high above the slough site. Proposed construction would occur

in winter months from January to March in 2025. So, peregrine falcons would not be nesting at that time and would not be subjected to construction noise.

Bald eagles and golden eagles do not nest at or near the slough site. The two eagle species are present high above Glen Canyon and the slough site during winter. Noise and construction disturbance would not impact these two eagle species.

**Migratory Birds – Waterfowl, Marsh Birds, and Shorebirds:** Since the lower slough serves as an important winter resting and feeding area for waterfowl, marsh birds, and shorebirds, impacts on these species would occur from construction activity, noise, displacement, and alteration of the local food base. The proposed action would be constructed from January to March in 2025, the exact time frame these bird species are resting and feeding at the lower slough. During construction, these birds would have to find other locations within Glen Canyon to continue resting and feeding, causing them to spend more of their winter energy reserves.

When these waterfowl, marsh birds, and shorebirds return to the lower slough location after the project is complete, they would find a channel narrowed with cooler, faster water that affects the food base these birds use. In future years, it is likely the number of birds trying to use this converted habitat site would become highly reduced. Waterfowl, marsh birds, and shorebirds spend energy in migration each year, and they must have wetland and other locations to use for feeding and resting as they try to replenish their energy and fat reserves. As a result, these birds may simply not visit the slough site anymore in favor of finding more suitable habitat elsewhere that would continue to support their needs.

**Species with Federal Status Near the Proposed Slough Project Area:** Of the eight species with federal status considered for this proposed slough channelization project, seven species are dismissed from further detailed analysis in this 2024 EA, and those seven species are listed in chapter 4 in section 4.1.3. This plan retains the California condor for further EA analysis below since it occurs near the proposed slough project vicinity. Condors have never been observed at the slough proposed project site. However, condors do soar above Glen Canyon and may rest high on top of canyon walls or could possibly land at the base of the canyon to feed on dead fish or other carrion. For these reasons, the measures described below would be implemented during the proposed project.

Activities involving heavy construction equipment would occur in the form of staging and storage at the Lees Ferry boat ramps, along with equipment transport via barge 12 miles up the Colorado River to the slough channel construction site. Impacts on condors are not anticipated, and park employees and construction workers would be briefed about condor conservation measures and what to do if they encounter a condor.

Condor conservation measures would be in place to protect condors in the very unlikely event a condor visits the construction site or visits construction equipment. These measures would be included in all pertinent documents and would be discussed during morning safety briefings prior to a day's construction activity. The following condor conservation measures would be implemented:

1. If a condor were spotted directly on or closely over the construction site, activities would cease until the bird left or was encouraged to leave by an approved biologist appointed by the National Park Service and the US Fish and Wildlife Service.
2. Project workers and supervisors would be instructed to avoid interaction with condors and to immediately contact park resources division personnel if a condor settled at the site.
3. The construction site would be cleaned up at the end of each day (e.g., trash removed, scrap materials picked up) to minimize the likelihood of condors visiting the site.
4. All dead animals found within 500 feet of the construction site would be immediately disposed in appropriate containment and removed from the site at the end of each working day.
5. To prevent water contamination and potential poisoning of condors, a spill prevention and cleanup plan would be developed and implemented for this project. The plan would include provisions for immediate cleanup of any hazardous substance, and it would define how each hazardous substance would be treated in case of leakage or spill.
6. All project personnel would be given a copy of literature regarding condor concerns.
7. Project personnel would be strictly prohibited from hazing or harassing condors.

If condors or other federally listed species enter the proposed project site, disturbance may result for these species in the form of human presence, noise, heavy equipment activity, and construction-related visual cues. Construction-related impacts, including noise, would be temporary, lasting for the duration of the activity (the hours of equipment operation on a given day). Human presence may occur at the Lees Ferry staging area, depending on security needs. The staging and construction period is expected to last 2.5 months. Equipment transport would be using a barge only. No helicopter flights would occur during this proposed project. As a result, population level effects would not occur.

**Cumulative Impacts:** With the wetland alterations described above in section 3.4.1.2.2 of this EA, the proposed action alternative contributes to the overall national and global decline of such habitat from human activity and climate change. Some of this habitat could be restored through mitigation (see appendix B) after the initial assessment of restoration capacity, including some portion of the 4.66 acres of sand/cobble fill placed on the right bank of the upper and lower sloughs. However, these considerations occur at a time when federal agencies are assessing which additional portions of river side habitat are contributing to spawning of warmwater nonnative fish and looking to identify which additional river side habitat locations could be altered or eliminated within the Glen Canyon reach, potentially causing additional losses of wetland, riparian, and submerged aquatic vegetation habitat that would otherwise be used by wildlife.

The proposed action alternative otherwise is subject to the following cumulative considerations. The overall cumulative impacts on wildlife in the corridor relate to the changes in riparian vegetation resulting from the construction of Glen Canyon Dam (NPS 2018). Future increased water demand and lower flows downstream of Glen Canyon Dam, which are expected under

climate change, could stress riparian and wetland vegetation, resulting in adverse impacts on wildlife habitats and the wildlife food base. Warmer discharges of water through the dam (attributed to climate change) could increase algae and invertebrates, increasing the food base for some wildlife species. If cool-mix flows continue from the dam, it is possible some of these stresses on wildlife habitat and food base may calm.

### **3.5 TRIBAL AND CULTURAL RESOURCES**

Cultural resources can be categorized as archeological resources, historic and prehistoric structures, cultural landscapes, Traditional Cultural Properties (TCPs), ethnographic resources, and museum collections. Many natural resources, such as plants and plant-gathering areas, water sources, minerals, animals, and other ecological resources, are also considered cultural resources, as they are integral to the identity of Tribes in various ways. The physical attributes of cultural resources are often nonrenewable, especially archeological sites, which often represent ancestral homes for a park's traditionally associated Tribes. Tribes also have an interest in how their traditional homelands are managed by state and federal agencies. Some examples of archeological or historic resources found in Glen Canyon along the Colorado River are shown in figure 3-19.





**Figure 3-19. Examples of archeological or historic resources in Glen Canyon within Glen Canyon NRA. The top photo shows the Descending Sheep Petroglyph Panel (NPS photo by C. Sequanna). The bottom photo shows historic buildings at the Lonely Dell Ranch in the vicinity of Lees Ferry (NPS photo).**

Historic properties are defined as those cultural resources that meet the eligibility criteria for listing in the National Register of Historic Places and are considered “significant” resources that must be taken into consideration during the planning of federal projects. Historic properties are defined in the National Historic Preservation Act, section 106 (36 CFR 800.16[I][1]) as any “prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior.” This term includes artifacts, records, and remains that are related to and located within such properties. This term also includes properties of traditional religious and cultural importance to an Indian Tribe or Native Hawaiian organization that meet the national register criteria. Historic properties can include TCPs, certain archeological sites, or historic districts.

National Park Service Bulletin No. 38 describes a TCP as a historic property that is eligible for inclusion in the National Register of Historic Places based on its associations with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community. Traditional Cultural Properties are rooted in a traditional community's history and are important in maintaining the continuing cultural identity of the community (Parker and King 1990). The cultural practices or beliefs that give a TCP its significance are still observed at the time a TCP is considered for inclusion in the national register.

### **3.5.1 Tribal and Cultural Resources – Affected Environment**

#### **3.5.1.1 Traditional Cultural Properties**

The Colorado River is a Traditional Cultural Property of interest to more than 30 Tribal nations, including the seven affiliated with the Glen Canyon portion of the river. Three of these affiliated Tribes (Navajo Nation, Ute Mountain Tribe, and Paiute Indian Tribe of Utah) participate in the Upper Colorado River Commission's negotiations and planning regarding water rights and related issues. Ethnographic reports (Stoffle et al. 1994; Roberts et al. 1995; Ferguson 1998; Austin et al. 2018; Hopkins and Hedquist 2018; Yeatts 2018) formally document the traditional cultural significance of the Colorado River and associated historic properties along the river. These reports better inform management of Tribal concerns and proposed recommendations for the continued management of the Colorado River corridor at Glen Canyon. Any actions on the river are, therefore, of great interest and concern to Tribes.

The Colorado River, as it flows through Glen Canyon, Marble Canyon, and Grand Canyon, has a prominent place in the history and worldview of the Indigenous peoples of the Southwest, and it continues to have an important place in contemporary Native American cultures, religions, and economies. As noted above, many Tribes regard the canyons as sacred space, the origin and home of their ancestors, and the residence of the spirits of their dead. Tribes also regard the canyons as the source of many culturally important resources, including plants, animals, mineral sources, and other resources naturally occurring in the environment. The canyons and all within are important to the genesis of the Tribes and to their contemporary ways of life rooted in traditions engendered by those experiences.

Associated Tribes have stated that they regard the Colorado River ecosystem, inclusive of the river and the land base from rim to rim within both Glen Canyon NRA below Glen Canyon Dam and Grand Canyon National Park, as a TCP. The Arizona State Historic Preservation Office has concurred with the determination as a TCP (Hopi CPO 2001; Dongoske 2011; Maldonado 2011; Coulam 2011). In the TCP document submitted by the Pueblo of Zuni and Hopi Tribe, some of the elements of the TCPs have been disclosed, and other elements are considered confidential, but all are considered important to the Tribes. A description of the importance of these elements to Tribes is provided throughout chapter 3 in the *Long-Term Experimental and Management Plan Environmental Impact Statement*. A description of the Tribal view of history and meaning of the Grand Canyon can be found in section 3.9 of the LTEMP EIS (DOI 2016).

Tribes are aware of significant features within Glen Canyon that are meaningful to them. Tribes know a pre-dam 1889 photo (figure 1-2) shows the slough site as a large dynamic sandbar with little or no vegetation, along with a backwater where the lower slough is currently located.

Tribes also know about the Descending Sheep Panel petroglyph in Glen Canyon, along with other canyon wall petroglyphs created long ago by Indigenous peoples in the vicinity both upriver and downriver from the -12-mile slough site. Tribes are also aware of springs within Glen Canyon, including at the upper slough. Notes summarizing details of slough topics discussed with Tribes in 2024 are provided in appendix C.

### **3.5.1.2 Archaeological Sites**

An archeological site or property is defined by the national register as a district, site, building, structure, or object. However, archeological properties are most often sites and districts. The national register further defines an archeological site as “a location that contains the physical evidence of past human behavior that allows for its interpretation” (ACHP 2024). An archeological site or property is a place or places where the remnants of a past culture survive in a physical context that allows for the interpretation of these remains. Archeological resources identified along the Colorado River reveal the relationships between the canyon and the people who occupied the area over the past 12,000 years. For some Tribal communities, archeological resources are markers left by their ancestors, the embodiment of those who came before, and are imbued with the spirits of the ancestors. They represent a physical link to the past.

A complete archeological inventory of the river corridor, encompassing all traversable terrain between Glen Canyon Dam and Separation Canyon from the river up to and including pre-dam river terraces, was completed in 1991 for the 1995 Glen Canyon Dam EIS (Fairley et al. 1994). This and subsequent survey efforts have documented nearly 500 properties in the near-shore environment of the river from Glen Canyon Dam to Lake Mead (NPS 2006). The Grand Canyon National Park Multiple Property Inventory National Register Determination of Eligibility considers archeological sites within the canyon, with significance and integrity to be eligible for the national register. These archeological sites are frequently considered as ethnographic resources or Traditional Cultural Properties to Tribes. A description of the types of archeological resources and the time frames into which they fall can be found in section 3.8 of the LTEMP EIS (DOI 2016).

There are no known archeological sites in the proposed slough channelization project boundary at the -12-mile marker on the river. The slough site, including the sand/cobble bar, slough shoreline, and river side channel were surveyed prior by Glen Canyon NRA and confirmed to not contain archeological sites. The submerged wreck of the steamboat Charles H. Spencer, abandoned in 1912, is in a shallow cove about 0.33 miles upstream from Lees Ferry.

The no-action alternative and the proposed action alternative in this 2024 EA are not expected to impact archeological sites at the slough site, in Lees Ferry, or in the rest of Glen Canyon. For these reasons, archeological sites are dismissed from further analysis in the EA below.

### **3.5.1.3 Historic Districts**

The Lonely Dell Ranch Historic District was nominated to and listed in the National Register of Historic Places in 1978 (Muhn 1977); 20 years later, the district was expanded to include Lees Ferry (Hubbard 1997), creating the Lees Ferry and Lonely Dell Ranch Historic District. This is the only historic district in the proposed staging area at Lees Ferry for the proposed slough project. The district contains 26 contributing elements, including historic structures, a cemetery,

irrigation ditches, and the remains of the Spencer Steamboat, which is completely submerged in the Colorado River except at low flows. Also contained in the district are numerous modern noncontributing structures, including maintenance buildings, a launch ramp, and a comfort station. The significance of the district is based on its association with early Mormon settlement, early ranching and agriculture, early mining, early USGS river gaging and dam exploration activities, the exploration and development of the Colorado Plateau, and as one of the few transportation crossings of the Colorado River for over 400 miles that was first crossed by Native Americans. Not included in the district, but very near it, are remnants of Puebloan architecture. Although Indigenous occupation is not currently identified as a contributing element to the district's national register eligibility, the National Park Service may revisit this evaluation as part of ongoing district management. Additionally, Lonely Dell Ranch has been identified as a historic vernacular landscape (see section 3.5.1.4), substantial for its association with Mormon settlement and with exploration and development of the Colorado Plateau.

The no-action alternative and the proposed action alternative in this 2024 EA are not expected to impact the historic district due to construction and storage activity being confined to current public use parking, boat ramps, and dock access. For these reasons, historic districts are dismissed from further analysis in the EA.

#### **3.5.1.4 Cultural Landscapes**

Cultural landscapes are defined as “a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with an historic event, activity, or person, or exhibiting other cultural or aesthetic values” (NPS 2009).

Glen, Marble, and Grand Canyons are significant for their human history and their ongoing roles in the lives and traditions of today’s Native Americans of the Colorado Plateau and those who work and visit the canyons. On a broad scale, the entire river corridor can be viewed as a cultural landscape in which Native Americans for millennia have farmed, hunted, gathered plants and minerals, and performed rituals. Ancient trails, remnants of stone structures, traces of fields, and prayer objects enshrined in travertine and salt are enduring evidence of a subtly altered landscape. Integral to this landscape are the animals, plants, and minerals traditionally used and valued by Native Americans. Native views and traditional knowledge on several resources in the project area can be found throughout chapter 3 in the LTEMP EIS (DOI 2016).

The historic vernacular landscape, as defined in the NPS Cultural Resource Management Guideline (NPS 1998), is represented at both at Lonely Dell Ranch and at Lees Ferry. This landscape is representative of the historic exploration, settlement, and recreational activity of the Colorado River area. A short description of this landscape can be found in section 3.8.2.3 of the LTEMP EIS (DOI 2016).

The no-action alternative and the proposed action alternative in this 2024 EA are not expected to impact the overall cultural landscape of Lees Ferry. Thus, cultural landscapes are dismissed from further analysis in the EA.

## **3.5.2 Tribal and Cultural Resources – Environmental Consequences**

### **3.5.2.1 Traditional Cultural Properties**

#### **3.5.2.1.1 Impacts of the No-Action Alternative on Traditional Cultural Properties**

**Current Conditions Under No-action:** With the no-action alternative, conditions described in the affected environment section could persist, depending on Glen Canyon Dam operations. Since the canyons are TCPs, which Tribes regard as the source of many culturally important resources, including plants and animals, the balance of life at the -12-mile slough is weighed, along with the balance of life for federally listed fish downriver in Marble and Grand Canyons. The upper slough, its spring, salamanders, toads, invertebrates, other wildlife, plants, and the overall habitat they live in all remain as described in the affected environment section.

The lower slough could remain unchanged and be cooled via tidal action and cool-mix from the base of Glen Canyon Dam, since cool-mix flows (BOR 2024a) proved to be effective in 2024 in reducing water temperatures in the river and lower slough. However, the cool-mix flows cannot cool the more isolated upper slough in which green sunfish like to breed. In addition, Reclamation decides each year if cool-mix flows should be implemented, and compliance for cool-mix flows expires in 2027 unless extended.

Nonnative fish, especially green sunfish, would still try to enter the slough site to breed and to eat local native fish, amphibians, and invertebrates. To help control green sunfish in the upper slough under the 2018 EA, the option remains to install a water-control structure between the sloughs. This structure would block travel of nonnative fish and allow Glen Canyon NRA to reduce upper slough water levels long enough to remove these nonnative fish. This water-control structure would allow local wildlife and their habitat to remain as they currently exist. Because of concerns about the spring and life (amphibians, other wildlife, invertebrates and plants) at the upper slough, the smaller 2018 EA channelization tool for the upper slough has deliberately not been used to date by Glen Canyon NRA. If there are no cool-mix flows (BOR 2024a) each year or after 2027 from the base of the dam during warm months, the no-action alternative means monitoring and removal actions in the sloughs might continue in the form of electrofishing, netting, or using chemical (Rotenone) treatments. These actions could once again be a concern for the Hopi Tribe and the Pueblo of Zuni regarding their documented TCP. The Hopi Tribe, Pueblo of Zuni, and Piute Tribes could continue to be concerned about the taking of life. Some Tribes generally object to agency actions that use mechanical and chemical field methods to remove (take the life of) nonnative fish because these actions are not consistent with the Tribe's cultural and religious values associated with the Colorado River and Glen and Grand Canyons. To help create balance in life, the National Park Service has already implemented several mitigation measures to reduce taking of life or else provide "beneficial uses" of removed fish to help sustain life in other ways.

To address impacts on the Colorado River ecosystem TCP, the National Park Service would continue to regularly inform Tribes of intended management actions and consult on the appropriate measures for mitigation based on the management action. Examples of potential mitigations include the live transport and relocation of green sunfish or the beneficial use of removed nonnative fish, as described above. Beneficial use involves collecting fish during management actions and transporting them to Tribes for either human consumption or for use



in eagle aviaries or similar uses. Although beneficial use has been used in the past (BOR 2011), it should be noted that what is considered beneficial use may not be the same for all Tribes and is considered only a partial mitigation by most Tribes. What a Tribe considers beneficial use may also change over time as communities become more aware of specific management actions.

If there are no cool-mix flows in the river and sloughs, and this occurs at a time of no management actions in the sloughs using 2018 EA tools or this 2024 EA proposed action, warmwater nonnative fish (especially green sunfish or smallmouth bass) could breed again in the river and sloughs below Glen Canyon Dam, then disperse downriver into Grand Canyon. This scenario is troubling because an increase in the numbers of warmwater nonnative fish in Grand Canyon could threaten survival of the federally threatened humpback chub and the federally endangered razorback sucker.

**Cumulative Impacts Related to No Action:** As described above under the no action alternative, no cool-mix flows (BOR 2024a) during seasons or years with elevated river water temperatures would contribute adverse cumulative impacts on the TCP by allowing warmwater nonnative fish to continue to spawn in the river and lower slough. This would force the loss of fish life from removal actions by agencies. The no-action alternative is not expected to contribute to cumulative impacts on archeological sites, historic districts, or cultural landscapes.

Future actions are expected to be like past and present actions in how they contribute to adverse cumulative impacts on cultural resources in Glen, Marble, and Grand Canyons. Cultural resources in the canyons (mostly archeological sites) are in an ongoing state of deterioration due to natural erosive processes, or, in some cases, human causes related to park visitation or to the presence and operation of Glen Canyon Dam. This includes the deterioration of sites exposed by erosion and intentional and unintentional damage (artifact movement, vandalism, and erosion) to archeological sites from visitor traffic.

Past, present, and future actions in the proposed project area continue to have ongoing adverse impacts on many Tribal communities (DOI 2016). Reclamation recently entered into a programmatic agreement to address potential effects on cultural and historic properties under the LTEMP. The LTEMP includes the mechanical removal of trout and the management of river flows for trout, both of which have an adverse impact on the Colorado River TCP because native fish are a contributing element. The National Park Service, Arizona Game and Fish Department, and the US Geological Survey conduct fish sampling and nonnative fish removals using electrofishing, netting, and Rotenone, which also have a taking of life adverse impact on the TCP. Actions and basin-wide trends affecting aquatic life, vegetation, and wildlife (as described above) also affect resources of value to Tribes. On the positive side, the Reclamation LTEMP includes vegetation treatments that improve native vegetation conditions and could lead to a more natural riparian ecosystem, contributing to the overall better health of the canyons in the TCP, which is a benefit.

#### **3.5.2.1.2 Impacts of the Proposed Action on Traditional Cultural Properties**

**Conditions Under the Proposed Action:** Under the 2024 proposed action alternative, a much deeper and wider 1,000-foot-long channel would be cut from the river mainstem down through the historic river side channel, across the middle of the spring and upper slough, and down into the lower slough. The spring and upper slough habitat would be directly impacted, causing the

loss of salamanders, toads, invertebrates, some plant life, some wetlands (0.14 acres), and up to 4.66 acres of riverine submerged aquatic vegetation. The composition of invertebrate species in the new channel would decline and then change to a lower level of invertebrates more adapted to a stream channel. The spring may continue to flow into the newly constructed channel and onward into the Colorado River.

With the canyons as Traditional Cultural Properties, which Tribes regard as the source of many culturally important resources, including plants and animals, the balance of life at the -12-mile slough is weighed, along with the balance of life for federally listed fish downriver in Marble and Grand Canyons. Mitigation actions (appendix B) after project completion would restore some of the wetlands, riparian habitat, and plant life to the slough site. Mitigation actions may include enhancing a known spring located downriver from the slough site. Mitigation may not be fully successful in restoring lost amphibians, such as salamanders and toads, or in restoring slough-like riverine waterfowl resting and feeding habitat.

The proposed action alternative is intended to work as an integrated tool with cooler river water and cool-mix flows to eliminate the need for intensive fish removal efforts from the sloughs. However, there is no guarantee that cool-mix flows would continue, leaving only slough channel flow rates as a possible deterrent to smallmouth bass nesting. If the proposed action alternative is implemented, taking of life removals of nonnative fish would continue in other parts of the river. If the proposed action is not successful at eliminating reproduction in the sloughs, taking of life removals of nonnative fish might still be required. However, if cool-mix flows continue, preventing nonnative fish from reproducing in the sloughs is expected to help reduce the taking of life and help reduce the number of nonnative fish that pose a threat to the federally threatened humpback chub, the federally endangered razorback sucker, and the other three native fish species located downriver through Grand Canyon.

Under the proposed action alternative, again to address impacts on the Colorado River ecosystem TCP, the National Park Service would continue to regularly inform Tribes of intended management actions and consult on the appropriate measures for mitigation based on the management action. Examples of potential mitigations include the live transport and relocation of green sunfish or the beneficial use of removed nonnative fish, as described above. Beneficial use involves collecting fish during management actions and transporting them to Tribes for either human consumption or for use in eagle aviaries or similar uses. Although beneficial use has been used in the past (BOR 2011), it should be noted that what is considered beneficial use may not be the same for all Tribes and is considered only a partial mitigation by most Tribes. What a Tribe considers beneficial use may also change over time as communities become more aware of specific management actions.

**Cumulative Impacts Related to the Proposed Action:** A large contributor to future cumulative effects is the LTEMP SEIS cool-mix flows from the base of Glen Canyon Dam (BOR 2024a). These cool-mix flows are proven effective in 2024 in reducing water temperature in the Colorado River and lower slough. Reclamation decides each year if cool-mix flows should be implemented, and compliance for cool-mix flows expires in 2027 unless extended.

If cool-mix flows (BOR 2024a) continue, the proposed action alternative would help prevent warmwater nonnative fish from reproducing in the sloughs. This action would help reduce the

taking of fish life and help reduce the number of nonnative fish that pose a threat to the federally threatened humpback chub and other native fish in the Colorado River. The proposed action alternative's contribution to cumulative impacts on cultural resources would thus be to reduce the taking of fish life, which eases impacts on the canyons in the TCP. The proposed action alternative is not expected to contribute to cumulative impacts on archeological sites, historic districts, or cultural landscapes.

Future actions are expected to be like past and present actions in how they contribute to adverse cumulative impacts on cultural resources in Glen, Marble, and Grand Canyons. Cultural resources in the canyons (mostly archeological sites) are in an ongoing state of deterioration due to natural erosive processes, or, in some cases, human causes related to park visitation or to the presence and operation of Glen Canyon Dam. This includes the deterioration of sites exposed by erosion and intentional and unintentional damage (artifact movement, vandalism, and erosion) to archeological sites from visitor traffic.

Past, present, and future actions in the proposed project area continue to have ongoing adverse impacts on many Tribal communities (DOI 2016). Reclamation recently entered into a programmatic agreement to address potential effects on cultural and historic properties under the LTEMP. The LTEMP includes the mechanical removal of trout and management river flows for trout, both of which have an adverse impact on the Colorado River TCP because native fish are a contributing element. The National Park Service, Arizona Game and Fish Department, and the US Geological Survey conduct fish sampling and nonnative fish removals using electrofishing, netting, and Rotenone, which also have a taking of life adverse impact on the TCP. Actions and basin-wide trends affecting aquatic life, vegetation, and wildlife (as described above) also affect resources of value to Tribes. On the positive side, the Reclamation LTEMP includes vegetation treatments that improve native vegetation conditions and could lead to a more natural riparian ecosystem, contributing to the overall better health of the canyons in the TCP, which is a benefit.

### **3.5.3 Native American Trust Assets and Trust Responsibility**

The National Park Service acknowledges its federal trust responsibility and the importance of Native American trust assets within the proposed slough channelization project area. The trust responsibility consists of the highest moral obligations that the United States must meet to ensure the protection of Tribal and individual Native American lands, assets, resources, and treaty and similarly recognized rights. Secretaries of the interior have recognized the trust responsibility repeatedly and have strongly emphasized the importance of honoring the United States' trust responsibility to federally recognized Tribes and individual Native American beneficiaries (Secretarial Order 3335; DOI 2014). Native American trust assets are legal interests in property held in trust by the US government for Native American Tribes or individuals. Examples of such resources are lands, minerals, or water rights.

The project area is bounded on the east by Navajo Nation land. The National Park Service has ongoing consultation with the Navajo Nation regarding potential effects of NPS management action on their lands, resources, trust assets, and reserved rights. Analyses of effects on resources show that the proposed action alternative is not likely to affect Native American lands, minerals, or water rights.

## **3.6 RECREATION, VISITOR USE, AND EXPERIENCE**

### **3.6.1 Recreation, Visitor Use, and Experience – Affected Environment**

#### **3.6.1.1 Glen Canyon National Recreation Area**

**Visitation and Recreation in the 15 Miles Below Glen Canyon Dam:** The Glen Canyon 15-mile reach includes the -12-mile slough project site and is heavily visited for multiple recreational uses (figure 3-20). Visitor use is highest from March through October, with up to 176,000 visitors per month in 2023. Visitor use is lowest during winter months, with 2023 visitors numbering 64,000 in December compared to 33,000 in January and 87,000 in February.



**Figure 3-20. Public use in the Glen Canyon NRA reach of the Colorado River occurs in many forms, including kayaking, rafting, and fishing (NPS photos)**



The Glen Canyon reach includes Lees Ferry boat launch facilities with restrooms, a shade pavilion, and interpretive facilities. The reach also includes commercial and private boating and rafting operations, along with six designated campsites accessed only by boat and which are located on sediment terraces and beaches along the river (DOI 2016). Visitors engage in trout fishing from boats or the shoreline, in private and commercial boating and rafting trips, or in nonmotorized activities such as kayaking, canoeing, and paddleboarding. Visitors engage in wildlife viewing, camping, hiking, climbing, bow hunting for carp, waterfowl hunting, visiting cultural sites, sightseeing, and creating arts such as painting. Navajo Nation land extends along much of the east side of the Colorado River, adjacent to the Glen Canyon NRA boundary. Hiking and canyoneering access is very limited due to high, steep canyon walls.

Public use of the Glen Canyon reach of the Colorado River below Glen Canyon Dam is growing annually. Between 2012 and 2023, annual visitation has grown from 210,000 visitors to approximately 1.2 million visitors at Lees Ferry, including the 15-mile Glen Canyon reach. In 2012, approximately 53,000 (25%) of the visitors accessed the area via the pontoon-raft concessions for one-way downriver trips that departed daily from the base of the dam and traveled to Lees Ferry (DOI 2016). Beginning in late 2023, Glen Canyon rafting trips now begin and end at Lees Ferry, helping 42,000 (3.5%) of visitors to enjoy the Glen Canyon corridor annually below the dam. Other activities visitors enjoy include fishing or swimming at Paria Beach, relaxing at the Lees Ferry campground, hiking the local trails and canyons, launches in commercial or private rafting trips down the Colorado River into Marble and Grand Canyons, or walking in the orchards at Lonely Dell Ranch Historic District, which includes a ranch house and grounds, ferry grounds, a sunken steamboat, historic structures, and interpretive signs.

Six commercial companies currently operate on the Colorado River in the Glen Canyon reach. All six companies provide backhaul services involving kayaks or other vessels. Five of the companies provide guided fishing. Three of the companies provide launch and retrieve services for human-powered vessels less than 26 feet in length. One of the companies provides both rafting and backhaul services. For backhaul services, customers experience a boat ride up the river to near the dam, allowing for single and multiple day trips down the river moving back to Lees Ferry. For rafting trips, half-day guided trips on motorized pontoon rafts run twice daily and are very popular, while full-day nonmotorized raft trips also occur.

**Duck Hunting:** Each year, duck hunters use boats to access the slough site for hunting during the Arizona waterfowl hunting season. When terrestrial vegetation is present on the sand/cobble bar at the slough site, some duck hunters set up hunting blinds. Other hunters prefer to hunt directly from their boat while complying with related state hunting regulations. Conversations with Arizona Game and Fish Department officials confirm a pattern during the annual duck hunting season in which weekend duck hunting involves roughly 8 to 15 boats with occupants hunting at sites up and down the river in the Glen Canyon reach. This weekend pattern and the length of the duck hunting season suggest the total number of duck hunters is likely to be in the hundreds (200 or more) per year for the Glen Canyon reach. Glen Canyon NRA and Arizona Game and Fish Department staff do not have annual counts of duck hunters exclusively using the 12-mile slough.

**Bow Hunting for Carp:** A small number of people visiting the slough site each year use bows to hunt for carp living in the calm waters of the slough. This activity is helpful in fish management

since carp are nonnative fish. The National Park Service and the Arizona Game and Fish Department do not have good annual estimates of the numbers of carp bow hunters using the slough site or the Glen Canyon corridor. Glen Canyon NRA staff believe the annual number of carp bow hunters to be a dozen or fewer visitors.

**Rainbow Trout Fishing:** The completion of Glen Canyon Dam on the Colorado River in 1963 provided the cold-water discharges necessary for creation of the Lees Ferry rainbow trout fishery in the 15-mile Glen Canyon reach of the Colorado River. The fishery was sustained by stocking from 1964 until 1991. Since that time, the fishery has sustained itself.

Fish in all waters of Glen Canyon NRA and Grand Canyon National Park are managed by the National Park Service, in cooperation with the Arizona Game and Fish Department and the US Fish and Wildlife Service and in accordance with the Comprehensive Fish Management Plan (NPS 2013). Five commercial guided fish operations served about 50% of boat-based fishing in 2011 and served about 3,000 clients in each of the preceding four years (DOI 2016).

The condition of the rainbow trout fishery has varied considerably over time in response to management actions, stocking, dam release patterns, changing reservoir conditions, and food availability. Competition for food resources occurs from nonnative brown trout within the Glen Canyon reach. Approximately 10,900 anglers used the fishery in 2014, of which 6,700 were boat anglers who accessed the boat-fishing section upriver of Lees Ferry, and 4,200 were walk-in shore anglers, mainly accessing the 1.2-mile walk-in section at Lees Ferry downstream of the mile marker 0 launch facility. Fishing occurs year-round, with peak fishing occurring in April and May, but remains high through October.

For the Lees Ferry vicinity in 2023, the Arizona Game and Fish Department (Rogowski, pers. comm. 2024) estimated a relative boat angler use of 3,598 (95% CI: 3,077 – 4,119) and for the walk-in area 1,491 (95% CI: 1251 – 1731). The Arizona Game and Fish Department calls this “relative angler use,” as this estimation method undercounts the number of anglers that use the fishery. Some preliminary investigations comparing creel data with game camera data revealed the methods are undercounting boat anglers by 32% on weekdays and by 38% on weekends (so, by about 35% overall). Similarly, for walk-in anglers, people start and finish fishing before AGFD surveys begin at 11:30 a.m., and some anglers wait to start fishing after the surveys end at 5:30–6:00 p.m. So, methods are currently under development to better estimate the number of anglers fishing outside of AGFD survey time frames, and this information will help develop better approaches to estimating yearly angler usage in the Lees Ferry area.

### **3.6.1.2 Colorado River in Grand Canyon National Park**

River rafting trips through Grand Canyon begin in Glen Canyon NRA at Lees Ferry. The National Park Service, in accordance with the Colorado River Management Plan (NPS 2006), manages resources within the river corridor, including the regulation of highly sought whitewater river trips through the Marble and Grand Canyon corridors. The Colorado River Management Plan established a number of just under 25,000 recreational users, who access the area on either commercial or privately guided trips that employ a variety of sizes and types of boats to run trips in Grand Canyon.

Commercial trips through Grand Canyon run from April through October, and private trips run year-round. Trips may run up to 25 days. Trips begin within Glen Canyon NRA at the Lees Ferry boat ramps at river mile 0. The trips end at Diamond Creek at river mile 226 or end at Pearce Ferry at river mile 280 in Lake Mead National Recreation Area.

### **3.6.2 Recreation, Visitor Use, and Experience – Environmental Consequences**

#### **3.6.2.1 Impacts of the No-Action Alternative on Recreation, Visitor Use, and Experience**

With the no-action alternative, conditions described in the affected environment section would continue. Heavy public use for multiple recreation opportunities would continue in the Glen Canyon reach. Facilities and services would still be provided. Concessioners and various permitted guides would continue to operate and possibly enhance their services. Duck hunting, carp bow hunting, and sport fishing for rainbow trout would continue in the Glen Canyon reach, including near or in the 12-mile slough. Impacts on local river fauna would continue to occur from nonnative brown trout in the Glen Canyon reach.

If the level of Lake Powell falls below 3,570 feet in elevation, then analysis shows increasing risks for entrainment passing nonnative fish through the dam into the river, along with increased river water temperatures (Eppehimer et al. 2024). This would likely produce related increases in the river of warmwater nonnative fish such as smallmouth bass and green sunfish, some of which could breed in the river or slough, adversely affecting rainbow trout through predation and competition that negatively affect recreational fishing. These effects might be somewhat mitigated by the LTEMP SEIS cool-mix flows from the base of Glen Canyon Dam (BOR 2024a), since cool-mix flows are effective in reducing water temperature in the river and lower slough in 2024. However, the cool-mix flows cannot cool the more isolated upper slough in which green sunfish like to breed. Note that Reclamation decides each year if cool-mix flows should be implemented, and compliance for cool-mix flows expires in 2027 unless extended.

With the no-action alternative in this 2024 EA, in the scenario where Reclamation decides to not implement cool-mix flows in a future year, both the river and sloughs could present favorable breeding conditions for smallmouth bass or green sunfish. This would make 2018 EA tools necessary, such as netting, electrofishing, or chemical treatments, each of which causes loss of fish life. Without cool-mix flows, the no-action alternative could result in rises in warmwater nonnative fish in the Colorado River and lower slough, causing additional adverse impacts on trout fishing recreation for visitors.

With the no-action alternative in this 2024 EA, smaller tools in the prior 2018 EA are still available to help reduce green sunfish and smallmouth bass in the upper and lower sloughs, providing some benefits to rainbow trout and recreational fishing. The 2018 EA tools are helpful, but less effective in controlling breeding and expansion of nonnative predatory fish when compared to the 2024 EA proposed alternative. If 2018 EA tools are used, only temporary and short-term disturbance at the local slough site might occur for visitors and recreational users, depending on the tools selected.

**Cumulative Impacts:** Cumulative effects from past and present actions in the Glen Canyon reach have generally been beneficial to visitors and recreation. Some reasonably foreseeable future impacts would be adverse (e.g., climate change effects on flows; see NPS 2018 for details).

Under the no-action alternative, no changes mean Glen Canyon NRA staff do not anticipate additional contributions to cumulative impacts from boating, duck hunting, or carp bow hunting. However, climate change effects and associated rises in warmwater fish may contribute to greater cumulative effects for rainbow trout and sportfishing in Glen Canyon.

### **3.6.2.2 Impacts of the Proposed Action Alternative on Recreation, Visitor Use, and Experience**

**General Impacts in the 15-Mile Glen Canyon Reach:** Construction of the proposed action alternative would potentially temporarily affect visitor recreation within the Glen Canyon reach. For this reason, the proposed project work would occur begin in January, with completion in March. This period is when public use and recreation is at its lowest level each year and coincides with the time frame when concessioner rafting trips do not occur.

Visitors seeking an isolated experience would be disturbed by the noise and visual disturbance from the construction work at the slough site. This would include noise and activity from workers when they were transported to and from the site. The barge and tugboat activity would cause noise and navigation concerns in the river, in addition to being an unusual sight for visitors to see in the Glen Canyon reach.

Boating traffic at Lees Ferry and along the Glen Canyon reach may be delayed by the barge moving heavy equipment up and down the river. The barge is expected to be larger and less maneuverable than other power boats using the river, so those other boats would have to yield to the barge. This could cause short delays for other boats traveling along the river if the barge were navigating a particularly narrow point on the river where other boats must wait to pass.

If the proposed action alternative were successful, it would reduce the portion of degradation of the rainbow trout fishery caused by predation and competition from smallmouth bass, helping to enhance recreational trout fishing.

**Impacts at the Lees Ferry Staging Area:** There would be acute impacts on Lees Ferry during the start and end dates of the proposed project. Barge assembly and loading would likely require closing part or all of the boat ramps at Lees Ferry for a short time period (perhaps one or two days). The closure would protect human health and safety by preventing the public from entering the location and interacting with the crane that would be loading barges into the water. The duration of the closure period is uncertain, but it is expected to be most of one day for barge unloading and assembly (and later for disassembly and loading at the end of the project). A full closure would prevent all boating activities.

A partial or full closure at the Lees Ferry boat ramps could result in the delay or cancellation of launches for guide services (fishing or kayak back hauls) in the Glen Canyon reach and for Grand Canyon river raft trips scheduled to travel downriver from Lees Ferry in early January and mid-March. At those times, trout anglers and boaters would not be able to launch during the closures. Glen Canyon NRA and Grand Canyon National Park staff would work together to notify permit holders and the fishing and boating communities so they may reschedule trip launches as needed. Similar closures and mitigation would be needed at the end of the project as the barge is removed and disassembled. Rafting in the Glen Canyon reach would not be disrupted since that rafting activity does not occur from January to mid-March.

Once the barge was assembled, heavy equipment would be loaded onto the barge. This would require the barge to be near the shore (within 5–10 feet) in water deeper than 3 feet. The construction crew would attempt to load equipment onto barge near the anchorage east of the boat launch (figure 2-1, right yellow box). However, if this is not possible due to water depth or insufficient path or ramp support, the equipment would need to be loaded onto the barge at the concrete boat ramp (figure 2-1, left yellow box). This would require closing the concrete boat ramp for a short time with each barge trip (potentially one hour per loading, with one to three loadings per day). Closing the concrete boat ramp may prevent some motorboats from being launched if they could not use the adjacent dirt launch.

A staging area would be set aside for storing construction equipment at Lees Ferry for the duration of the project. The proposed site is located at the east side of the dirt/gravel parking lot at Lees Ferry. This equipment storage area may be fenced and have 24-hour security. Public access to this area would be prohibited to prevent vandalism of the stored equipment, and the site may also be fenced off if the National Park Service deems it necessary.

**Impacts at the Slough Site:** Specific visitation and recreational impacts at the slough site are described below for visitation and recreational uses.

**Visitation and Recreation During Construction:** Visitors seeking an isolated experience at or near the slough would experience disturbance from encounters with noise and from visual disturbance witnessing heavy equipment doing construction work at the slough. Visitors would also be disturbed from the noise and activity from workers transported to and from the work site using boats. Sound from construction equipment may travel in unpredictable ways in the canyon environment. Dust may also be generated by heavy equipment at the slough site.

Visitors would not be permitted to access the slough site during construction for safety reasons for both visitors and workers. This would also help keep the heavy construction equipment safe from curious boaters, anglers, and hunters. If the National Park Service expects visitors to continue trying to access the slough during construction, Reclamation staff would consider a 24-hour security presence.

These effects on visitors would be expected on a daily basis for the duration of the construction period, currently proposed as January to March in 2025. Additional visitor disturbance would occur along the 12-mile river reach when the barge is transporting equipment to or from the slough site. All of these effects would end once construction is complete.

**Duck Hunting:** Duck hunting would be directly impacted by the proposed project alternative in both the short and long term. During slough channel construction, waterfowl would be unlikely to visit their traditional winter feeding and resting habitat in the lower slough. The waterfowl are expected to move elsewhere away from disturbance from heavy equipment noise and related activity. In future years, waterfowl may not return to the traditional lower slough site because it is channelized with cooler water and faster flows affecting waterfowl food base. Waterfowl would have to use an alternate site located elsewhere, and this would make it more difficult for duck hunters to finish their hunts successfully.

**Bow Hunting for Carp:** Because the lower slough would be channelized, water moving through the channel would be cooler and faster, which might affect the food base, plant materials, and



other factors important to carp. Carp bow hunting opportunities may diminish at the slough site after channelization is complete.

**Rainbow Trout Fishing:** The proposed project might help rainbow trout and enhance recreational trout fishing in the following manner. The new channel would flow with faster and cooler water with better aeration that is more attractive to rainbow trout. During times when Reclamation chooses to not implement cool-mix flows, when river and slough water temperatures warm enough for nonnative fish to breed, the new channel may cause water to flow fast enough to disrupt smallmouth bass nesting at the slough site, causing fewer bass and thus reducing pressure on trout from competition and predation in the Glen Canyon reach.

**Cumulative Impacts:** Cumulative effects from past and present actions in the Glen Canyon reach have generally been beneficial to visitors and recreation. Some reasonably foreseeable future impacts would be adverse (e.g., climate change effects on flows; see NPS 2018 for details). Boating would remain at current levels or higher, so Glen Canyon NRA staff do not expect any contributions to cumulative impacts from boating. The proposed action would adversely affect duck hunting and carp bow hunting due to habitat conversion and thus contribute to overall cumulative effects on those activities and associated species. For rainbow trout and associated sportfishing, the proposed action would initially cause small adverse impacts during the construction period, but in the long-term would benefit trout and native fish species by reducing predation and competition by warmwater nonnative fish, resulting in some relief and reversal in cumulative effects related to trout. These project-related gains for trout and native fish would be reversed in any warmwater season when cool-mix flows are needed but do not occur.

CHAPTER

4

**CONSULTATION  
AND  
COORDINATION**



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## **CHAPTER 4. CONSULTATION AND COORDINATION**

### **4.1 AGENCIES AND TRIBES CONSULTED**

#### **4.1.1 Agencies**

The following agencies and organizations were contacted and invited to participate in the planning process:

- Bureau of Reclamation
- US Geological Survey
- US Fish and Wildlife Service
- Arizona Game and Fish Department
- Arizona State Historic Preservation Office
- Grand Canyon Monitoring and Research Center
- National Park Service

For this proposed slough channelization project, the National Park Service invited Reclamation to be a participating agency to advise and assist with the development of the proposed action and the draft slough EA. Slough modification has been discussed since 2012, with agency coordination increasing in 2015 and 2016. Reclamation provided the National Park Service with a technical report in 2018 that evaluated various options to reduce temperature in the river mile -12 slough and reduce the overall ability of the slough to support warmwater nonnative fish species. The detection of spawning smallmouth bass in the lower slough on June 30, 2022, reinvigorated slough modification discussions. Various meetings were held from early 2022 through September 2024 to develop new slough modification options, provide status updates, and provide opportunities for discussion. Reclamation provided new modification designs in May and August in 2023, and further developed the channelization proposal with the National Park Service from January to May in 2024. The National Park Service facilitated interdisciplinary team discussions from February through May in 2024. This team was composed of resource managers and subject matter experts from the National Park Service, Reclamation, Arizona Game and Fish Department, US Geological Survey and US Fish and Wildlife Service.

The National Park Service participated in Reclamation's multiagency Glen Canyon Dam Adaptive Management Program (GCDAMP). The National Park Service provided updates and reports on the status of rapid response actions focused for managing nonnative fish in the Colorado River, including updates regarding this proposed slough channelization EA, to the multiagency Technical Workgroup and Adaptive Management Work Group meetings from mid-2022 through 2024. These updates provided a forum for input from the many GCDAMP stakeholders interested in management of Colorado River resources.

#### **4.1.2 National Historic Preservation Act and Consultations with Tribes and SHPO**

**Consultations in 2024:** In keeping with provisions of the National Environmental Policy Act; section 106 of the National Historic Preservation Act of 1996, as amended; NPS *Management Policies 2006* (section 5.2.1); and Executive Order 13007, “Indian Sacred Sites” and Executive Order 13175, “Consultation and Coordination With Indian Tribal Governments,” Glen Canyon NRA initiated early consultation regarding proposed slough channelization with the seven Tribes affiliated directly with Glen Canyon. Glen Canyon NRA also initiated consultation with the Arizona State Historic Preservation Office. Consultation letters regarding the most recent designs for proposed slough channelization were sent to Tribes by Glen Canyon NRA on April 25, 2024, with follow-up letters sent to Tribes on July 22, 2024.

Glen Canyon NRA is talking with Tribes and the Arizona State Historic Preservation Office to hear perspectives and identify concerns. Discussions include help to define an Area of Potential Effect and assess the effects of the proposed slough channelization project on Traditional Cultural Properties. Consultations are ongoing, so Glen Canyon NRA will continue to consult to ensure perspectives and concerns are adequately addressed. Glen Canyon NRA’s consultations with Tribes in 2024 include the following affiliated Tribes traditionally associated with the Glen Canyon NRA portion of the Colorado River Basin:

- Hopi Tribe
- Kaibab Paiute Tribe
- Navajo Nation
- Paiute Indian Tribe of Utah
- Pueblo of Zuni
- San Juan Southern Paiute Tribe
- Ute Mountain Ute Tribe

Two additional Tribes consider the canyons (Glen, Marble, and Grand) as a whole and express interest in the proposed slough channelization project. For these reasons, Glen Canyon NRA also invites comments and consultation with these Tribes:

- Hualapai Tribe
- Havasupai Tribe

Telephone and teleconference conversations in 2024 include Glen Canyon NRA consultation discussions with the Pueblo of Zuni, Navajo Nation, Hopi Tribe, Kaibab Paiute Tribe, the Paiute Tribe of Utah, and the San Juan Southern Paiute Tribe. Glen Canyon NRA has also reached out to the Ute Mountain Ute Tribe to encourage discussions.

On September 5, 2024, representatives from Navajo Nation, the Kaibab Paiute Tribe, and the Paiute Indian Tribe of Utah met with Glen Canyon NRA officials to attend a morning river raft



trip to view the -12-mile slough. Consultation discussions continued in the afternoon at the Weaver house at the Lonely Dell Ranch in the Lees Ferry vicinity of Glen Canyon NRA.

Notes summarizing details of topics discussed with Tribes in 2024 are provided in appendix C. Consultation has brought forth current concerns about the 2024 EA planning pace being too fast and about the need to consider a third alternative in comparison to the proposed action alternative. Tribes also shared concerns about life trade-offs in relation to potential impacts from slough channelization, including the potential loss of amphibians, their habitat (wetland, riparian, slough), and the potential loss of plants of ceremonial or medicinal significance, while also in general support of humpback chub conservation. Tribes expressed traditional thinking about dragonflies, salamanders, and the presence of a spring as a TCP that supports the upper slough. Tribes consider water to be sacred, and springs are particularly important, as they are an uncontaminated water source for life, ceremonies, prayers, crafts, and drinking.

During 2024 consultation on the proposed slough channelization project, four Tribes expressed concerns with the pace of the proposed project and EA process. Each Tribe stated there has not been enough time to receive and review adequate data on current and projected fish populations, along with other information requests described in appendix A. Three Tribes expressed that the project is proceeding through a time of religious ceremony and rest that prevents them from responding to the slough EA accelerated time line. Three Tribes request the project be delayed to at least winter of 2026, with the additional use of cool-mix and netting in 2025 if conditions warrant it, to allow the National Park Service to receive the results of in-progress studies of the spring and salamanders in the upper slough, and to share more data and models about fish populations with Tribes. This would give Tribes more time to consider the proposed slough channelization project.

**Consultations in 2022 and 2023:** Consultations in 2022 and 2023 included phone and teleconference discussions, in-person meetings, and -12-mile slough visit field trips via rafts.

On August 4, 2023, representatives from the Pueblo of Zuni met with officials from Glen Canyon NRA and Grand Canyon National Park staff to attend a morning river raft trip to view the -12-mile slough. Consultation discussions continued in the afternoon at the Lees Ferry ranger station in Glen Canyon NRA. The Governor, religious leaders, and entire Council of the Pueblo of Zuni attended this consultation day.

On August 29, 2022, representatives from the Hualapai Tribe, Moapa Band of Paiute Indians, and the Pueblo of Zuni attended a river raft field visit to the -12-mile slough, with officials present from Glen Canyon NRA and Grand Canyon National Park. Consultation discussions occurred while rafting and while viewing slough site.

**Consultations in 2018:** National Park Service consultations with Tribes about warmwater nonnative fish management and related smaller slough site options are also described in the prior Expanded Nonnative Aquatic Species Management Plan EA (NPS 2018). Officials from both Glen Canyon NRA and Grand Canyon National Park consulted with Tribes during in-person government-to-government meetings about smaller, more simple designs and actions for potential slough management, including a smaller channelization design. Pages 57 to 64 in the 2018 EA describe Tribal and cultural resources considered at that time, including viewpoints

expressed by some Tribes. The Pueblo of Zuni and additional Tribes assisted with writing the 2018 EA.

**Prior Consultations:** For the Colorado River Basin, the National Park Service has engaged in consultations with Tribes and Reclamation on fish management issues for decades. Tribes have consulted on numerous previous agency decisions. These include a 2011 Nonnative Fish EA (BOR 2011), the 2013 Comprehensive Fish Management EA (NPS 2013), consultations with the National Park Service in 2015 about green sunfish management options, and Reclamation's 2016 LTEMP EIS (DOI 2016) and related nonnative fish management programmatic agreement with Tribes under the National Historic Preservation Act.

The 2013 Comprehensive Fish Management EA included consultation with the Hualapai Tribe and 11 other Traditionally Associated Tribes affiliated with the combined Glen and Grand Canyon segments of the Colorado River. The 2013 consultation considered how actions on the Colorado River in Glen Canyon can have potential effects on sacred landscapes, sites, and culturally significant native species and their habitats. Pueblo of Zuni leaders expressed concern for the taking of life from the Colorado River.

In 2015, Glen Canyon NRA staff consulted with the Hopi Tribe, the Hualapai Tribe, the Kaibab Paiute Tribe, the Navajo Nation, and the Pueblo of Zuni on a proposed chemical (Rotenone) treatment in the slough to remove nonnative green sunfish. An option to channelize the slough was discussed as an action that might reduce water temperature and discourage nonnative fish from spawning. At that time, channelization was encouraged as a potential alternative, which helps to avoid an action using chemical (Rotenone) treatments to remove nonnative fish. Tribes also expressed the importance of federal agencies committing to long-term planning to prevent future nonnative fish invasions through Glen Canyon Dam.

#### **4.1.3 Endangered Species Act Consultation**

**Consultation Approach:** Glen Canyon NRA is consulting with the US Fish and Wildlife Service regarding consideration of federally listed and candidate species under section 7 of the Endangered Species Act of 1973 (Public Law 93-205; 87 Stat 884), as amended. Pre-consultation began in May 2024, with subsequent discussions occurring from June through September in 2024. Glen Canyon NRA staff used the USFWS IPaC online computer system to develop a draft biological assessment related to the proposed slough channelization project. At the time of writing this EA, Glen Canyon NRA and the USFWS staff are consulting informally and further discussing the biological assessment, expecting to follow an informal consultation time line.

**Federal Status Species That Do Not Occur in the Proposed Slough Project Area:** The species with federal status described below do not occur in the proposed slough channelization project area, primarily because there is no suitable habitat within proposed project boundaries. Glen Canyon NRA employees regularly assess habitat and species status within park boundaries, including along the Colorado River and its tributaries. The project site for proposed slough channelization (-12-mile river mark) is visited frequently by park employees to monitor, manage and assess habitat conditions, vegetation, fish, and other wildlife.

**Razorback sucker (*Xyrauchen texanus*; Endangered):** Within Glen Canyon NRA, the 15 miles below the Glen Canyon Dam contain waters not currently occupied by razorback suckers.

For many years, this species has not been detected via repeated annual netting and electrofishing surveys by multiple agencies in this 15-mile reach of the Colorado River. Habitat conditions (e.g., water temperature, turbidity, flows, river morphology) changed dramatically after construction of Glen Canyon Dam, substantially reducing suitable river conditions for this species. For these reasons, this species does not occur at the -12-mile slough proposed project site, and Glen Canyon NRA considers this species to be extirpated in the reach of the Colorado River between from Glen Canyon Dam downriver to Lees Ferry. Glen Canyon NRA staff continue to look for razorback suckers during its netting and electrofishing surveys each year.

Critical habitat is currently designated under the Endangered Species Act of 1973 for razorback suckers in the Colorado River from its confluence of the Paria River (below Lees Ferry), through Grand Canyon and into Lake Mead. Razorback suckers have been present downriver in Grand Canyon and in recent years having migrated up from Lake Mead with some larvae detected. Razorback sucker larvae were detected in prior years. Because razorback sucker population numbers have been small, while larvae have not been recently detected, the National Park Service augmented populations within Grand Canyon. If no action to reduce breeding by warmwater nonnative fish is implemented by Reclamation or the National Park Service under the 2018 EA (NPS 2018), the 2024 LTEMP SEIS (cool-mix; Reclamation 2024a), or this 2024 EA proposed alternative, the razorback sucker could be affected negatively by increased breeding and dispersal of warmwater nonnative fish. Actions described by these three documents could help reduce this negative effect downstream.

**Humpback chub (*Gila cypha*; Threatened):** The humpback chub is federally listed as threatened under the Endangered Species Act of 1973, and it was recently downlisted from endangered, largely because of the abundance of humpback chub in Grand Canyon. Humpback chub have not been present in Glen Canyon since the Glen Canyon Dam was constructed, and the nearest subpopulation is at river mile marker 30, downstream of the project area in Grand Canyon. However, the largest subpopulation of humpback chub in existence (approximately 95% of known adult fish) are downstream in Grand Canyon and could benefit from the proposed alternative via the reduction of breeding by warmwater nonnative fish in the Colorado River. Smallmouth bass were considered the largest threat to humpback chub in a USFWS species status assessment (USFWS 2017). If no action to reduce breeding by warmwater nonnative fish is implemented by Reclamation or the National Park Service under the 2018 EA (NPS 2018), under the 2024 LTEMP SEIS (cool-mix; Reclamation 2024a) or under this 2024 EA proposed alternative, the humpback chub could be affected negatively from increased breeding and dispersal of warmwater nonnative fish. Actions described by these three documents could help reduce this negative effect downstream.

**Mexican Spotted Owl (*Strix occidentalis*; Threatened):** The Mexican spotted owl in northern Arizona is federally listed as threatened under the Endangered Species Act of 1973. It generally occurs in mixed-conifer forests or Madrean pine-oak forest or in rocky canyons. In the rocky canyons, nesting is mostly in caves or on cliff ledges in steep-walled canyons (NPS 2010). The nearest Mexican spotted owl critical habitat is located 40 miles from the proposed project site.

**Southwestern willow flycatcher (*Empidonax traillii extimus*; Endangered):** While Glen Canyon NRA strives to improve habitat for this flycatcher where possible, no suitable habitat currently exists for the southwestern willow flycatcher in the proposed slough project site. This

species does occur downriver throughout Grand Canyon National Park in riparian habitats, including some locations dominated by invasive tamarisk. Resident flycatchers were documented nesting in Marble Canyon and in western Grand Canyon near Lake Mead (DOI 2016). The breeding season of the southwestern willow flycatcher is May through August (BOR 2007; Sogge et al. 1997, 2010).

**Yellow-Billed Cuckoo (*Coccyzus americanus*; Threatened):** This bird does not occur at the proposed slough project site, primarily because there is no suitable habitat, such as cottonwood trees or other important habitat components. Cuckoos were known to breed at a few sites in the western Grand Canyon near the Lake Mead delta. The riparian community at these sites is primarily willow, tamarisk, and seepwillow (DOI 2016). The yellow-billed cuckoo breeding season is generally May through September, according to Johnson et al. 2010.

**Welsh's Milkweed (*Asclepias welshii*; Threatened):** No suitable habitat exists for Welch's milkweed in the proposed slough project site, and this explains why this plant is never seen in the vicinity of the proposed project. No aeolian sand dune habitat is located at the site of the proposed slough project. This plant may possibly occur in aeolian dune habitat located outside of Glen Canyon up on the rim or farther away across plateaus in Arizona and Utah.

**Monarch Butterfly (*Danaus Plexippus*; Candidate):** The monarch butterfly is a candidate species under the Endangered Species Act of 1973. Essential habitat elements, such as the presence of milkweed plants, do not occur in the proposed slough channelization project area. Food plants for monarchs are of minimal occurrence at the slough site, which may explain why monarchs are not seen at the slough by employees during migration or other times of year.





## APPENDIXES



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## **APPENDIX A: DECISIONS ON IMPACT TOPICS AND PROJECT ALTERNATIVES – RETAIN VS. CONSIDER BUT DISMISS**

### **IMPACT TOPICS**

#### **Impact Topics Retained for Detailed Analysis**

The National Park Service determined which issues to analyze in this EA using input from agencies, traditionally associated Tribes, other stakeholders, and the public. Considering this input, along with issues central to the proposal and topics needed to distinguish between alternatives, or points of contention among agencies in considering impacts, the following impact topics are carried forward for further analysis. The topics addressed in this EA are aquatic resources, including aquatic habitats, nonnative aquatic species, and native aquatic species; terrestrial resources, including wetland and riparian vegetation and wildlife; cultural resources (including TCPs); Tribal resources and Indian Trust Assets and trust responsibility; recreation; water quality; visitor use; and experience.

#### **Impact Topics Considered But Dismissed from Detailed Analysis**

The following topics are not addressed in this EA because they are not central to the proposal and decision or are not needed to distinguish between alternatives, or are not points of contention among agencies, or are not impacts in relation to the proposed project. Impact topics dismissed from detailed analysis in this EA include air quality, archeological sites, cultural landscapes, museum collections, historic districts, prehistoric/historic structures, lightscares, energy resources, floodplains, human health and safety, paleontological and geological resources, soils, socioeconomics (e.g., land use and minority and low-income populations, size, migration patterns), socioeconomics, soundscapes (however, sound impacts on wildlife and visitor use and experience were considered), viewsheds, and wilderness.

### **PROJECT ALTERNATIVES**

#### **Alternatives Considered but Dismissed from Detailed Analysis**

Alternatives 3 and 4 below were considered by the National Park Service but were dismissed from detailed EA analyses, because the National Park Service and partner agencies believe alternatives 3 and 4 to be less effective for reducing spawning by warmwater nonnative predatory fish when compared to the proposed alternative described in chapter 2.

#### **Alternative 3: Construct the Channel to Go Around the Spring and the Upper Slough**

Alternative 3 constructs the channel to go around the spring and the upper slough on its way into the lower slough. Alternative 3 addresses both water temperature and water velocity in the constructed channel, including in the lower slough. Alternative 3 would implement smaller management actions in the upper slough, including some previously identified in the 2013 CFMP (NPS 2013) or in the 2018 EA (NPS 2018). For example, the National Park Service could

build small structures in the upper slough to allow easier nonnative fish removal from the upper slough or else screen between the upper and lower slough to prevent fish movements during times when the side channel is not flowing. Glen Canyon NRA would continue to apply green sunfish management and removal techniques (e.g., netting, pumping) in the upper slough because green sunfish would continue to try to spawn there. High flow events would bring new nonnative fish into the upper slough, thus triggering follow-up actions by park staff to remove nonnative fish from the upper slough after each high flow event.

Alternative 3 would conserve the spring, the upper slough, and the balance of ecology and hydrology that currently occurs there. Alternative 3 continues to support salamanders, toads, invertebrates, and other species that live in and around the upper slough. When water temperature is low enough from cool-mix flows or normal river flows, and water velocity is high enough in the constructed channel, nesting or spawning by smallmouth bass and green sunfish would be eliminated in the lower slough, creating substantial benefits to humpback chub, flannelmouth suckers, and other native fish. Alternative 3 would still require the capture and relocation of a badger to ensure no harm during channel construction. Alternative 3 would still impact winter waterfowl resting and feeding in the lower slough, along with causing reduced duck hunting success in winter.

Alternative 3 was dismissed from detailed analysis in this EA because it is less effective in reducing spawning by warmwater nonnative fish. Green sunfish would continue to try to spawn in the upper slough. For these reasons, the National Park Service determined that alternative 4 does not fully resolve the nonnative fish-based purpose and need for which slough channelization is proposed.

#### **Alternative 4: Address Water Temperature Only**

Alternative 4 addresses water temperature only in the form of cooling the water in the upper and lower sloughs (Sixta and Randle 2023). Lower levels of construction using smaller equipment in three phases initially were proposed by Reclamation during May 2023. Alternative 4 would construct a smaller, shorter channel 7 feet deep, 2 feet wide at the bottom, and 6 feet wide at the top, where the channel extends from the river mainstem through the historic side channel into and through the upper slough. This smaller channel would cut through the middle of the spring with fill placed to eliminate the upper slough pond. A cut would be made in the berm between the upper and lower slough to drain the upper slough before filling it. Smaller amounts of sand, cobble, and rock would be used to narrow the lower slough.

Alternative 4 was not designed to speed up water flow to a threshold that disturbs smallmouth bass nesting attempts. The success of alternative 4 is solely dependent upon cool water below 16°C flowing through the river mainstem, the constructed side channel, and the lower slough. Reclamation can achieve cool water using cool-mix flows during summer months or by using normal flows from dam operations during late fall, early spring season, and winter months. Humpback chub, flannelmouth suckers, and other native fish would benefit from alternative 4 only in the case that Reclamation keeps water temperatures cool below 16°C.

Alternative 4 directly impacts the spring, the upper slough, and the balance of ecology and hydrology that currently occurs there. Alternative 4 would directly impact salamanders, toads,

invertebrates, and other species that live in and around the upper slough. Alternative 4 would still require the capture and relocation of a badger to ensure no harm during channel construction. Alternative 4 would leave the lower slough in its current form, so winter waterfowl resting and feeding areas would remain unaffected, and duck hunting success would continue. Compared to the proposed alternative, lower level, but similar, impacts would occur under alternative 4 at the spring, the upper slough, and related habitat and species, but fewer impacts would occur in the lower slough.

Alternative 4 was dismissed from detailed analysis in this EA because it is less effective in reducing spawning by warmwater nonnative fish. This is partly because alternative 4 addresses water temperature only and is dependent upon Reclamation keeping water temperatures cool. For these reasons, the National Park Service determined that alternative 4 does not fully resolve the nonnative fish-based purpose and need for which slough channelization is proposed.

## **APPENDIX B: MITIGATION AND RESTORATION AFTER CHANNELIZING THE -12 MILE SLOUGH**

Restoring a river side channel at the slough site converts still-water slough riparian/wetland habitat into a faster-flowing restored river side channel with riparian habitat. This habitat conversion brings positive change in managing nonnative warmwater fish but impacts a spring, the upper slough it supports, and the associated habitat upon which amphibians and invertebrates depend during their life cycle. For these reasons, post-project mitigation, restoration, and monitoring are important to help restore balance in the Glen Canyon portion of the Colorado River. This includes ecological, resource, and life balance important to many Tribes in these canyons so important in their creation stories, heritage, and well-being.

### **PROPOSED APPROACH IN MITIGATION**

Mitigation may include some longtime concerns expressed to Glen Canyon NRA by some Tribes. For example, Tribes have asked Glen Canyon NRA to move portable toilets along the river away from petroglyph panels as a way of achieving better balance and respect for cultural values. Glen Canyon NRA would consider this and other actions as discussions with Tribes continue.

Native vegetation would be restored both on-site at the slough and off-site at one or more other locations within the Glen Canyon reach of the Colorado River. Potential off-site mitigation locations would be assessed in 2025, with off-site mitigation actions implemented from 2026 through 2029. Off-site mitigation would include actions to restore balance regarding resource values impacted by slough channelization. Hence, potential mitigation sites would be evaluated for benefits to native vegetation, spring, wetland, and riparian values while also considering benefits to salamanders, toads, invertebrates, waterfowl, and shorebirds. More than one mitigation site may be selected, and actions would tap a resource toolbox that includes possible prescribed fire and clearing with hand tools. The amount of post-project wetland and riparian habitat restored would depend on multiple factors, including site condition, species presence, and level of disturbance by the visiting public.

One potential mitigation site suggested to Glen Canyon NRA is the location near Horseshoe bend often called Leopard Frog Marsh (on river left, mile marker -9.12). For this reason, this 2024 EA incorporated by reference the Glen Canyon NRA 2008 Environmental Assessment for Hidden Slough Pilot Site (NPS 2008b) with its considerations, consultations, and pilot actions. This 2008 EA informs additional potential mitigation actions at Leopard Frog Marsh and elsewhere in the Glen Canyon reach. A second potential mitigation location is also called Hidden Slough, but is located on the right riverbank at the -6.3 mile marker.

If feasible, mitigation may include additional monitoring of fish, salamanders, toads, and invertebrates in the riparian channel of the post-project slough site from 2026 through 2029. The schedule for plant monitoring and restoration is provided below.

While all these mitigation actions are intended to span five years, roughly 2025–2029, adjustments in timing and years in mitigation may become necessary pending, such funding,



available personnel, site condition, competition from nonnative plants, and the ability of restored species to generate and thrive.

## **PROPOSED SCHEDULE FOR NATIVE PLANTS**

### **Summer 2024**

Glen Canyon NRA employees would collect native seed from the slough site and along the river from Lees Ferry to the dam for the following species, most of which are culturally substantial to local Tribes. Other plant species may be added to the list below.

*Artemisia ludoviciana*

*Carex emoryi*

*Aristida purpurea*

*Equisetum xferissii*

*Sporobolus flexuosus*

*Thymophylla pentachaeta*

*Euthamia occidentalis*

*Stanleya pinnata*

*Apocynum cannabinum*

### **November 2024**

Glen Canyon NRA employees would take cuttings from *Salix exigua* and remove native *Carex* clumps to overwinter in the greenhouse. *Juncus articulatus* and *Juncus arcticus* would also be collected as rhizomes or full plants.

### **Winter 2024**

The proposed slough channelization project would occur from January 1 to March 15 in 2025.

### **Summer 2025**

Glen Canyon NRA employees would observe soil and plant dynamics at the slough site, both at the sand/cobble bar and alongside the newly constructed channel. Pending monitoring and observations, nonnative vegetation would be treated or removed, then efforts would begin to establish native plants using seeds, cuttings, and other stored native plants and plant materials.

### **Fall 2025**

Native vegetation and seeds would be planted as needed.

### **Years 2026–2029**

Nonnative vegetation would be removed, and native vegetation would be planted as the site(s) becomes ready. This work would occur both on-site at the slough and off-site at one or more mitigation locations in the Glen Canyon segment of the Colorado River corridor.

## **APPENDIX C: SUMMARY OF 2024 DISCUSSIONS WITH GLEN CANYON AFFILIATED TRIBES REGARDING PROPOSED SLOUGH CHANNELIZATION**

### **NOTES FROM 2024 MEETINGS (PHONE, TEAMS, OR IN PERSON)**

Since January 2024, Glen Canyon National Recreation Area (NRA) has engaged in meaningful conversations with six Tribes concerning the proposed slough channelization project at the -12-mile marker on the Colorado River, located 3 miles below Glen Canyon Dam. Comments from Tribes are multifold, and below is a summary of the concerns and issues shared with the National Park Service from representatives of each Tribe.

Telephone and teleconference conversations in 2024 include Glen Canyon NRA consultation discussions with the Pueblo of Zuni, Navajo Nation, Hopi Tribe, Kaibab Paiute Tribe, the Paiute Tribe of Utah, and the San Juan Southern Paiute Tribe. Glen Canyon NRA staff have also reached out to the Ute Mountain Ute Tribe to encourage discussions.

On September 5, 2024, representatives from Navajo Nation, the Kaibab Paiute Tribe, and the Paiute Indian Tribe of Utah met with Glen Canyon NRA officials to attend a morning river raft trip to view the -12-mile slough. Consultation discussions continued in the afternoon at the Weaver house at the Lonely Dell Ranch in the Lees Ferry vicinity in Glen Canyon NRA.

**Pace of the Slough EA and Proposed Project:** Many concerns were expressed by Tribes about not only the project itself but also about the highly accelerated speed at which project planning is moving. Some Tribe representatives feel the speed of the project and EA do not genuinely invite good faith in consultations by the agencies with Tribes. Tribes ask that the project planning pace slow down to allow more time for Tribes to consider the proposed slough channelization project, its context, data, benefits, and impacts. Tribes ask to receive more information on plant and animal life and on cultural concerns before agencies continue to pressure them to decide consensus or not. Tribes seek additional time to work with the Arizona State Preservation Office and Glen Canyon NRA while Tribes consider how to define the area of potential effect and think further about Traditional Cultural Properties. Tribes ask the National Park Service to advocate for more time for Tribes to review the slough channelization project, keeping in mind important events for Tribes that include upcoming winter ceremonies.

Four Tribes expressed concerns with the pace of the proposed project and EA process. Each Tribe stated that there has not been enough time to receive and review adequate data on current and projected fish populations, along with other information requests described below in this appendix. Three Tribes expressed that the project is proceeding through a time of religious ceremony and rest that prevents them from responding to the slough EA accelerated time line. Three Tribes request the project be delayed to at least winter of 2026, with the additional use of cool-mix and netting in 2025, if conditions warrant it, to allow the National Park Service to receive results of in-progress studies of the spring and salamanders in the upper slough, and to share more data and models about fish populations with Tribes. This would give Tribes more time to consider the proposed slough channelization project.

**Requests for a Third Alternative:** Both the Pueblo of Zuni and the San Juan Southern Paiute Tribe are requesting that Glen Canyon NRA consider a third alternative that considers species life and the spring at the upper slough.

**Holistic Approach:** Tribes appreciate the wholistic approach Glen Canyon NRA is practicing by looking at all aspects of the proposed slough channelization project, including all life and all species, habitat, benefits, and impacts.

**Sacred Spaces and the Importance of Life:** Each Tribe expressed the importance of sacred spaces that include the canyons, the Colorado River, and springs, including the spring in the upper slough. Water is life, and all life along the waters of the river and canyons are important.

**Additional Concerns About Species Life:** Tribes shared concerns about the Bureau of Reclamation's failure to keep smallmouth bass from coming through the dam into the waterway and question if this slough channelization action would be affective in the long run. In some views, the focus on smallmouth bass in the Glen Canyon Dam Adaptive Management Plan may be at the expense of other life forms at the slough and elsewhere along the Colorado River, and this slough project is potentially a reflection of agency unwillingness to consider the whole picture. Concerns were expressed over culturally significant plant and animal populations that may be destroyed if the slough channelization project is constructed.

**Species Life Trade-Offs:** In general, some Tribes support helping to conserve the humpback chub and other federally listed fish species. However, in speaking about potential gains and losses to species life (both plants and animals) related to the proposed slough channelization project, four Tribes told Glen Canyon NRA that, because all life is important, it is not appropriate for federal agencies to ask Tribes to make a choice regarding which species should live or die. Some Tribes express concerns for survival of the humpback chub and other native species downstream, but the proposed slough channelization project was described by one Paiute representative as an impossible choice given what species could be lost in relation to each project alternative.

**Leave Nature Alone:** One Tribe representative shared with Glen Canyon NRA officials the concept of "leave nature alone," asking why people must continually alter or affect life in the canyons along the river. The representative shared that sometimes nature knows best how to maintain life balance and natural habitats in the canyons.

**Concerns About the Spring in the Upper Slough:** Given data on the spring in the upper slough newly arrived during the week of August 19, 2024, and given that the spring was only just confirmed to Tribes on the morning of August 23, 2024, and knowing that results for the remaining four spring testing parameters may not come until October 2024 or later, Tribes feel it is not fair for the National Park Service to ask for recommendations from Tribes at this time. As known from decades of conversations with Tribes, springs are incredibly important and hold spiritual, ceremonial, and ecological significance, and the disturbance or destruction of a spring would affect all these realms. Springs are places of ceremony and blessings and should be protected. The remaining four upper slough spring parameters await results for are crucial information, as knowing the age of the water released from the spring can help Tribes to understand whether this spring was used by their ancestors. One Tribe representative expressed the importance of identifying which aquifer the upper slough spring water comes from.

**Pilgrimages:** The Paiute Tribe of Utah speaks of pilgrimages back in time in the canyon walls along the Colorado River. During those travels, Paiute people valued life and would use, tend to, and pray for springs, expressing blessings or ceremonies at these locations along the river. If the spring at the upper slough was noticeable by Piute people back then, they would have tended to the upper slough spring.

**Dragonflies and Salamanders:** The Paiute Tribe of Utah and the Pueblo of Zuni both speak of the importance of dragonflies in their culture. Dragonflies are a sacred animal and culturally significant, where an abundance of dragonflies indicates good waters and other good signs beneficial to the people of the Tribe. The Pueblo of Zuni considers both salamanders and dragonflies to be highly revered because of their association with water, especially at springs. This is reflected in Zuni pottery and other Zuni arts or crafts.

**Wetlands / Climate Change:** Tribes expressed that the slough site needs to be viewed holistically as a rare wetland area within the river corridor. Wetland areas are important lifeways, and these are sacred areas that are becoming increasingly rare due to human impact and climate change. So, wetlands should be treated with the same respect given endangered species like the humpback chub. Pueblo of Zuni cultural history expresses the sacred nature of wetland habitats, and they have a long history of supporting these habitats. Navajo Nation, the Kaibab Piute Tribe, the Pueblo of Zuni, and the Piute Indian Tribe of Utah all recognize the importance of planning for climate change on behalf of Tribes and agencies.

**Waterfowl:** Tribes believe waterfowl (ducks, marsh birds, shorebirds) should be protected and conserved on the Colorado River, since they are one of many life forms along the Colorado River corridor. Tribes believe duck hunting should not be a park public use priority.

**Suggested Upper Slough Management:** An alternative idea was expressed as a less-damaging way to manage the smallmouth bass without channelizing the upper slough, which was used by the Pueblo of Zuni or another Tribe to lower the water, remove nonnative fish, and then let the water refill. This method of managing water level is also applied at springs where Pueblo of Zuni members perform ceremonies and use the clays from the spring for pots or painting.

**Zuni View of Interrelationships:** People of the Pueblo of Zuni do not make a distinction between natural and cultural resources. In the view of Zuni people, all resources have value together, and there is interdependence among resources and life forms, which define the total complex ecosystem. Affecting one life form or one resource can cause systemwide social, cultural or ecosystem effects. Stability and balance of life and resources in the system are important.

**Zuni-Chaco Historic District:** The Pueblo of Zuni describes this historic district as the Ashiwi-Chaco District. The Pueblo of Zuni emphasizes the importance of the National Park Service recognizing and considering the district since it extends across lands from the Colorado River canyons (Grand and Glen) into southeastern Utah, then eastward to Chaco Canyon Historical Park and to Bandelier National Park in New Mexico, then southward down into Chihuahua, Mexico, then extending back up to the canyons, including current-day Pueblo of Zuni lands. Pueblo of Zuni representatives emphasize the importance of considering balance, heritage and interconnections within the canyons and the district and regarding all life forms, including Zuni ancestors, their migration history, knowledge, and struggles. The district is a cultural landscape

that is essential to Zuni perpetuity and includes Zuni stewardship, springs, wetlands, animals and plants. Associated spiritual interrelatedness also includes the concept of sentient beings (greater-than-human life forms which perceive, feel, and are aware).

**Zuni Consultation Requests:** The Pueblo of Zuni requests formal consultation regarding the spring and upper slough and surrounding riparian/wetland area. The Pueblo of Zuni expresses that the spring and upper slough should be considered a Traditional Cultural Property because of substantial traditional and cultural importance.

**NPS Responsibilities in Compliance:** Tribes expressed that the National Park Service has a trust responsibility to protect the river and landscape and the upper slough and its spring as a Traditional Cultural Property. Tribes remind the National Park Service to share a copy of the draft slough channelization EA with them before the EA goes into the public comment period. Some of the Tribes expressed that government agencies need to consider climate change more seriously regarding its effects on Tribal communities, including cultural considerations.

**Questions from Tribes:** Questions expressed by Tribes to Glen Canyon NRA include the following topics:

1. Where is the spring water discharging? (Glen Canyon NRA explained the spring water enters the upper slough from its bottom deepest point at this slough's upper edge.)
2. How old is the spring water? (Glen Canyon NRA shared that water samples, such as for Tritium, may help answer this question later this year.)
3. If the cool-mix water from Glen Canyon Dam and tidal action in the lower slough is keeping smallmouth bass from breeding, is this slough channelization project necessary? (Glen Canyon NRA shared the pros and cons of cool-mix flows or not, of project construction or not, and combinations of the two.)
4. If the water warms again due to the loss of cool-mix water flows, will this slough project be useful in the long run? (Glen Canyon NRA replied, saying the project would not be as effective as intended, though faster water flows in the proposed channel may help disturb smallmouth bass nesting.)
5. If this slough channelization project moves forward, how can we avoid or mitigate the loss of life and habitat for the native animals and plants at the slough site? (Glen Canyon NRA replied that the proposed project would cause some direct impacts at the slough site, but mitigation actions can be used on-site and off-site to restore life balance through activities such as planting native vegetation, improving habitat for amphibians off-site, enhancing conditions surrounding another spring off-site, or other actions.)
6. Which aquifer does the spring draw from? What is the spring's water composition from chemical analysis? (Glen Canyon NRA staff replied that they hope to have data from four more spring study parameters later in 2024. These additional data may or may not help to answer these two questions.)



7. What historic information can be shared with Tribes regarding history of the wetland at the upper slough? Do we know how old the wetland is? (Glen Canyon NRA staff explained that the slough, its side channels, and adjacent sand/cobble bar have at times been completely under water, depending on river flows. For this reason, the National Park Service does not have complete information regarding age of wetland characteristics at the slough site.)

**Requests from Tribes for Additional Information:** Tribes are requesting additional information about the proposed slough channelization project area and general vicinity, along with additional time to consider this information before making decisions or giving consensus. Information requested includes the following topics:

1. Ethnobotany – The study of interrelations between humans and plants. Tribes wish to know what information Glen Canyon NRA can share regarding Indigenous knowledge and practices related to plant history, classification, cultivation, and use as food, medicine, and shelter in Glen Canyon or specifically at the slough site.
2. A list of plants currently present at the slough site that have ceremonial, medicinal, or other significance to Tribes.
3. Spring data – Tribes request learning about the upper slough spring data from all six parameters studied, along with the science expert’s full interpretation of that data. This information may become available in October 2024 or later.
4. Amphibian and invertebrate data – Tribes expressed interest in learning more about data on salamanders at the upper slough and any other information Glen Canyon NRA can share regarding amphibians and dragonflies or damselflies at the slough site. This information may become available in October 2024 or later.
5. Glen Canyon cultural information, including archeological information.
6. Updates on fish data as they become available. This includes data on how many nonnative fish are entering the Colorado River through Glen Canyon Dam. It also includes data on how the -12-mile slough and proposed channelization project would affect the numbers and distribution of smallmouth bass in the Colorado River system.
7. More discussion of the effects on species life (gains or losses in plants and animals)m both downriver (in Grand Canyon) and at the immediate slough project area.

## **APPENDIX D: 2024 SLOUGH SITE WETLAND DELINEATION REPORT**



— BUREAU OF —  
**RECLAMATION**

### **Draft Aquatic Resources Determination for Glen Canyon Slough Modification Project**

**For Colorado River below Glen Canyon Dam**

**Glen Canyon National Recreation Area, Page, AZ**

**Prepared by**

**Bureau of Reclamation Albuquerque Area Office, Albuquerque, NM  
for**

**Bureau of Reclamation Upper Colorado Basin Regional Office,  
Flagstaff, AZ**

**US Army Corps of Engineers Action Number:**

**April 26, 2024**



## **MISSION STATEMENTS**

The US Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

## 1. INTRODUCTION

The United States Bureau of Reclamation (Reclamation) completed an aquatic resources inventory, including wetland delineation and identification of the ordinary high water mark (OHWM), for Reclamation's Glen Canyon Slough Modification Project on the Colorado River. This document presents the methods and results of the delineation of potential jurisdictional waters and wetlands of the United States within the Glen Canyon Slough Modification Project boundaries (project area). The delineation was conducted by Reclamation Albuquerque Area Office biologists. The project area encompasses approximately 7 acres and is located within the Glen Canyon National Recreation Area near Glen Canyon Dam and Page, Arizona.

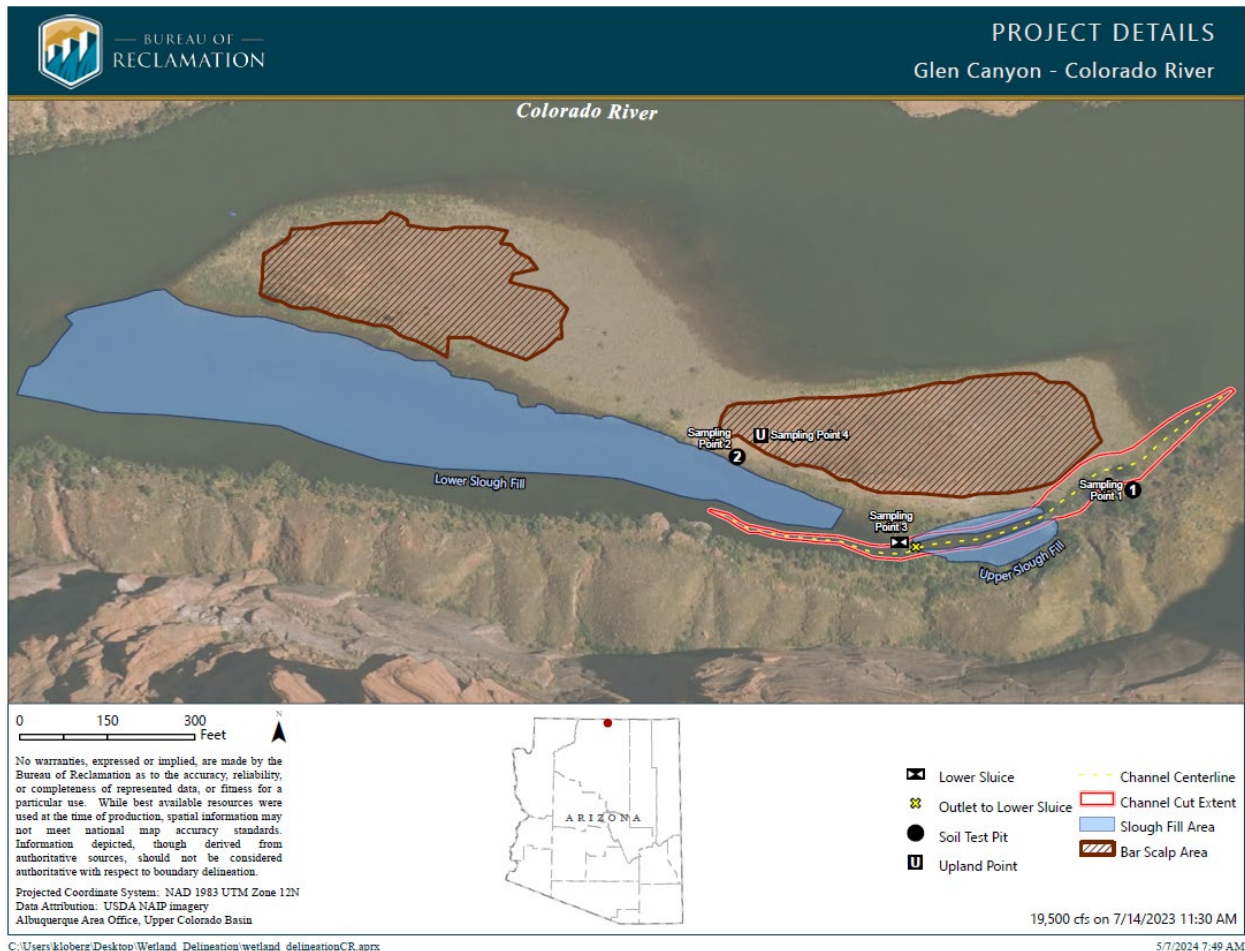
The following list summarizes the potential impacts on waters and wetlands of the United States from implementation of the Glen Canyon Slough Modification Project.

**Table D-1. Potential Impacts on Waters and Wetlands of the United States with the Implementation of the Glen Canyon Slough Modification Project**

Impact type	Classification	Acres Impacted
Riverine (Channel Cut)	River Channel Excavation	-0.32 Temporary
Riverine (Slough Fill)	River Channel Fill	-4.66 Temporary
Palustrine Emergent 1	Wetland Excavation	-0.09 Permanent
Palustrine Emergent 2	Wetland Fill	-0.02 Permanent
Palustrine Scrub Shrub 1	Wetland Excavation	-0.03 Permanent
Palustrine Emergent Restoration	Wetland	+0.04 Restoration
Wetland (Total Impacts)		0.10

Additional information on project details and location are shown on the following map in figure D-1.





**Figure D-1. Project details map**

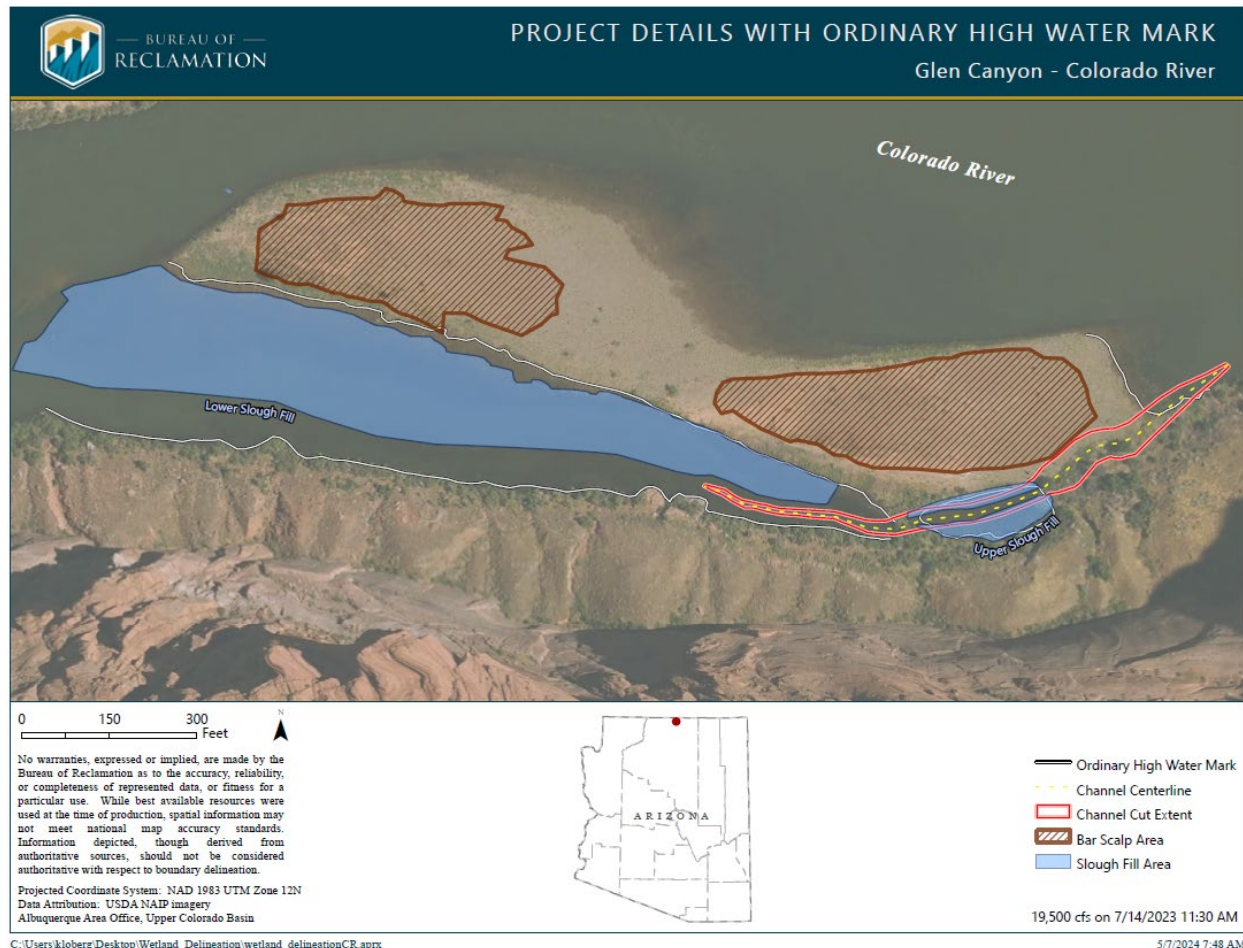
After the completion of Glen Canyon Dam in 1963, Lake Powell began trapping the sediment load of the Colorado River. In response, the clearwater releases from Glen Canyon Dam resulted in the channel downstream to incise, armor, and narrow. Approximately 3.5 miles downstream from Glen Canyon Dam (river mile -12), a large portion of the riverbed became exposed above the water surface as a large gravel bar (BOR 2023).

The temperature of the Colorado River water does not change much after it is released through the dam and before it travels 3.5 miles to the upper and lower sloughs at river mile -12. Water in the sloughs exchanges slowly with the river. On summer days when Colorado River discharge is relatively steady because of typical dam operations on weekends and holidays, water temperatures in the lower slough can warm as much as 5 to 15°C above the river water temperatures (BOR 2023).

Possible alternatives were previously developed to alter the sloughs to make the habitat less favorable to nonnative, warmwater fish. The preferred alternative (proposed project) discussed in this aquatic resources inventory includes (1) excavating a narrow, but deeper channel (using manual labor and hand tools) between the upper and lower sloughs to partially drain the upper slough; (2) excavating a longer and narrow side channel (using small, mechanized equipment) between the Colorado River and the upper slough to allow river water to continually enter the



upper slough and continue flowing through the lower slough—with some of the excavated gravel, cobble, and sand used to fill in the deepest portions of the upper slough; and (3) narrowing the width of the lower slough (using small, mechanized equipment) by placing gravel, cobble, and sand from the upland portion of the gravel bar to form a shallow bank in the lower slough (BOR 2023). See figure D-2 for additional details, including OHWM.



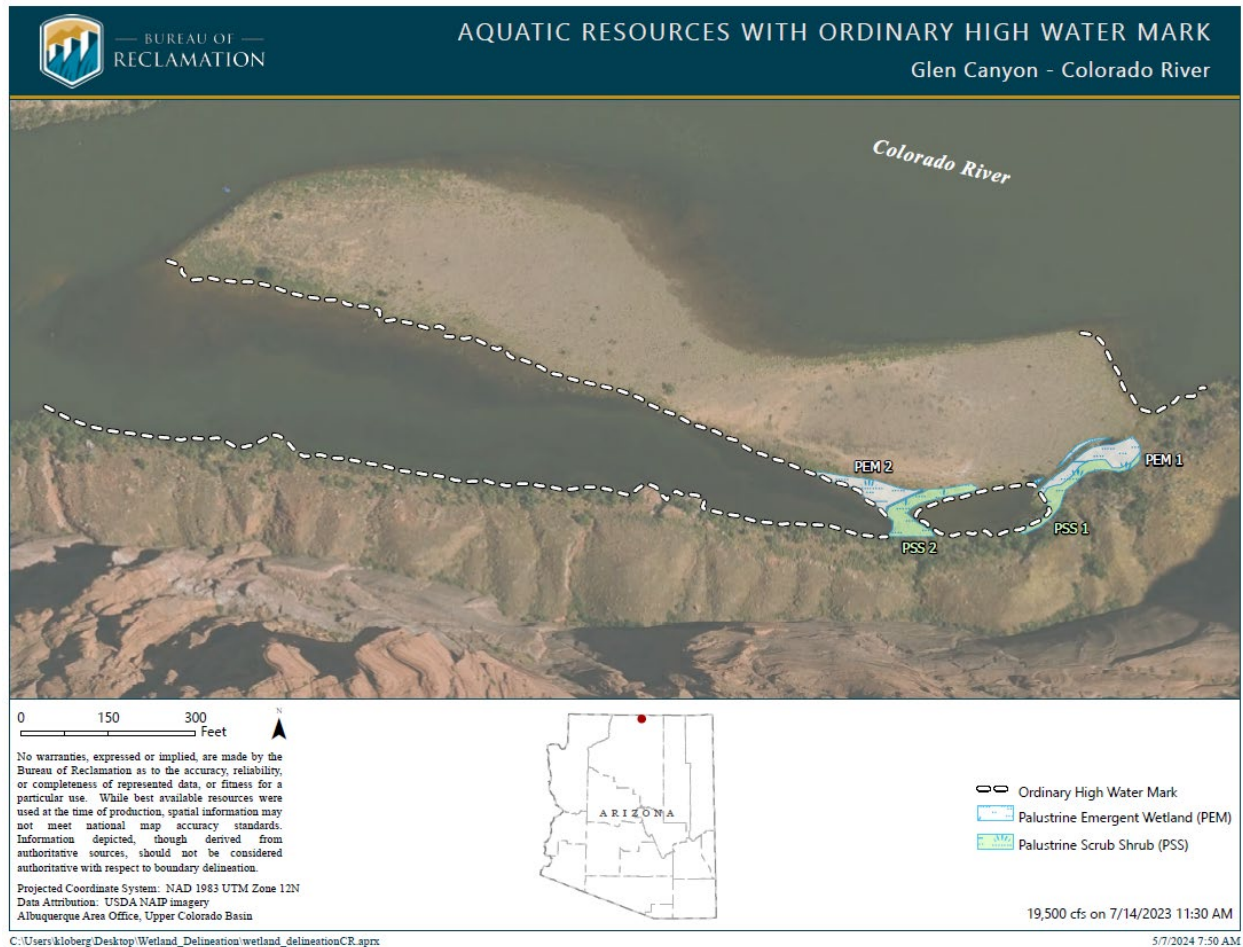
**Figure D-2. Projects detail map with the OHWM**

Implementing the three phases is expected to result in water temperatures in the upper and lower sloughs that approximate water temperatures in the adjacent Colorado River. Only natural materials (gravel, cobble, and sand) would be used to modify the habitat. Due to the length of time that the large and armored gravel bar has existed, the habitat modifications are expected to be self-sustaining and require little, if any, maintenance (BOR 2023).

All waters and wetlands of the United States delineated within the project area may be subject to federal jurisdiction by the US Army Corps of Engineers (USACE) under section 404 of the Clean Water Act, and they may also be subject to state jurisdiction through state regulations. The results of this delineation are preliminary and must be reviewed and verified in writing by the Corps of Engineers to be considered a delineation of waters and wetlands of the United States.

The aquatic resources survey identified approximately 7 acres of potential jurisdictional waters of the United States within the project area, consisting of the Colorado River channel and

connected sloughs below the OHWM. The potential jurisdictional wetlands of the United States within the project area include both palustrine emergent and palustrine scrub-shrub wetlands located primarily between and adjacent to the OHWM in the river channel and sloughs . See further details for aquatic resources with OHWM in figure D-3.



**Figure D-3. Aquatic resources with OHWM**

## 2. LOCATION

The wetland delineation survey area is located on a bank formation near the target slough along the Colorado River, approximately 11 miles north of Lee's Ferry Boat Launch (Sect 02, T 40 N, R 8 E, Gila-Salt River Principal Meridian, Coconino County, Glen Canyon, Arizona) (see figure D-1). Wetland delineation data were collected at the following locations:

**Table D-2. Wetland delineation data locations**

Location Name	Latitude	Longitude
Sampling Point 1	36.900134°	-111.504954°
Sampling Point 2	36.900280°	-111.507272°
Sampling Point 3	36.899861°	-111.506223°
Sampling Point 4	36.900381°	-111.507136°

### **3. PURPOSE**

This report documents the wetland delineation (including presence/absence of wetlands and OHWM in a portion of the survey area) conducted on April 16, 2024, to determine the presence of potential jurisdictional waters and wetlands of the United States within the limits of the proposed project downstream of Glen Canyon Dam at river mile -12. As described previously in the introduction, Reclamation proposes to use a combination of channel excavation and fill in the slough area to facilitate river water moving through the system. Alterations of the slough habitats are expected to help prevent nonnative fish species from spawning in the slough via lower temperatures. Due to higher water temperature in the sloughs, as well as the low velocity habitat, the current conditions provide suitable breeding habitat for these warmwater, nonnative fishes.

The purpose of the project is to eliminate these backwater areas in the sloughs that provide breeding habitat for the invasive small mouth bass (*Micropterus dolomieu*). This would, in turn, reduce small mouth bass populations in the Colorado River, benefitting the federally listed endangered and threatened fish species located further downstream of the project site such as the bonytail (*Gila elegans*), razorback sucker (*Xyrauchen texanus*), Colorado pikeminnow (*Ptychocheilus lucius*), and the humpback chub (*Gila cypha*).

### **4. LOCATION DESCRIPTION**

The wetland delineation survey area is located on a bank formation along the Colorado River at approximately 3,100 feet in elevation at river mile -12, downstream of Glen Canyon Dam and completely within the Glen Canyon National Recreation Area. The bank formation experiences frequent water level fluctuations that are relatively constant throughout the year based on periodic releases from the dam. The wetland delineation survey area is located primarily on the southern side of the bank formation, adjacent to two interconnected sloughs that have formed. The National Wetlands Inventory identified two riverine habitat classifications at the site, including R3USC and R3UBH (USFWS 2024; appendix C). The wetland delineation survey area near the sloughs were primarily located in the R3USC classification.

The vegetation overstory (large tree) component was very limited on the bank formation and mainly occurred at slightly higher elevations above and adjacent to the wetland and riparian area boundary. Tree species observed in this overstory fringe that was noted adjacent to the sloughs included a few large common hackberry trees (*Celtis occidentalis*), a Siberian elm (*Ulmus pumila*), and one red mulberry (*Ulmus pumila*). Additionally, Glen Canyon National Recreation Area

personnel had completed cottonwood (*Populus deltoides*) plantings for restoration in several areas on the bank formation. The midstory component primarily comprised coyote willow (*Salix exigua*), with a few salt cedar (*Tamarix ramosissima*) and Emory's baccharis (*Baccharis salicina*) present as well. Emory's sedge (*Carex emoryi*), tall fescue (*Schedonorus arundinaceus*), Ferriss' horsetail (*Equisetum X ferrissii*), and other various grasses, sedges, and rushes were located throughout the project site.

The soil matrix for the area identified a Razito-Riverwash complex at a 55% composition with 1% to 4% slopes on flood plains that are rarely flooded. A Rock outcrop-Torriorthents complex, at 60% composition with 20% to 65% slopes on plateaus with a high presence of boulders was also identified as part of the soil matrix for the area. Neither of the soil matrices mentioned for the area were identified as having hydric soils (USGS 2024; appendix D).

## 5. METHODS

A wetland delineation per the USACE 1987 Wetland Delineation Manual (1987 manual) and the 2008 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (supplement) was conducted on April 16, 2024. The supplement was selected for this survey due to the project elevation, vegetation, and climatic conditions, which are generally consistent with the parameters outlined in the supplement for the Interior Deserts Land Resource Area (USACE 2008a). The field determination of the OHWM in the project area followed the USACE regulatory guidance letter No. 05-05 (USACE 2005), along with the document, "A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region" (USACE 2008b). Additionally, controlled releases from Glen Canyon Dam support the field observations of the OHWM at approximately 19,500 cfs.

Per the 1987 manual, the method selected was a routine determination with on-site inspection for an area less than 5 acres in size, with one sample data point established in each plant community observed, for a total of 4 sampling points. Sample plots included a 33-foot radius for each of the tree and sapling/shrub vegetation strata and for the herbaceous and woody vine strata. A data and the assessment of riparian vegetation patterns and change downstream from Glen Canyon Dam from 2014 to 2019 report provided by the US Geological Survey and the Munsell Color Chart (2000) were used to identify indicators of hydrophytic vegetation, hydric soils, and wetland hydrology. In accordance with the supplement, if an observed plant species was listed as having no regional indicator or no occurrence, the indicator status of the nearest region, Region 0 (California) (Reed 1988c) or Region 8 (Intermountain) (Reed 1988d), was used to assist in determining hydrophytic vegetation. Per the supplement, if a plant did not occur on any of the applicable regional lists, the plant was assumed to be an upland species.

Soil pits were dug at Sampling Points 1, 2, and 4. The soil pit located at Sampling Point 2 was used for Sampling Point 3 due to likeness in slope and elevation while also being close in proximity. The soil pits were located in the center of the plant community. Sample plot photographs were taken at each sampling point. The depth of each soil pit generally ranged from 14 to 18 inches in depth, and the saturated to semi-saturated soil plug cross-section was used to analyze the soil for the presence of visible indicators of hydric soils such as redoximorphic features and pore linings. Vegetation, soils, and hydrology data collected at each sample plot were extrapolated

across the plant community that the plot occurred within. It is important to note that Sampling Point 2 did have wetland characteristics, but it was located below the OHWM.

## 6. RESULTS

Refer to appendix A for the wetland determination data sheets. See appendix B for the ground photographs of wetland delineation data plots. Note that although Sampling Point 2 had exhibited all three wetland indicators, it was below the OHWM and was, therefore, considered as vegetated river channel and not a delineated wetland.

**Vegetation Information:** Hydrophytic vegetation was observed in three of the four sampling points due to the vegetation passing the dominance test. See table D-3 for a summary of the vegetation data at each of the sampling points.

**Table D-3. Vegetation table summary**

Sampling Point	Dominance Test*	Hydrophytic Vegetation Present
1	Passed	Yes
2	Passed	Yes
3	Passed	Yes
4	Failed	No

\* Dominance test from regional supplement to the *USACE Wetland Delineation Manual: Arid West Region* (2008)

**Soils:** As previously stated, a soil pit was not dug at Sampling Point 3 and used Sampling Point 2 data due to likeness in slope and elevation while also being close in proximity to one another. The soils observed were generally red/orange (matrix beginning with 5YR) sandy soils with sandy redox features present within the matrices. Depleted matrices were identified in three of the four soil plug cross sections. Table D-4 identifies the hydric soil indicators and indicates whether hydric soil was present in the survey area. See the wetland determination data sheets in appendix A for details of each sample plot.

**Table D-4. Soil table summary**

Sampling Point	Hydric Soil Indicators	Hydric Soils
1	S5	Yes
2	S5, F3	Yes
3	S5*, F3*	Yes*
4	S5, F3	Yes

\* Indicates that Sampling Point 3 used Sampling Point 2 soil data due to due to likeness in slope and elevation while also being close in proximity to one another

**Hydrology:** Indicators of wetland hydrology were observed in three of the four sampling points. Table 3 identifies the wetland hydrology indicators observed in the survey area and



indicates whether wetland hydrology was present. See the wetland determination data sheets in appendix A for details of each sampling point.

**Table D-5. Hydric indicators summary**

Sampling Point	Wetland Hydrology Primary Indicators	Wetland Hydrology Present
1	A3, B1	Yes
2	A2, A3, B13	Yes
3	A2, A3, B13	Yes
4	N/A	No

## 7. SUMMARY

Three of the four sampling points met the requirements to be classified as a wetland. Although Sampling Point 2 was defined as a wetland, it occurs below the OHWM of the river, considered a vegetated slope within the channel of the river and not within a delineated wetland. Table D-6 summarizes the wetland requirement status for each sampling point. See the wetland determination data sheets in appendix A for details of each sampling point.

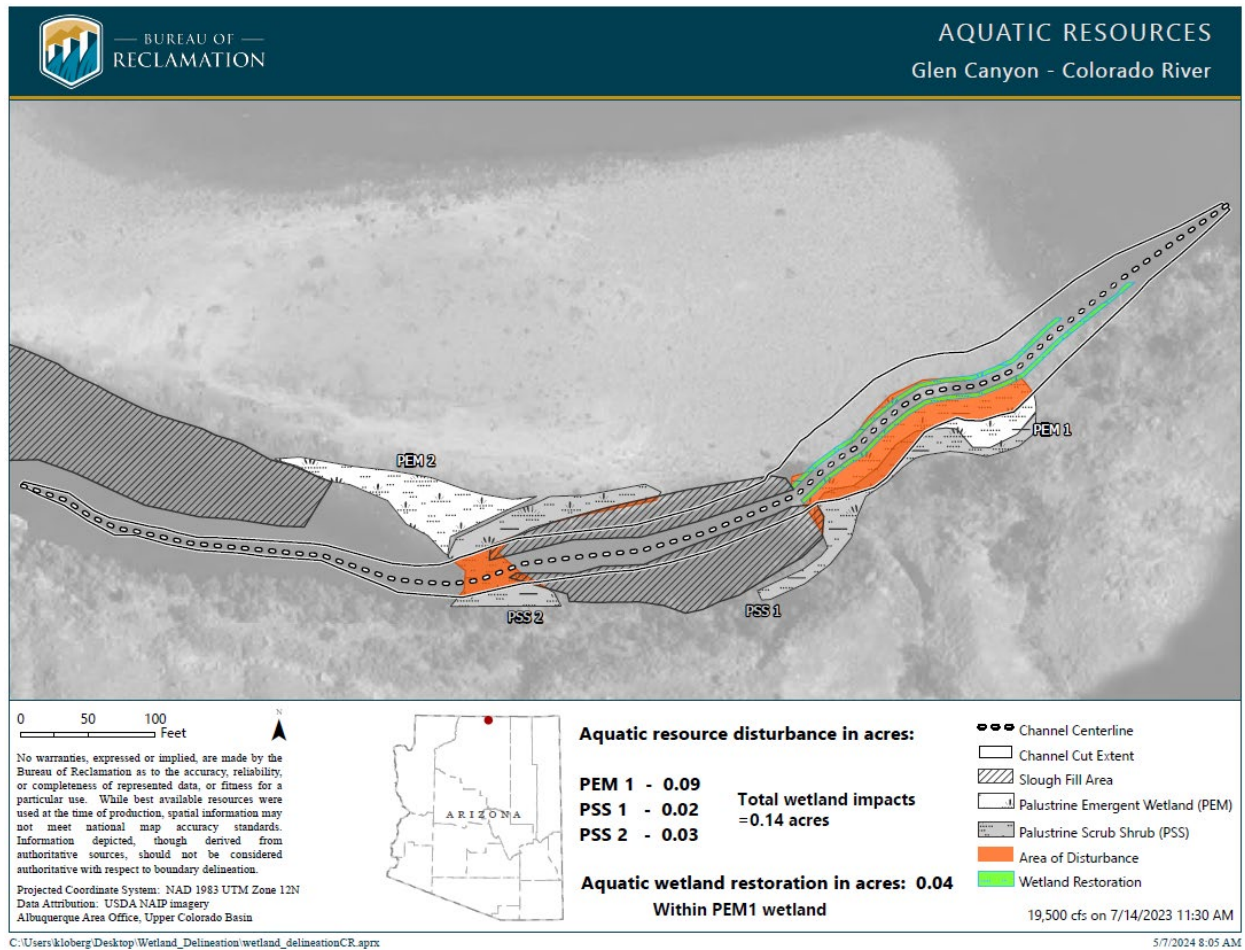
**Table D-6. Wetland determination summary**

Sampling Point	Wetland Characteristics Requirements Met	Meets the Conditions to Be Considered a Wetland by the Army Corps of Engineers
1	Vegetation, Soils, Hydrology	Yes
2	Vegetation, Soils, Hydrology	Yes
3	Vegetation, Soils, Hydrology	Yes
4	Soils	No

The project area between Sampling Point 1 and Sampling Point 3 occurs within the Palustrine Emergent Wetland classification, with about 0.09 acres of wetland impacted due to the proposed activities within the project area. The Palustrine Scrub Shrub Wetland classification occurs on both sides of the slough, and approximately 0.05 acres of this classification would be impacted due to the proposed activities within the project area. In addition, 0.04 acres of aquatic habitat restoration within the Palustrine Emergent Wetland classification is planned to be carried out as part of the proposed actions on this project. The sum total of wetlands impacted due to the proposed actions of the project, after accounting for the acreage of planned aquatic wetland restoration, would total 0.10 acres. See figure D-6 for further information.

The proposed actions for this project would also impact riverine aquatic resources. The proposed channel cut excavations would impact approximately 0.32 acres of riverine aquatic resources. The impacts on riverine aquatic resources due to the proposed slough fill activity

would impact approximately 4.66 acres. In total, 4.98 acres of riverine aquatic resources would be impacted due to the proposed actions of this project. See figure D-5 for additional details.



**Figure D-4. Impacts of project features over wetlands to show acreage of impacts**

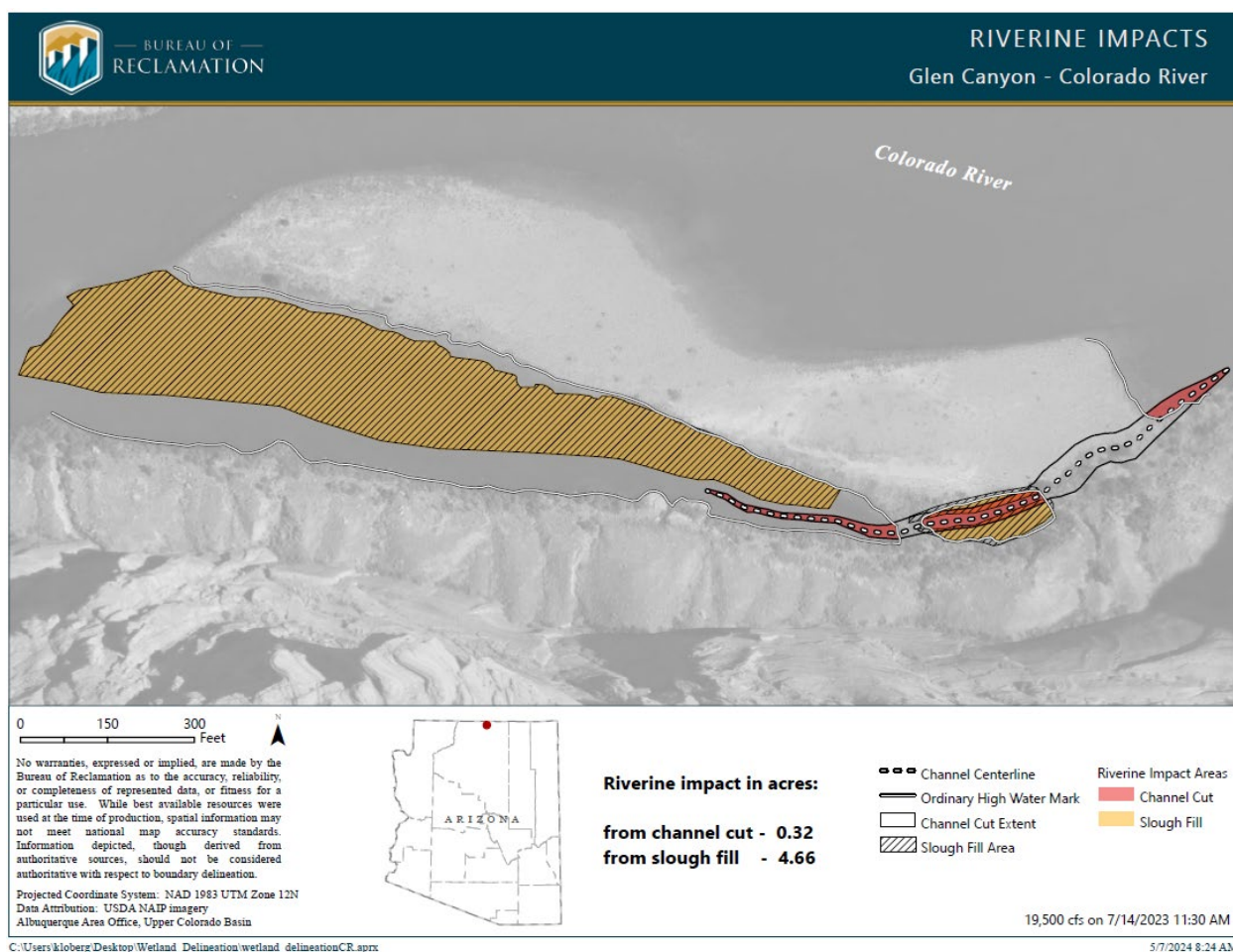


Figure D-5. Riverine impacts

## 8. COORDINATION

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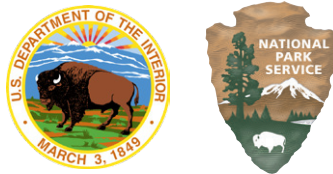
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As the nation’s principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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Warm Water Nonnative Fish Management Plan / Environmental Assessment  
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