FINAL COLORADO RIVER COMPREHENSIVE MANAGEMENT PLAN

Prepared for the Utah Department of Natural Resources, Division of Forestry, Fire & State Lands

JANUARY 2020

SWCA ENVIRONMENTAL CONSULTANTS | CRSA

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Prepared for

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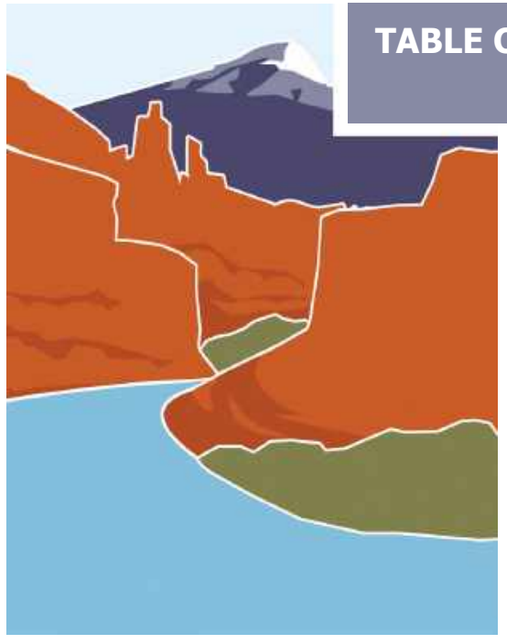

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ABBREVIATIONS

%g	percentage of gravity
°C	degrees Celsius
A.D.	anno Domini
BLM	U.S. Bureau of Land Management
BMP	best management practices
CRCMP	Colorado River Comprehensive Management Plan
CWA	Clean Water Act
CWMA	cooperative weed management areas
DOGM	Utah Division of Oil, Gas and Mining
DPS	distinct population segment
DOE	U.S. Department of Energy
DSPR	Utah Division of State Parks and Recreation
DWQ	Utah Division of Water Quality
DWR	Utah Division of Wildlife Resources
DWRe	Utah Division of Water Resources
DWRi	Utah Division of Water Rights
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFSL	Utah Division of Forestry, Fire & State Lands
GIS	global information system
HMP	hazard mitigation plan
IBA	important bird area
kg	kilograms
km	kilometer
m	meter
mm	millimeters
MOU	memorandum of understanding
NFIP	National Flood Insurance Program
NPS	U.S. National Park Service
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
NSO	no surface occupancy
OHWM	ordinary high water mark
PFYC	Potential Fossil Yield Classification
RDCC	Resource Development Coordinating Committee
RM	river mile
ROE	right-of-entry
SGCN	species of greatest conservation need
SHPO	Utah State Historic Preservation Office
SITLA	State of Utah School and Institutional Trust Lands Administration
SPC	Utah wildlife species of concern
SWCA	SWCA Environmental Consultants
SWReGAP	Southwest Regional Gap Analysis Project
TL	total length
TMDL	total maximum daily load

UDAF	Utah Department of Agriculture and Food
UDEQ	Utah Department of Environmental Quality
UDOT	Utah Department of Transportation
UGS	Utah Geological Survey
UMTRA	Moab Uranium Mill Tailings Remedial Action Project
UPDES	Utah Pollution Discharge Elimination System
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USU	Utah State University
WIA	walk-in access
WMA	wildlife management areas
WSRA	Wild and Scenic Rivers Act

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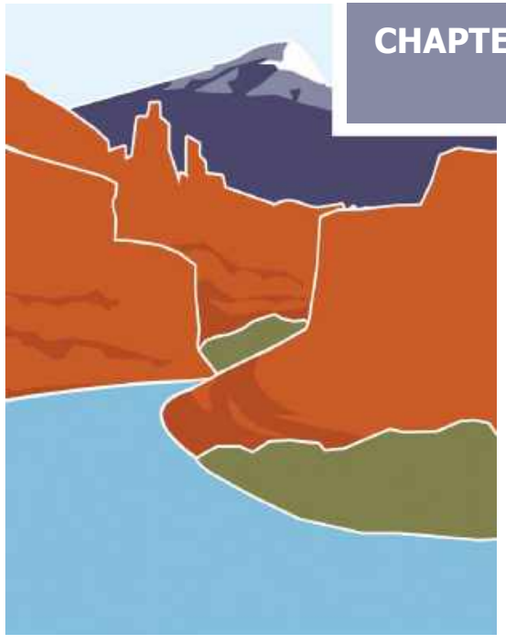


CHAPTER 1 – INTRODUCTION

1.1 Project Vision and Goals

The Utah Department of Natural Resources, Division of Forestry, Fire & State Lands (FFSL) has developed the 2020 *Colorado River Comprehensive Management Plan* (CRCMP) to prescribe management goals and objectives for sovereign lands along the Colorado River in Garfield, Grand, Kane, and San Juan Counties, Utah (Figure 1.1).[1] The CRCMP has also been developed to ensure that navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality (known as Public Trust values; Utah Administrative Code R652-2-200) are given due consideration and balanced with the benefits to be derived from any proposed use, pursuant to Utah Administrative Code R652-2. Primary management responsibility for the river's resources lies with FFSL, according to Title 65A of the Utah Code, which governs management of all state lands under the jurisdiction of FFSL. Utah Code 65A-2-1 states that "[t]he division [FFSL] shall administer state lands under comprehensive land management programs using multiple-use, sustained-yield principles." Briefly summarized, the overarching management objectives of FFSL are to balance and sustain the use of the Public Trust resources and to provide for reasonable beneficial uses of those resources consistent with their long-term protection and conservation.

FFSL's vision for this CRCMP planning process is as follows:

> *The State of Utah, through the Equal Footing doctrine, claims fee title ownership of the bed and banks of the Colorado River. FFSL has direct management jurisdiction over lands lying below the ordinary high-water mark (i.e., the top of bank) of navigable bodies of water at statehood. FFSL recognizes the importance of the Colorado River ecosystem and its natural, cultural, recreational, agricultural, and aesthetic amenities, including those resource values and uses that extend beyond its banks and affect or are affected by actions on sovereign lands. Accordingly, FFSL considers it imperative that management of the Colorado River include coordination in planning and actions with other agencies having jurisdictional and management responsibility over these resources.*

The Colorado River is a valuable ecosystem of statewide importance. Sustainable management in the context of multiple use of the Colorado River will ensure that the ecological health (e.g., water quality, bank stability, riparian areas, aquatic organisms, wildlife, and wetlands), scenic attributes, recreation opportunities (e.g., boating, fishing, hunting, and birding), and irrigation are maintained into the future. FFSL will ensure that the management of this resource is based on a holistic view—including the use of adaptive management, as necessary—to ensure long-term sustainability. Responsible stewardship of the Colorado River's resources will provide a lasting benefit to the Public Trust.

[1] Certain segments of the Colorado River in Garfield, Grand, Kane, and San Juan Counties are not considered sovereign lands because they were not navigable bodies of water at the time of statehood.

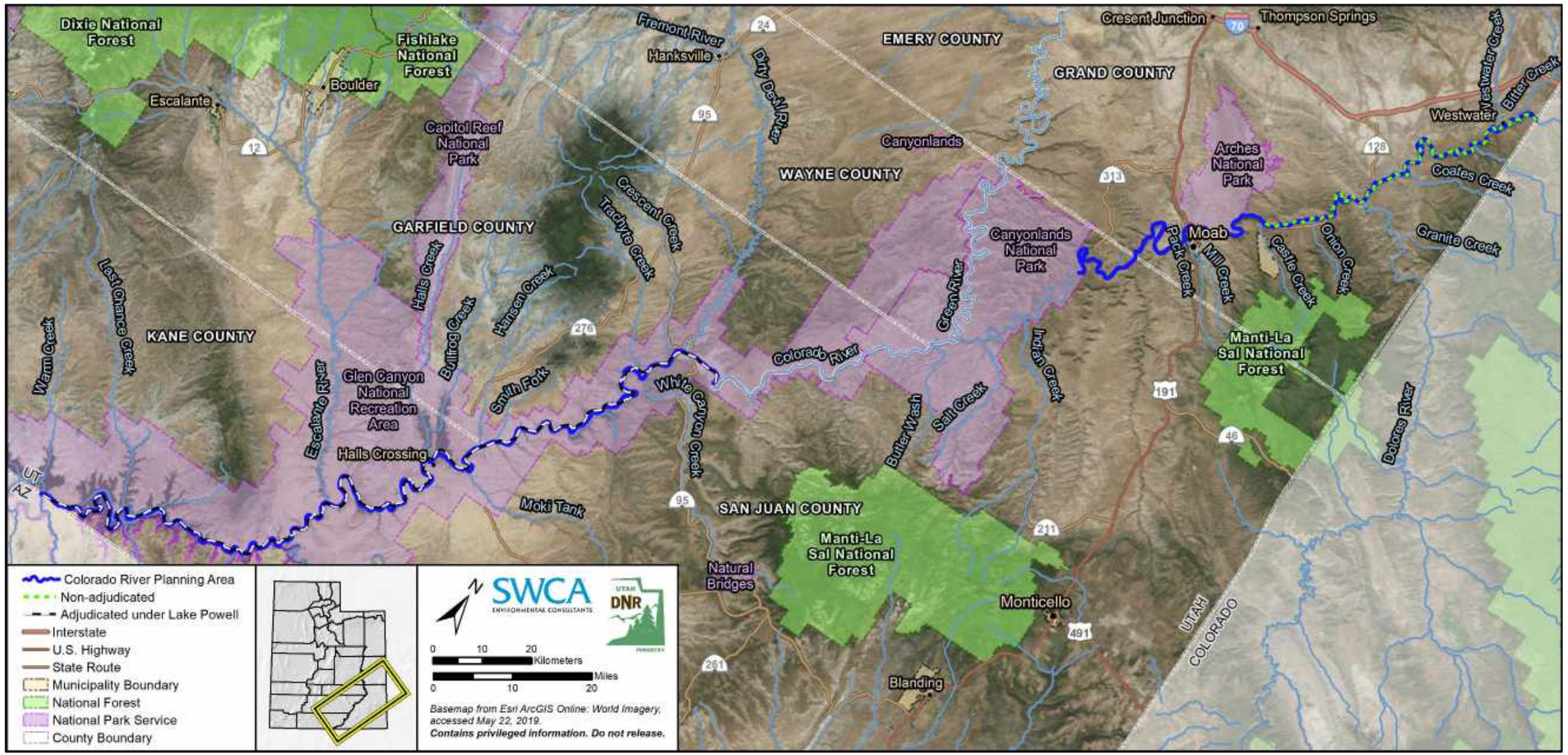


Figure 1.1. Colorado River sovereign lands (the planning area).

To meet land management mandates, FFSL's goal for the CRCMP is to ensure that FFSL maintains clear and consistent guidance regarding management direction and proper coordination, permitting requirements, and best management practices (BMPs) for implementing projects that may affect Colorado River sovereign lands. Specifically, the objectives for the CRCMP process are as follows:

- Create the first comprehensive management plan for Colorado River sovereign lands (i.e., the planning area).
- Ensure that sovereign lands management remains consistent with Public Trust obligations.
- Incorporate principles of multiple use while conserving ecosystem, water, mineral, and community resources.
- Integrate existing information, data, public involvement, and scientific research that have been developed on the Colorado River into clear and consistent management practices.
- Coordinate with Utah Department of Natural Resource divisions, Utah Department of Environmental Quality (UDEQ) divisions, federal agencies, local government, tribes, stakeholders, and other interested parties regarding management, permitting, maintenance, planning, and research on the Colorado River.

Drafting the Plan

Existing information and previously established management practices for the Colorado River were reviewed to inform the development of the CRCMP. This review allowed the CRCMP to be built on previously compiled data sources and current management strategies.

In addition to existing data, development of the CRCMP relied on feedback from the public, counties, municipalities, federal agencies, and other stakeholders, as per Utah Administrative Code R652-90-600. The public outreach process for the CRCMP was combined with that of the *Green River Comprehensive Management Plan* (SWCA Environmental Consultants [SWCA] et al. 2020), which was developed concurrently. For a summary of the public outreach process and a summary of FFSL's responses to public comments, see Appendix A. Several individuals from consulting firms were involved in preparing the CRCMP, including the project managers, resource specialists, graphic designers, technical editors, and formatters. A list of these individuals is provided in Appendix B.

Other state agencies contributed to the development of the CRCMP by providing data, technical information, insight into management and jurisdictional roles, and oversight of content. Representatives from these entities formed the CRCMP planning team. A list of planning team members involved in finalizing the CRCMP is provided in Table 1.1.

Table 1.1. Colorado River Comprehensive Management Plan Planning Team

First Name	Last Name	Representing	Title
Mike	Allred	Utah Division of Water Quality	Environmental scientist
Laura	Ault	Utah Division of Forestry, Fire & State Lands	Sovereign lands program manager
Roger	Barton	Utah Department of Agriculture and Food	Conservation district coordinator
Hollie	Brown	Utah Division of Oil, Gas and Mining	Information specialist
Skyler	Buck	Utah Division of Water Resources	Water resources engineer
Amy	Dickey	Utah Division of Water Quality	Environmental scientist
Chris	Fausett	State of Utah School and Institutional Trust Lands Administration	Deputy assistant director
Darrell	Gillman	Utah Department of Agriculture and Food	Conservation district coordinator
Scott	Hacking	Utah Department of Environmental Quality	District engineer
Makeda	Hanson	Utah Division of Wildlife Resources	Regional habitat manager
Daniel	Hinckley	Utah Department of Transportation	Region 4, Moab
Ty	Hunter	Utah Division of State Parks and Recreation	Boating program manager
Chris	Keleher	Utah Division of Wildlife Resources	Species recovery program director
Naomi	Kisen	Utah Department of Transportation	Natural resources/National Environmental Policy Act program
Scott	McGettigan	Utah Division of Water Resources	Water resources engineer
Chris	Merritt	State Historic Preservation Office	Program specialist
Marc	Stilson	Utah Division of Water Rights	Regional engineer
Matthew	Thayn	Utah Division of Wildlife Resources	Lead construction specialist
Laura	Vernon	Utah Division of Forestry, Fire & State Lands	Sovereign lands planner
Carissa	Watanabe	Utah Department of Transportation	Environmental performance manager
Grant	Willis	Utah Geological Survey	Mapping program manager
Brody	Young	Utah Division of State Parks and Recreation	Assistant boating program manager

The CRCMP is intended to be revised approximately every 10 years. However, the plan can be updated or amended more frequently as issues arise during implementation, as statute or rules change, or to accommodate new information. In accordance with Utah Administrative Code, the revision process is open to the public for comment.

How to Use the Plan

The CRCMP is intended to facilitate access to data, river use class information, permitting processes, and BMPs to assist stakeholders in planning and implementing projects that may affect Colorado River sovereign lands. This introductory chapter provides an overview of the regulatory environment and sets the stage for the management plan and how it applies to different management scenarios, including a description of the authorizing and permitting processes. The map book at the end of this chapter (Figure 1.8 [maps 1–18]) provides an accessible visual reference of the river's use classes as prescribed in Utah Administrative Code R652-70-200. Chapter 2 summarizes the current conditions of the river and focuses on ecosystem, water, geology and mineral, and community resources. This, in combination with public outreach, provides the basis for Chapter 3, which discusses desired future conditions, management goals and objectives, and BMPs that may apply to ongoing management and permitting decisions for projects proposed by state government agencies, local governments, stakeholders, adjacent landowners, private entities, and others. Throughout the CRCMP, colored boxes called "Further Reading" are used to refer the reader to other Colorado River–related documents or websites. These include primary documents, information, and management practices that were used in the planning process or that may be helpful or interesting to reference. Chapter 4 provides a list of literature cited for the plan. Unless otherwise stated, all photographs and graphics in the plan are courtesy of FFSL or were provided by the authors of the plan.

Information in the CRCMP is supported by three online resources: 1) a CRCMP interactive portable document format (PDF), 2) a CRCMP Esri story map, and 3) a geographic information system (GIS) spatial data viewer. All of these resources are found on the FFSL website and provide supplemental formats with which to view the CRCMP, understand the

regulatory context behind the CRCMP, and visualize available data used to make management decisions. Although the interactive PDF will remain the same until the plan is updated, both the Esri story map and GIS spatial data viewer can be modified as new data and other information become available for the Colorado River. These three online resources are discussed further below.

- Interactive PDF: This electronic document, viewable in Adobe Reader, is identical to a hard copy of the CRCMP; however, this format provides the reader with hyperlinks to additional reading, a nimble Table of Contents to navigate from one section to another, and the ability to make electronic notes in the document and print copies without concern for browser or word processing differences.
- Esri story map: This format combines the text and graphics in the plan with geospatial data to create maps that guide users along the Colorado River and provide important information such as river use classes and current conditions. Resource maps are static but do allow the user to zoom in to a specific area of interest. The Esri story map is organized by tabs and includes background and resource information. Along the left side of each tab is a bar that includes a selection of text and graphics taken from the CRCMP.
- GIS spatial data viewer: To view all GIS spatial data compiled and catalogued for the CRCMP, users can operate this GIS data viewing tool without support from GIS professionals or a background in this field. To better understand current conditions, users can turn data layers (there are more than 60) on and off, which allows a unique perspective and virtual tour of the Colorado River. Combining existing authorization locations, river use class, and stream alteration permit information can help municipalities plan the next utility crossing or bank restoration project. Similarly, reviewing boater access locations can allow boaters to prepare for their next float trip down the Colorado River. GIS data layers are found in colored boxes throughout the plan.

1.2 Ownership, Regulatory, and Management Context

Colorado River Bed and Bank

Because segments of the Colorado River were navigable at statehood in 1896, the State of Utah claims fee title ownership to the bed and banks of those segments of the river by virtue of the Equal Footing Doctrine (Slade et al. 1997). Exceptions may exist in certain locations where unique title issues are present, and nothing in the plan is intended to represent an adjudication of ownership of any particular tract. The CRCMP is created for FFSL's planning purposes, and FFSL recognizes that certain title and boundary questions may have to be addressed on a case-by-case basis in the future. The State of Utah considers the bed and banks of the Colorado River as "sovereign land." The Utah State Legislature defines sovereign land as "those lands lying below the ordinary high water mark [OHWM] of navigable bodies of water at the date of statehood and owned by the state by virtue of its sovereignty" (Utah Code 65A-1-1). As noted in this definition, the state's ownership extends to the OHWM; however, knowing exactly where the OHWM was located at statehood is challenging. For this reason, and because the OHWM has not been mapped continuously along the Colorado, a case-by-case demarcation of the OHWM may be required as part of a permit authorization process.

In 1965, FFSL's predecessor agency exchanged school trust lands and sovereign lands in the newly designated Canyonlands National Park for U.S. Bureau of Land Management (BLM) lands north of Moab. Parcels near Crescent Junction and Courthouse Ridge were selected from the Canyonlands exchange for their paleontological and wildlife habitat values to be managed as sovereign lands (referred to as Moab Sovereign Exchange Lands), whereas the remaining lands were designated as State of Utah School and Institutional Trust Lands Administration (SITLA) lands. The Courthouse Ridge parcel is only a few miles north of the sovereign lands of the Colorado River.

Unadjudicated Section of Colorado River

Portions of the Colorado River have been adjudicated in terms of ownership of the submerged lands constituting the bed of the river, but a significant stretch of the Colorado River remains unadjudicated in terms of title. Specifically, "the Colorado river from the mouth of Castle creek (about 14 miles above the town of Moab) to the boundary line between Utah and Arizona, 296 miles (including the portion of the Colorado river above the mouth of the Green river which had formerly been known as the Grand river)" was adjudicated and held navigable for title purposes by the United States Supreme Court in 1931 in *United States v. Utah* (283 U.S. 64). In other words, the Court determined the State of Utah has title to the bed of the Colorado River in this section. The remaining portion (referred to in this discussion as the unadjudicated section), which consists of the Colorado River as it enters Utah from Colorado and flows south to Castle Creek, has not been adjudicated in terms of riverbed ownership.

The State of Utah, through FFSL, has not, to date, initiated any proceedings to adjudicate title to the riverbed in the unadjudicated section, primarily because of title adjudication priorities on other sovereign lands. FFSL believes recent precedent issued by the United States Supreme Court in 2012 in *PPL v. Montana* (565 U.S. 576) and an analysis of historical data and geomorphology present solid legal and factual grounds to claim ownership of the unadjudicated section. FFSL is currently exploring procedural options to formally adjudicate ownership.

The United States is the owner of most of the upland property adjacent to the unadjudicated section.[2] To date, neither the United States nor a private landowner has initiated litigation to determine riverbed ownership within the unadjudicated section. Several reports issued by the BLM contain findings of navigability along this section.[3]

Because this section of the Colorado River has not yet been adjudicated, interim management of the riverbed will be accomplished through cooperation with the federal government. FFSL is working to complete a temporary memorandum of understanding (MOU) with the BLM, the agency responsible for managing the federal land adjacent to the river. The MOU will govern cooperative management of the unadjudicated section of the river from bank to bank during the pendency of adjudication. Until the MOU is in place, FFSL will manage the unadjudicated section of the river in a way that does not conflict with current BLM management of adjacent land. Management goals and objectives in the CMP will be used to guide joint management and will ensure consistent management along all five river segments. In the event an MOU is negotiated and executed, FFSL will amend the CMP to include the terms of the MOU.

If and when ownership is formally adjudicated and it is determined the State of Utah holds title to the unadjudicated section or a portion of this section, FFSL will amend the CMP to reflect its ownership and management of the riverbed.

Sovereign Lands Under Lake Powell

As mentioned earlier, the United States Supreme Court determined that title to the bed of the Colorado River from the mouth of Castle Creek to the boundary line between Utah and Arizona belonged to the State of Utah (*United States v. Utah*, 283 U.S. 64 [1931]). Although this decision was issued prior to the building of Glen Canyon Dam and filling of Lake Powell, the State of Utah retains title to the bed of the river submerged under Lake Powell (hereafter referred to as the Glen Canyon segment). It is anticipated the State of Utah and the United States will have to negotiate alternate resolution for the submerged Glen Canyon segment of the Colorado River.

[2] In addition to the United States, there are approximately 23 private owners of land parcels located adjacent to the unadjudicated section.

[3] Compare the conclusion of Mary G. von Koch on page 19 of the *Navigability Report of the Upper Colorado and Lower Dolores Rivers Within Utah* (von Koch 1987) that the unadjudicated section was navigable except for the "section of the Colorado River known as Westwater Canyon and starting at Westwater Creek and ending 12.8 miles downstream at Cottonwood Creek" with the conclusion on page 21 in the *Navigability Report of the Upper Colorado and Lower Dolores Rivers* (Anonymous n.d. [1983]) that "in review of the history of the subject rivers and reports pre-taining [sic] to waterflow, topography, and general characteristics and in review of precedent court cases there appears no basis for a finding of navigability of the Upper Colorado and the Lower Dolores Rivers" (for purposes of issuing hydrocarbon and metalliferous leases).

The Glen Canyon segment of the Colorado River is included in the CMP planning area because some portions of this segment may not be submerged, depending on water levels. In areas where the river lies below the OHWM, FFSL will exercise its jurisdiction and manage the riverbed from bank to bank. FFSL will not manage the riverbed underlying Lake Powell where the water level is above the OHWM.

Colorado River Sovereign Land Boundaries

The boundary of sovereign land underlying a river is intrinsically more difficult to define than that of a lake because rivers are more susceptible to substantial geographic movement and shifts in location over time. A thorough examination of the laws of water boundaries, particularly as they pertain to rivers, is complex and beyond the scope of this management plan. However, there are a few basic concepts that are important in understanding the management of rivers as sovereign lands.

Most rivers meander over time unless human-made or natural barriers exist to prevent such movement. As the course of the river changes, natural and artificial processes of erosion, reliction, avulsion, and accretion[4] may affect landownership. Generally, the gradual processes of accretion, reliction, and erosion change the property boundaries between private and public ownership. An adjacent, upland landowner may obtain title to any dry land added by accretion or reliction and/or may lose title to dry land eroded and now covered by water.

For the purposes of sovereign land management, state ownership of the riverbed generally follows the movement of the river over time as it naturally meanders because of erosion, reliction, and accretion processes. However, landownership remains fixed following sudden avulsive events. Avulsive events can result from natural occurrences such as flash floods or from human-made causes such as channel straightening or artificial channel relocation.

Currently, FFSL is not planning to initiate a boundary settlement process for the Colorado River as it has done at Utah Lake and Bear Lake. FFSL has settled boundaries of other sovereign land resources with some adjacent upland landowners on a case-by-case basis and plans to continue with this approach as boundary issues along the Colorado River arise.

The Public Trust Over Sovereign Lands

The Public Trust Doctrine is a legal principle derived from English common law. It provides that Public Trust lands, waters, and living resources in a state are held by the state in trust for the benefit of all people (Slade et al. 1997). The doctrine establishes the right of the public to use Public Trust resources, and also establishes the responsibilities of the states when managing Public Trust assets (Slade et al. 1997). In general, Public Trust waters consist of the navigable waters in a state, whereas Public Trust lands are the lands beneath those waters up to the OHWM at statehood. The living resources (e.g., fish, aquatic plants and wildlife) inhabiting these lands and water are also subject to the Public Trust Doctrine (Slade et al. 1997).

The roots of the Public Trust Doctrine date back to the Institutes of Justinian and the accompanying Digest, compiled in the sixth century, which collectively formed Roman civil law. Under Roman law, the air, sea, shores of the sea, and running waters were held in common by all citizens. The rights of fishing, navigation, and public use of the banks of a river or shore were common to all (Slade et al. 1997). These principals of Roman civil law were adopted, for the most part, by English common law, which recognized public rights in all tidewaters (i.e., navigable waters) and the lands beneath. English common law, in turn, became the law of the 13 original states (Slade et al. 1997).

[4] *reliction* = gradual recession of water, leaving land permanently uncovered; *avulsion* = rapid abandonment of a river channel and the formation of a new river channel; *accretion* = the gradual deposition of sediment along the edge of a channel.

The Equal Footing Doctrine is the principle of United States constitutional law that mandates that new states be admitted to the Union as equals to the original 13 states. The Equal Footing Doctrine perpetuated the Public Trust Doctrine from the 13 original states to each of the 37 new states. As each new state entered the Union, it received in trust those lands beneath navigable waters for the citizens of the new state (Slade et al. 1997).

The State of Utah has recognized and declared that the bed and banks of navigable waters within the state are owned by the state and are among the basic resources of the state, and that there exists, and has existed since statehood, a Public Trust over and upon these waters (Utah Administrative Code R652-2-200). Segments of the Colorado River are included in this category of navigable waters and are managed by FFSL for public benefit consistent with the Public Trust Doctrine.

Historically, the common law rights in Public Trust lands and waters were directly related to navigation, fishing, and commerce. As society has evolved, the public's use of trust lands and waters has changed. The Public Trust Doctrine has expanded from preserving the public's right to use trust lands and waters for navigation, fishing, and commerce to include recreation, environmental protection, and the preservation of scenic beauty (Slade et al. 1997). Recognition of this evolution in the Public Trust Doctrine is found in the following text from Utah Administrative Code R652-2: "It is also recognized that the public health, interest, safety, and welfare require that all uses on, beneath or above the beds of navigable lakes and streams of the state be regulated, so that the protection of navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality will be given due consideration."

Colorado River Management

The Utah State Legislature has designated FFSL as the executive authority for the management of sovereign lands in Utah, including the Colorado River. Because the precise location of the OHWM at the time of statehood is not known for the entire Colorado River, FFSL generally manages the river from the top of bank to the top of the opposite bank as illustrated in Figure 1.2. The top-of-bank-to-top-of-bank management boundary along the entire river allows FFSL to provide consistent management of this state sovereign land.

FFSL supports partnerships and collaborations with other entities that have jurisdiction and/or management authority on the Colorado River (see Figure 1.2 and Sections 1.3, 1.4, and 1.5), as well as with interested stakeholders, to improve overall river management and decision-making.

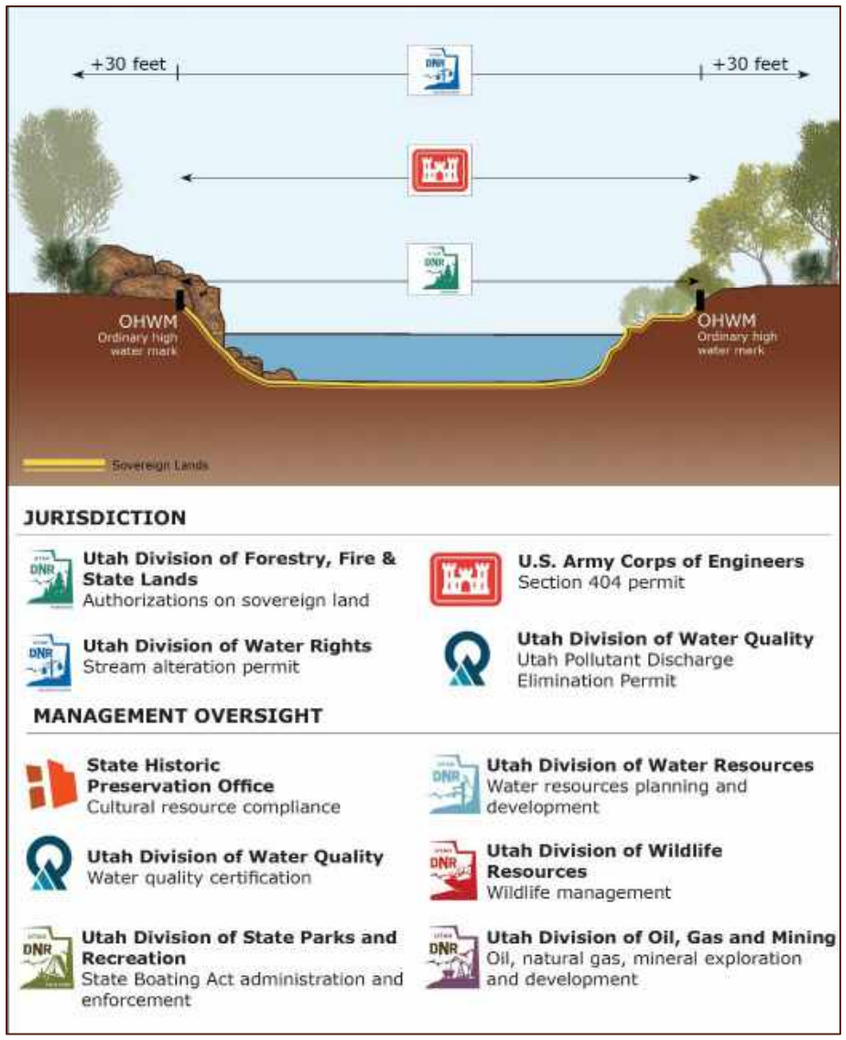


Figure 1.2. Colorado River cross section showing agency management jurisdiction for the river.

Multiple-Use Approach

FFSL administers state lands using multiple-use, sustained-yield principles as required by Utah Code 65A-2-1 and Utah Administrative Code R652-90-800. There is no particular hierarchy of uses on sovereign lands. FFSL recognizes that protection of **navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality** must be given due consideration and balanced against the need for, justification of, or benefit from any proposed use (Utah Administrative Code R652-2-200). Implementation of multiple-use policies must avoid substantial impairment of Public Trust resources. As a trustee, FFSL must also strive for an appropriate balance among compatible and competing uses on the Colorado River.

River Mile System and River Segments

One method of identifying features along rivers is by using river miles (RMs) as reference points. The RMs used in the plan are based on the *Guide to the Colorado & Green Rivers in the Canyonlands of Utah & Colorado* (Martin and Whitis 2016). The starting point (RM 0) on the Colorado River is the gauging station at Lee's Ferry, located approximately 9 miles south of the Utah-Arizona state line (outside of sovereign lands). RM numbers increase in the upstream direction on the Colorado River to the confluence of the Colorado and Green Rivers within Canyonlands National Park (hereafter referred to as The Confluence). At The Confluence, the RM numbering restarts at 0 and again increases in the upstream direction on both the Colorado River and the Green River. Commonly used river segment names, associated with RMs, are used throughout the plan (Table 1.2). RMs in the plan may be slightly edited from Martin and Whitis (2016) for continuity between river segments. Where applicable (and with the exception of Table 1.2), RMs are rounded to the nearest 0.5 mile.

Table 1.2. Colorado River Comprehensive Management Plan River Segments and Associated River Miles

River Segment	River Miles	Segment Identification	Description (length)
Above Westwater	131.7 to 127.6	C-1-AW	Utah-Colorado state line to the Westwater Ranger Station (4.1 miles)
Westwater Canyon Wilderness Study Area	127.6 to 113	C-2-WSA	River segment in the Westwater Canyon Wilderness Study Area (14.6 miles)
The Moab Daily	113 to 47.3	C-3-TMD	Bald Eagle Campground to the Potash boater access point (65.7 miles)
Meander Canyon	47.3 to 31	C-4-MC	Potash boater access point to the border of Canyonlands National Park (16.3 miles)
Glen Canyon	176 to the Utah-Arizona state line	C-5-GC	River segment under Lake Powell. This segment is below The Confluence; therefore, RM numbering for this segment is calculated from RM 0 at Lee's Ferry.

Notes: Because the Glen Canyon segment is under Lake Powell and the actual bed of the river cannot be determined, the total RMs for the Glen Canyon segment cannot be calculated. RM references are for management purposes only and may not represent precisely the ownership interests and/or fee title claimed by the State of Utah.

Special Designations

Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act (WSRA) was passed by Congress in 1968. The WSRA's purpose was to set aside "certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations" (16 United States Code 1271 et seq.). Rivers must be both eligible ("free-flowing" with one or more "outstandingly remarkable values") and suitable (whether designation is the best way to manage or protect the eligible river corridor) in order to be designated as wild and scenic. Depending on the type and degree of human development associated with the river and adjacent lands (e.g., impoundments, shoreline development), eligible rivers are preliminarily classified as wild, scenic, or recreational.

After the eligibility and suitability determinations are complete, federal agencies can formally recommend designation to the National Wild and Scenic Rivers System. Congress must approve any rivers recommended by federal agencies for designation. A river authorized for study by Congress receives statutory protection under Public Law 90-542 Section 7(b), water resources projects; Section 8(b), land disposition; and Section 9(b), mining and mineral leasing. A river identified for study through a federal agency is not protected under the WSRA. Rather, protection of its outstanding remarkable values and other characteristics occurs through other agency decisions.

The BLM has identified portions of the four northern river segments (all segments except for Glen Canyon) as suitable for recommendation into the National Wild and Scenic Rivers System with classifications of wild (approximately RM 112 to RM 125), scenic (approximately RM 100 to 112 and RM 31 to RM 48.5), and recreational (approximately RM 48.5 to RM 100) (see the GIS spatial data viewer for additional detail). In addition, the Above Westwater segment and the north end of the Westwater Canyon Wilderness Study Area segment have been determined eligible for scenic designation, which is an initial step in the river assessment process prior to the determination of suitability. These areas can be viewed on the GIS spatial data viewer.

1.3 Utah Department of Natural Resources Management Responsibilities

Utah Division of Forestry, Fire & State Lands

The State of Utah claims fee title ownership of the sovereign lands of the bed of the Colorado River. FFSL has direct management jurisdiction from top of bank to top of bank of the river (see Figure 1.2) and manages the river under the Public Trust Doctrine for the use and enjoyment by the public. To ensure effective implementation of Utah's multiple-use approach, FFSL strives to assure public access to navigable waters for commerce, navigation, fishing, swimming, and recreational boating, while also working to preserve the ecological and cultural values of Colorado River sovereign lands. Other sovereign lands connected to or close to the Colorado River are two segments of the Green River and the Moab Exchange

lands, which were acquired by the State of Utah in 1965 in an exchange for sovereign lands in the then-newly designated Canyonlands National Park. The Moab Exchange lands consist of the Dalton Wells parcel (approximately 10 miles north of Moab, Utah, along U.S. Route 191) and the Prairie Dog Haven parcel (near the intersection of U.S. Route 191 and Interstate 70). Holistic management of the Colorado and Green Rivers is recommended because the Green River flows into and influences the Colorado River.

Utah Division of Oil, Gas and Mining

The mission of the Utah Division of Oil, Gas and Mining (DOGM) is to "regulate the exploration and development of coal, oil and gas, and other minerals in a manner that encourages responsible reclamation and development; protects correlative rights; prevents waste and protects human health and safety, the environment and the interest of the state and its citizens" (Utah Department of Natural Resources 2018). The Board of Oil, Gas, and Mining is the policy-making body for DOGM. DOGM's coal program is responsible for providing permits to coal companies, site inspections, and oversight of the reclamation and bond release process. DOGM's oil and gas program regulates the exploration and development of oil and natural gas resources, and the minerals program regulates exploration and development of all non-coal mineral resources (e.g., copper, gold, and silver). Coal and mineral deposits, including oil, gas, and hydrocarbon resources, in state-owned lands are reserved to the state. DOGM may permit the exploration and development of these resources from beneath sovereign lands with permission from FFSL.

Utah Division of State Parks and Recreation

Title 79-4 of the Utah Code establishes the Utah Division of State Parks and Recreation (DSPR) and the Board of Parks and Recreation and sets forth their responsibilities. Under Utah Code 79-4-802, the DSPR has the discretion to give grants to local governments and state agencies for riverway enhancement projects with funds appropriated by the Utah State Legislature for that purpose. Grants for riverway enhancement projects must be for rivers or streams that are impacted by high-density populations or are prone to flooding, and these grants must include a plan to provide employment opportunities for youth, including at-risk youth.

The DSPR also is required to administrate and enforce the State Boating Act (Utah Code 73-18), which includes duties such as ensuring the safety of vessels and persons on the water, registering boats, zoning certain waters of the state for non-motorized use, regulating commercial operators, and regulating waterway markers and other permanent objects in waters of the state.

Utah Division of Water Resources

The mission of the Utah Division of Water Resources (DWRe) and the Board of Water Resources is to plan, conserve, develop, and protect Utah's water resources, pursuant to Title 73 of the Utah Code. DWRe conducts studies and planning for water use in the Colorado River watershed. The Board of Water Resources has divided the State of Utah into eight river districts for management purposes. The planning area is in the Upper Colorado River District and in the Lower Colorado River District.

Utah Division of Water Rights

The Utah Division of Water Rights (DWRi) regulates the appropriation and distribution of water in the state of Utah, pursuant to Title 73 of the Utah Code. The State Engineer, who is the director of DWRi, gives approval for the diversion and use of any water, regulates the alteration of natural streams such as the Colorado River, and has the authority to regulate dams to protect public safety. All projects within twice the width of the Colorado River active channel up to 30 feet are regulated by DWRi under the Stream Alteration Program (see Figure 1.2). DWRi has authority to regulate dam safety and inspects the potash pond dams near the Colorado River, located about 20 miles west of Moab, Utah.

FFSL does not adjudicate water rights in Utah, and nothing in the plan is intended to, nor shall it be construed to, revoke, cancel, suspend, limit, modify, regulate, affect, or impair any existing appropriated, decreed, contracted, or other water right approved by DWRi that is owned by the holder of a permit issued under the CRCMP. In addition, nothing in the plan is intended to affect any right or interest of the permittee under any such water right, including the right to impound, store, divert, and use water as authorized under any such regulation or affect any vested water right. When FFSL requests that a person obtain a permit for a water diversion structure or other encroachment on sovereign land, it is exercising authority only as a property owner where it has jurisdiction.

Utah Division of Wildlife Resources

Title 23 of the Utah Code establishes the Utah Division of Wildlife Resources (DWR) and the Wildlife Board and sets forth their duties and powers. Utah Code 23-14-1 states that "The Division of Wildlife Resources is the wildlife authority for Utah and is vested with the functions, powers, duties, rights and responsibilities provided in this title and other law." DWR also manages lands and access areas along the Colorado River for the benefit of the public. As part of its responsibility, DWR implements restoration projects to enhance fish and wildlife habitat and to increase fish and wildlife population numbers.

Utah Geological Survey

The Utah Geological Survey (UGS) was established to survey, investigate, and provide information on the geology, topography, paleontology, and mineral resources of the state (Utah Code 79-2), including geologic hazards such as earthquakes and faults. The Board of Utah Geological Survey is the policy-making body for the UGS. A permit is required from UGS before excavating for critical paleontological resources on lands owned or controlled by the state.

1.4 Other State and Local Entities Management Responsibilities

State of Utah School and Institutional Trust Lands Administration

SITLA manages 3.4 million acres of land in Utah held in trust for 12 state institutions. SITLA works with private businesses to generate revenue from these lands (through surface and subsurface development and real estate transactions), which is deposited into permanent endowments for each beneficiary. SITLA is an adjacent landowner along Colorado River sovereign lands.

Utah Department of Agriculture and Food

The Utah Department of Agriculture and Food's (UDAF) mission is to promote the healthy growth of Utah agriculture, conserve natural resources, and protect the food supply. It accomplishes this through administration of Utah's agricultural laws that mandate a variety of activities such as inspections, loan issuance, pest and disease control, and public information programs. Especially relevant to Colorado River sovereign lands are UDAF's grazing improvement, noxious weed detection and control, environmental stewardship certification, and agricultural land preservation programs. Utah conservation districts, local groups created to improve and protect natural resources for public benefit, are under the purview of UDAF.

Utah Department of Transportation

The Utah Department of Transportation (UDOT) plans, designs, and implements transportation projects (e.g., bridges, roads, bike lanes, and public transit) while adhering to state and federal environmental laws and regulations. Transportation infrastructure may cross the Colorado River or parallel its banks. Although there are no specific UDOT

guidelines or regulations regarding the Colorado River, the agency is required to prepare environmental analysis and documentation for federally funded and state-funded transportation projects and implement measures to minimize harm to the environment.

Utah Division of Water Quality

The UDEQ Division of Water Quality (DWQ) and the Utah Water Quality Board are responsible for maintaining, protecting, and enhancing the quality of Utah's surface and groundwater resources. Title 19, Chapter 5 of the Utah Code charges the board and division to develop programs for the prevention and abatement of water pollution. The board is also responsible for establishing water quality standards throughout the state; enforcing technology-based, secondary treatment effluent standards or other more stringent discharge limits to meet instream standards; reviewing plans, specifications, and other data relative to wastewater disposal systems and municipal separate stormwater systems; and establishing and conducting a continuing planning process for control of water pollution. DWQ completed a total maximum daily load report in 2014 for selenium in the Colorado River watershed in Grand and San Juan Counties (UDEQ 2014). DWQ also administers the Water Quality Certification Program under Section 401 of the Clean Water Act (CWA) and the Nonpoint Source Management Program under Section 319 of the CWA.

Utah State Historic Preservation Office

The Utah State Historic Preservation Office (SHPO) within the Utah Division of State History provides review, comment, and guidance to agencies needing to comply with cultural resource regulations. Utah Code 9-8-404 requires that state agencies consider their actions on historic properties and provide the Utah SHPO with an opportunity to comment on those actions. Section 106 of the National Historic Preservation Act (54 United States Code 300101 et seq.) applies similarly in cases where there is a federal undertaking (money, land, permitting, etc.); the federal agency is required to consult with SHPO. Generally, for both state and federal actions, a historic property is something that is more than 50 years old; retains integrity; and is eligible for, or listed on, the National Register of Historic Places.

The Utah SHPO does not have regulatory authority over state or federal projects, but instead offers advice and comment on a proposed undertaking to hopefully avoid or minimize effects to a historic property. Under federal statute, the Utah SHPO is the central clearinghouse for historical and archaeological information for Utah, including federal, state, and private lands. Architectural information is available freely to the public; however, archaeological site information is protected by federal law (Archaeological Resources Protection Act of 1979) and state law (Government Records Access and Management Act), whereby only approved archaeologists can view the sensitive information. Outside the formal compliance process, the Utah SHPO can provide advice on how to manage historic properties and can offer potential funding opportunities in certain cases.

Local Government

Counties and cities with jurisdiction over lands abutting the Colorado River have important management responsibilities, are river stakeholders, and are partners with FFSL in ongoing and future projects. Local government performs functions related to public safety, education, recreation, tourism, land use and planning, and weed management among other subjects.

General Public

FFSL manages Colorado River sovereign lands for the benefit of the general public in accordance with the Public Trust. Feedback from the public is always welcome. Community involvement in ongoing sovereign lands management (e.g., service projects involving restoration or education) is encouraged, assuming efforts are coordinated with and approved by FFSL.

1.5 Federal Agencies Management Responsibilities

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP), which is fundamental to reducing flood losses. In this program, *floodplain management* is defined to include all actions that states and communities can take to minimize damage to new and existing buildings and infrastructure. Communities along the Colorado River, such as Moab, incorporate NFIP requirements into their zoning codes, subdivision ordinances, and/or building codes or adopt special-purpose floodplain management ordinances. The NFIP requirements apply to areas mapped as the 100-year flood on Flood Insurance Rate Maps issued by FEMA. Local officials are responsible for administering and enforcing local floodplain management regulations within their jurisdiction (see Figure 1.2).

Federal Energy Regulatory Commission

The Federal Energy Regulatory Commission (FERC) is an independent agency that regulates the interstate transmission of electricity, natural gas, and oil. Of most relevance to the Colorado River is FERC's responsibility to license and inspect private, municipal, and state hydroelectric projects.

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) provides farmers and ranchers with financial and technical assistance to apply conservation practices "on the ground" that not only help the environment but also agricultural operations, including those in the planning area. In Utah, the NRCS administers Farm Bill programs such as Agricultural Conservation Easement and Small Watershed, as well as the Emergency Watershed Protection Program, which provides technical and financial assistance to communities affected by natural disasters such as floods.

U.S. Army Corps of Engineers

Under Section 404 of the CWA, the U.S. Army Corps of Engineers (USACE) is responsible for regulating placement of fill material in the nation's waters, including the Colorado River (see Figure 1.2). USACE's management responsibilities under the CWA are to protect the nation's aquatic resources from unnecessary adverse impacts.

U.S. Bureau of Land Management

The BLM manages approximately 245 million acres of public surface land and 700 million acres of subsurface mineral estate (BLM n.d. [2019]). The BLM's mission directs the agency to manage public land for multiple uses while conserving natural, historical, and cultural resources. Multiple uses on BLM lands include renewable energy development (e.g., solar, wind), conventional energy development (e.g., oil and gas, coal), livestock grazing, hard rock mining (e.g., gold, silver), leasable and saleable minerals (e.g., phosphate), timber harvesting, and outdoor recreation (e.g., camping, rafting). The conservation side of BLM's mission includes preserving specially designated landscapes, such as National Conservation Lands (e.g., national monuments, wilderness areas). The BLM is an adjacent landowner along Colorado River sovereign lands.

U.S. Bureau of Reclamation

The U.S. Bureau of Reclamation (USBR) manages, develops, and protects water and water-related resources in an environmentally and economically sound manner for the American public. It operates 338 reservoirs and is the nation's largest wholesale water supplier (USBR 2018). The USBR operates Glen Canyon Dam on the Colorado River, which is 12 RMs south of the planning area.

U.S. Department of Energy

The mission of the U.S. Department of Energy (DOE) is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through science and technological solutions. The DOE's responsibilities include the nation's nuclear weapons program, energy conservation, radioactive waste disposal, domestic energy production, and energy-related research. The DOE operates the 480-acre Moab Uranium Mill Tailings Remedial Action (UMTRA) Project adjacent to the Colorado River, located approximately 3 miles northwest of Moab in Grand County, Utah. The Moab UMTRA project is moving mill tailings and other contaminated materials from a former uranium-ore processing facility (mill site) and from off-site properties in Moab to an engineered disposal cell located 30 miles north, near Crescent Junction, Utah (DOE 2018). Groundwater beneath the site was contaminated by the mill site. In 2003, DOE implemented a groundwater interim action system to protect surface water quality and to recover contaminants prior to discharge to the Colorado River. As of June 2019, the Moab UMTRA project had removed more than 9.7 million tons of the 16 million tons of tailings present, and the project is projected to be completed in the 2030s (DOE 2018; Moran 2019).

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) develops and enforces regulations to protect human health and the environment. The EPA works to ensure that the public has clean air, land, and water, and supports national efforts to reduce environmental risks based on best available scientific information. In addition, the EPA gives grants to state environmental programs, nonprofits, educational institutions, and others. The EPA is also involved in the development of area contingency plans for oil spills that could threaten waters of the United States, including the Colorado River.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) is responsible for protecting flora and fauna, including fish and migratory birds; complying with the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act of 1918; and protecting threatened, endangered, and candidate species found in and near the Colorado River as required by the Endangered Species Act of 1973 (ESA). The USFWS also conducts scientific investigations to document and remedy contaminant-related problems for fish and wildlife and monitors long-term contaminant trends, among other services.

U.S. National Park Service

Since 1916, the U.S. National Park Service (NPS) has been the management agency for the National Park System. The mission of the NPS is to preserve unimpaired natural and cultural resources and values of the national parks for the enjoyment, education, and inspiration of current and future generations. Two national park units are located adjacent to Colorado River sovereign lands: Arches National Park and Canyonlands National Park. In addition, the NPS manages the Glen Canyon National Recreation Area, which contains Colorado River sovereign lands.

1.6 Tribal Management Responsibilities

Navajo Nation

The Navajo Nation covers more than 27,000 square miles of northeastern Arizona, southeastern Utah, and northwestern New Mexico, and it is home to the Navajo people (Navajo Nation Department of Information Technology 2011). The nation borders Lake Powell, the reservoir created by Glen Canyon Dam, and is considered an adjacent landowner to Colorado sovereign lands in the plan. The Navajo Nation has several agencies that manage natural resources, including the Navajo Nation Environmental Protection Agency and the Navajo Nation Division of Natural Resources (which includes departments for water resources, archaeology, agriculture, parks and recreation, and fish and wildlife).

Ute Mountain Ute Tribe

The Ute Mountain Ute Tribe is one of three federally recognized tribes of the Ute Nation. The Ute Mountain Ute Tribe's reservation is in southeast Utah, southwest Colorado, and northern New Mexico. Most of the reservation is in Colorado and New Mexico. There are two communities on the reservation: a small community in White Mesa, Utah, and the tribal headquarters in Towaoc, Colorado. The Ute Mountain Ute Tribe is a stakeholder in the CRCMP process.

1.7 County and Municipal Zoning

The Colorado River borders one municipality and four counties. Each municipality and county entity along the river has the authority to authorize land uses up to the OHWM. However, the natural resources and ecological systems of the Colorado River do not observe property boundaries. Management decisions made by FFSL regarding the river will affect and are affected by the land uses and associated activities on adjacent lands.

The priority for FFSL's management of the riverbed is to continue protecting and sustaining the Public Trust resources of the Colorado River while recognizing that local governments need to provide services to their constituents that may have an impact on the natural environment (e.g., transportation, utilities, and recreation infrastructure). For these reasons, it is important to understand the types of land uses and projects authorized by each municipality and county's general plan and zoning ordinance. Coordination regarding "greenbelts" and development patterns should be an ongoing discussion for the well-being of adjacent residents and for the river. Population growth and infrastructure development in and around municipalities and towns could place increasing pressure on the river corridor.

The CRCMP recognizes FFSL's commitment to maintaining environmental quality for Utah citizens and specifically to minimizing impacts to the environment. However, the CRCMP and FFSL have no authority over regulations on any lands adjacent to the river. The counties and municipalities use their own land use zoning designations to indicate the allowed uses for properties adjacent to the Colorado River. In addition to the current zoning maps and ordinances, future land use maps and general plans portray expected and anticipated uses, which may differ from the current zoning and/or existing land uses in place. A summary of the current zoning for land uses in each county is provided in the following sections. Please refer to the GIS spatial data viewer available on the FFSL website to view the zoning per county.

Garfield County

Approximately 45 miles of the planning area river corridor is in Garfield County (this portion of the river corridor is also shared with San Juan County as it defines the counties' borders). There are no municipalities adjacent to these sovereign lands.

The county has zoned some of the land adjacent to the planning area as Multiple Use (see the GIS spatial data viewer). This category allows for a variety of uses at the same period of time on the same land, without impairing the productivity of the land (Garfield County 2007).

Grand County

Approximately 91 miles of the planning area river corridor is in Grand County. One municipality in the county has jurisdiction over land uses adjacent to sovereign lands: the city of Moab. Of the 91 miles of river corridor in Grand County, approximately 0.11 mile is in or adjacent to Moab.

The city of Moab has zoned some of the land adjacent to the planning area as Resort Commercial and Commercial. Grand County has zoned land adjacent to the planning area as Multiple Use (range, resource, and recreation), Commercial, Residential, Industrial, Recreation, and Open Space.

Kane County

Approximately 101 miles of the planning area river corridor is in Kane County (this portion of the river corridor is also shared with San Juan County as it defines the counties' borders). There are no municipalities adjacent to these sovereign lands.

The county has zoned the land adjacent to the planning area as Recreation. This zoning is complementary with the designated Glen Canyon National Recreation Area.

San Juan County

Approximately 167 miles of the planning area river corridor is in San Juan County (this mileage includes the mileage listed for Garfield and Kane Counties). There are no municipalities adjacent to these sovereign lands.

The county has zoned some of the land adjacent to the planning area as Multiple Use and Agriculture.

1.8 Collaborative Management Groups

The Colorado River system flows through seven states and two countries, and is an important water supply for agriculture, industry, municipalities, recreation, and wildlife. A number of collaborative groups provide multi-stakeholder management efforts on the Colorado River. Several key groups are discussed below.

Colorado River Basin Salinity Control Forum and Council

The Colorado River Basin Salinity Control Forum is an organization of the seven Colorado River basin states of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming. The purposes of the forum are to coordinate the states' salinity control efforts, coordinate with federal agencies on implementation of the Colorado River Basin Salinity Control Program, share information on salinity control, and promote efforts to reduce the salt loading to the Colorado River. Forum efforts could affect agricultural stakeholders and water quality in Colorado River sovereign lands.

The Colorado River Basin Salinity Control Advisory Council was created by the Colorado River Basin Salinity Control Act in 1974 as a federal advisory committee to make recommendations to the federal government on the implementation of the Colorado River Basin Salinity Control Program. The advisory council has common membership with the forum, and meetings are generally held in conjunction with each other.

Glen Canyon Dam Adaptive Management Work Group

The Glen Canyon Dam Adaptive Management Work Group is a federal advisory committee that monitors the results of Glen Canyon Dam's operating criteria and plans adopted by the Secretary of the Interior, and suggests appropriate changes to those plans and operating criteria. Members include the seven Colorado River basin states (including Utah), six tribes, federal agencies such as the USBR and NPS, recreation interests, environmental groups, and federal power purchase contractors. Changes in the management of Glen Canyon Dam can affect Colorado River sovereign lands that are currently inundated by or adjacent to Lake Powell.

Upper Colorado River Commission

The Upper Colorado River Commission is an interstate water-administrative agency established with the enactment of the 1948 Upper Colorado River Basin Compact. The commission's role is to administer water from the Colorado River to the Upper Division (i.e., Wyoming, Colorado, Utah, and New Mexico) and to ensure water is released in accordance with the 1922 Colorado River Compact to the Lower Division (i.e., Nevada, Arizona, and California) and to Mexico. The commission promotes interstate goodwill, seeks to remove causes of controversy, guarantees water storage, and ensures expeditious agricultural and industrial development of the upper basin of the Colorado River. The commission consists of one representative appointed by the Governor of each Upper Division state and one member appointed by the President to represent the United States. DWRe is a member agency of the commission.

Upper Colorado River Endangered Fish Recovery Program

The Upper Colorado River Endangered Fish Recovery Program is a partnership of local, state (including Utah), and federal agencies; water and power interests; and environmental groups working to recover four species of endangered fish in the upper basin of the Colorado River, while allowing for water development. The recovery program involves restoring and managing stream flows and habitat; boosting wild, endangered fish populations with

hatchery-raised fish; and reducing negative interactions with some species of nonnative fish. The recovery program sets goals to provide measurable criteria for downlisting (change in status from endangered to threatened) and delisting (removal from ESA protection) the endangered fish in the Colorado River. Recovery program efforts can affect endangered fish in Colorado River sovereign lands. DWR is a member of this group.

1.9 Adjacent Land Management Plans

Interagency coordination and communication are essential to ensuring the sustainability of Public Trust values on Colorado River sovereign lands. Approximately 56% of the adjacent landownership within 50 feet of the river banks is federally owned (BLM and NPS) and approximately 39% is state owned. The types of management plans already in place for these lands are discussed below.

Bureau of Land Management Resource Management Plans

The Federal Land Policy and Management Act of 1976 directs the BLM to develop and periodically revise resource management plans (RMPs) to guide management of BLM-administered lands under the principals of multiple use and sustained yield. RMPs provide a comprehensive, long-term framework for the allocation of present and future resources and for management decisions that balance uses with resource protection. Land use planning goals, objectives, and management actions are established in an RMP. The BLM Moab, Monticello, Richfield, and Kanab Field Offices all have RMPs in place that cover lands near the planning area.

National Park Service Foundation Documents

The NPS is required to develop a foundation document for each national park unit to outline the purpose and significance of the park unit, interpretive themes, fundamental resources and values, and special mandates and administrative commitments. The foundation document provides the underlying guidance for planning decisions in a park unit. Individual park units may also develop separate plans for the management of particular resources, such as noxious species. Foundation documents have been developed for Arches National Park, Canyonlands National Park, and Glen Canyon National Recreation Area near the planning area.

County Resource Management Plans

Utah Code 17-27a-401 requires counties to include a county RMP for public lands as part of their general plan. The county RMP must address 28 topics, including livestock grazing, agriculture, fire management, noxious weeds, water rights, ditches and canals, water quality and hydrology, floodplains and river terraces, wetlands, riparian areas, wildlife, fisheries, recreation, and mineral resources. The county RMP establishes findings pertaining to each topic or resource, describes defined objectives, and outlines general policies and guidelines on how objectives should be accomplished. County RMPs have been developed for the four counties with Colorado River sovereign lands.

1.10 Utah Division of Forestry, Fire & State Lands Authorization Process

FFSL is the executive authority for the management of sovereign lands and is required to prescribe standards and conditions for the authorization and development of surface resources on sovereign lands. Authorizations (easements, general permits, and rights-of-entry [ROEs]) issued by FFSL must be in compliance with state law, administrative rules, and the Public Trust Doctrine and must adhere to multiple-use, sustained-yield principles. Each authorization (easement, general permit, or ROE) must also comply with this CRCMP. Figure 1.3 demonstrates FFSL's most commonly used authorization processes (processes are subject to change depending on the proposed activity and permit), and Figure 1.4 provides a standard authorization checklist. FFSL's authorization processes are governed by applicable laws. Unpermitted actions violate state laws and are subject to a civil penalty. Without a CMP, the authorization process requires site-specific planning.

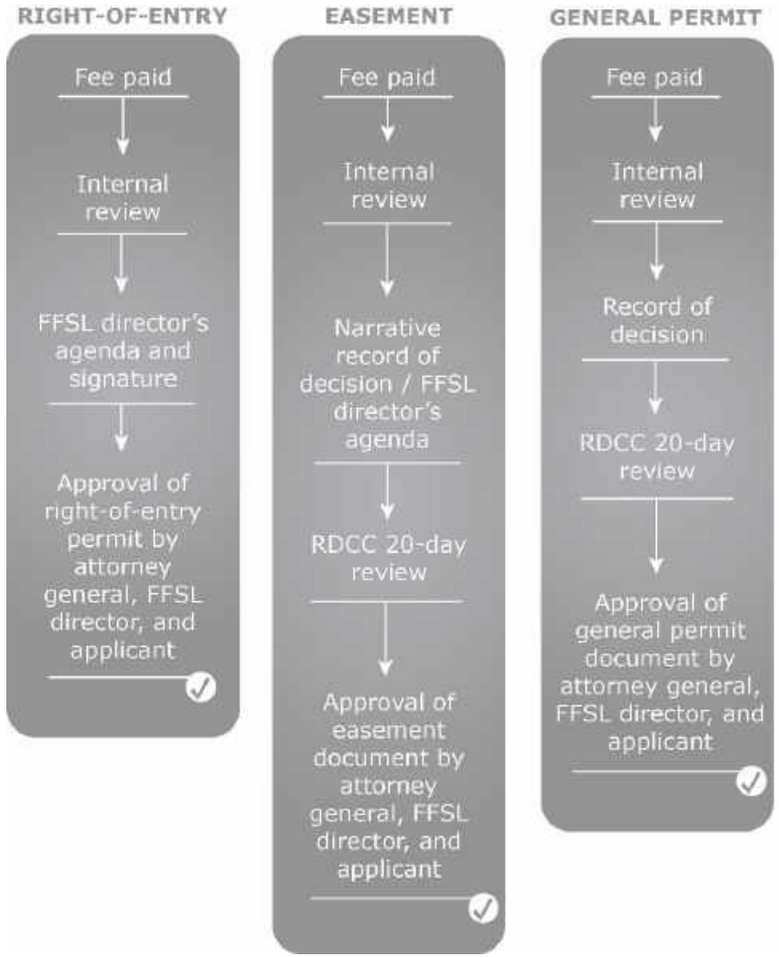


Figure 1.3. Authorization process diagram.[5]

Figure 1.4. Application checklist.[5]

Types of Authorizations

Easements

An easement (Utah Administrative Code R652-40) across the Colorado River may be issued by FFSL for bridges, above- and below-grade utility lines, or pipelines. Easement fees are based on determined rates, which may include linear rate or appraised value. Easements are granted for no more than a term of 30 years and are subject to a 20-day review by the state's Resource Development Coordinating Committee.

[5] *This diagram is for illustrative purposes only. FFSL follows all applicable legal doctrines, statutes, and regulations for authorizations.*

General Permits

General permits are issued for public or private use of sovereign lands. Public use may include roads, bridges, recreation areas, dikes, or flood-control structures. Private use may include agricultural uses that are constructed adjacent to upland private property or facilities for the launching, docking or mooring of boats constructed for the use of the adjacent upland owner. An adjacent upland owner is defined as any person who owns adjacent upland property which is improved with, and used solely for, a single-family dwelling. General permits are issued for no more than 30 years and are subject to a 20-day review by the Resource Development Coordinating Committee.

Rights-of-Entry

An ROE (Utah Administrative Code R652-41) allows non-exclusive, non-permanent, or occasional commercial or non-commercial use of sovereign lands for a short-term period of generally no more than 1 year. ROEs are generally issued for filming, commercial recreation ventures, research, organized events, and non-commercial ventures lasting more than 15 days.

Authorization Renewals

The permittee should submit a written request to FFSL to be considered for a permit renewal. This should be done at least 3 months prior to the expiration date of the current permit, unless otherwise directed. Permit renewals are then evaluated by FFSL based on current use and regulations.

1.11 River Use Class System and Maps

According to Utah Administrative Code R652-70-200, sovereign lands should be classified based on their current and planned uses. Table 1.3 lists and describes the river use classes that guide management and use on the Colorado River. River use classes are applied to specific locations along the Colorado River based on adjacent landownership and uses. Other parameters such as existing authorizations, environmental factors, county and municipal zoning adjacent to the Colorado River, and established deed restrictions or conservation easements are also considered. Table 1.3 also describes the specific parameters used to designate river use classes along the Colorado River. The distribution of river use classes by river segment in percentages is found in Chapter 2, Table 2.1.

Table 1.3. Classification of Sovereign Lands along the Colorado River

River Use Class*	Description*	Example along the Colorado River	Percentage Based on Acreage of each Class	Parameters
Class 1	Manage to protect existing resource development uses	Authorized boater access points, campgrounds, bridges	2%	Areas with existing authorizations Areas with existing development
Class 2	Manage to protect potential resource development options	None	0%	Areas with established, permanent structures without a current easement from FFSL
Class 3	Manage as open for consideration of any use	Red Cliffs Lodge, Sorrel River Ranch Resort	7%	Areas of private land Areas zoned for commercial, industrial, residential, or development
Class 4	Manage for resource inventory and analysis	Class 4 is not applied to the CRCMP planning area.		
Class 5	Manage to protect potential resource preservation options	Westwater Canyon Wilderness Study Area	18%	BLM land Potential wild and scenic river corridors Wilderness study areas Areas zoned open space Conservation of agricultural uses
Class 6	Manage to protect existing resource preservation uses	Areas adjacent to Arches National Park, the Scott M. Matheson Wetland Preserve	73%	Local, county, state, or federal conservation protection areas Parcels holding conservation easements Conservation of cultural resources such as national scenic and historic trails

* Data from Utah Administrative Code R652-70-200.

Examples of how specific classes and uses were assigned to the river system based on current and potential use are found on Figures 1.5 and 1.6, respectively. For example, areas along the river with existing, permitted utilities, boater access points, roads, and diversion canals (items 1, 6, 12, and 15 on Figure 1.6) are considered Class 1 reaches of the river. Segments of the river that are adjacent to private land or may have commercial or industrial uses are considered Class 3 areas (item 13 on Figure 1.6). Finally, reaches of the river associated with agricultural uses or zoned open space (items 3, 4, and 5 on Figure 1.6) and that warrant protection of cultural resources or are afforded legal conservation protection (items 9 and 10 on Figure 1.6) are considered Class 5 and Class 6 areas, respectively. For the purposes of illustration, Figures 1.5 and 1.6 show multiple river use classes and uses in a small area. In practice, river use classes and uses are usually not this condensed.

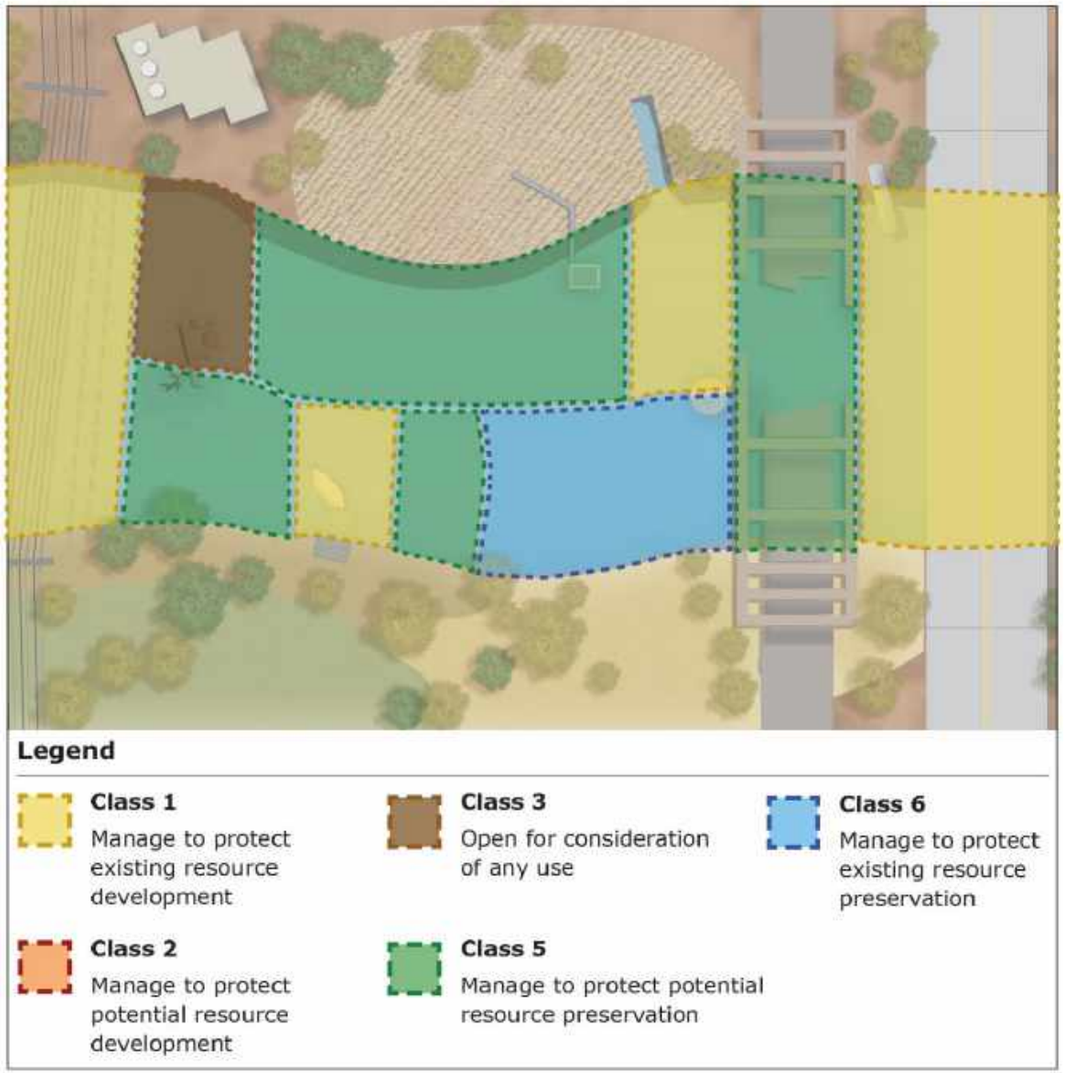


Figure 1.5. Colorado River plan view showing conceptual river use classes.

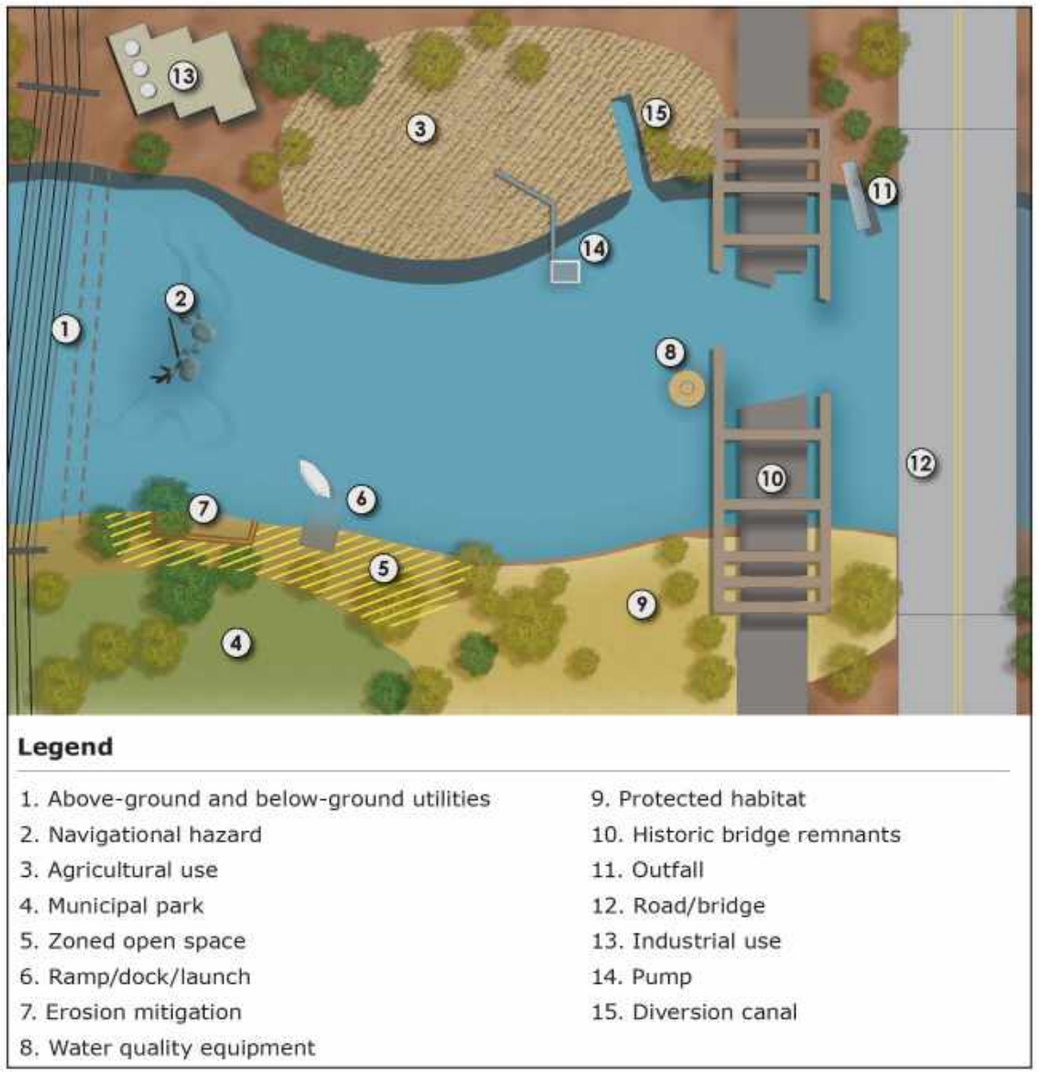


Figure 1.6. Colorado River plan view showing conceptual river uses.

Segments of the river that are associated with agriculture are zoned Class 5 and are managed to protect potential resource (agriculture) preservation options. This classification was selected because agriculture is a key economic activity; is of regional and state-wide importance; and informs the history, lifestyle, and culture of particular areas (e.g., Colorado River). In addition, zoning agricultural areas as Class 5 helps protect important habitat for wildlife species.

Where Table 1.3 lists the river use classes, Figure 1.8—a map book of the Colorado River made up of 18 individual maps—shows the reader the specific locations of these river use classes along the sovereign land segments of the Colorado River. Figure 1.7 provides a map book index showing the entire planning area. Note: Some river use class locations, e.g., Class 1, can be difficult to see because of their width and the scale at which the map book is made. In addition, the Glen Canyon river segment is shown at a different scale than the remainder of the river segments because it has only one class. For the most accurate view of all river use class locations, please use the GIS spatial data viewer available on the FFSL website.

Further Reading

Green River Comprehensive Management Plan (SWCA Environmental Consultants et al. 2020)

Guide to the Colorado & Green Rivers in the Canyonlands of Utah & Colorado (Martin and Whitis 2016)

Fact Sheet. Overview of the Moab UMTRA Project (U.S. Department of Energy 2018)

Putting the Public Trust Doctrine to Work: The Application of the Public Trust Doctrine to the Management of Lands, Waters and Living Resources of the Coastal States (Slade et al. 1997)

GIS Data Layers

FFSL Authorizations, Landownership, Political Boundaries, River Miles, River Segments, River Use Classes, Sovereign Lands of the Colorado River, Zoning

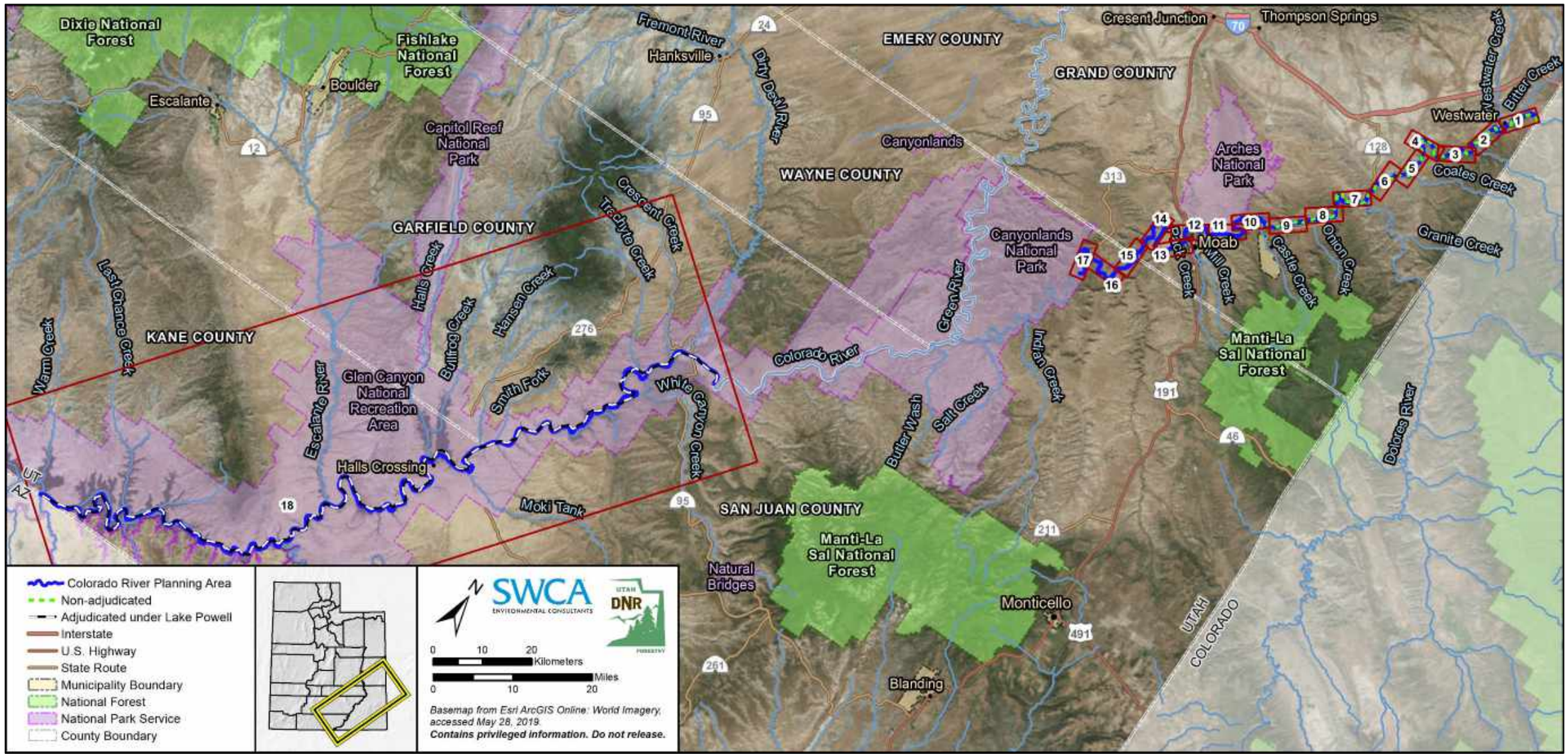


Figure 1.7. River use classes map book index for the Colorado River Comprehensive Management Plan planning area.

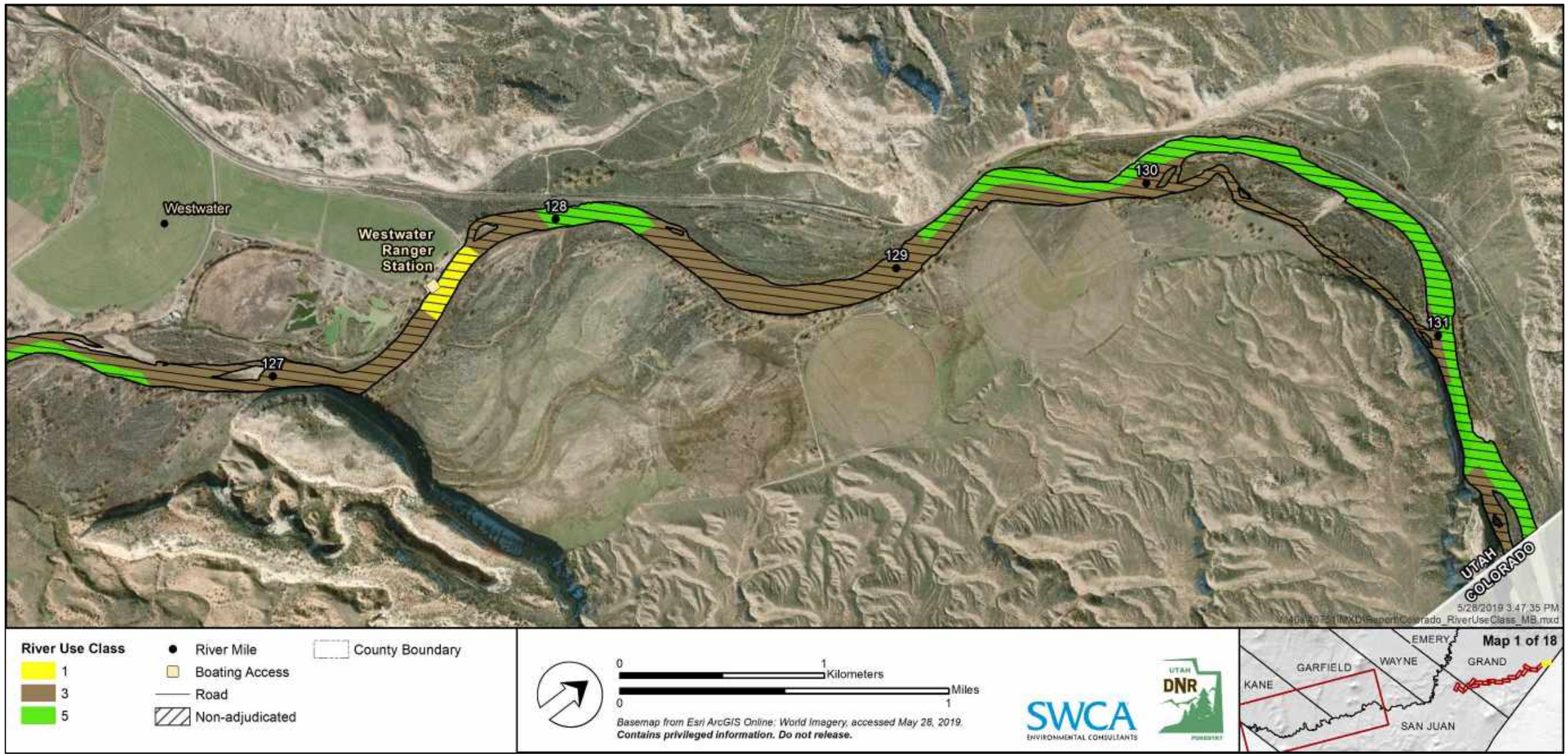


Figure 1.8. River use classes for the Colorado River, Map 1 of 18.

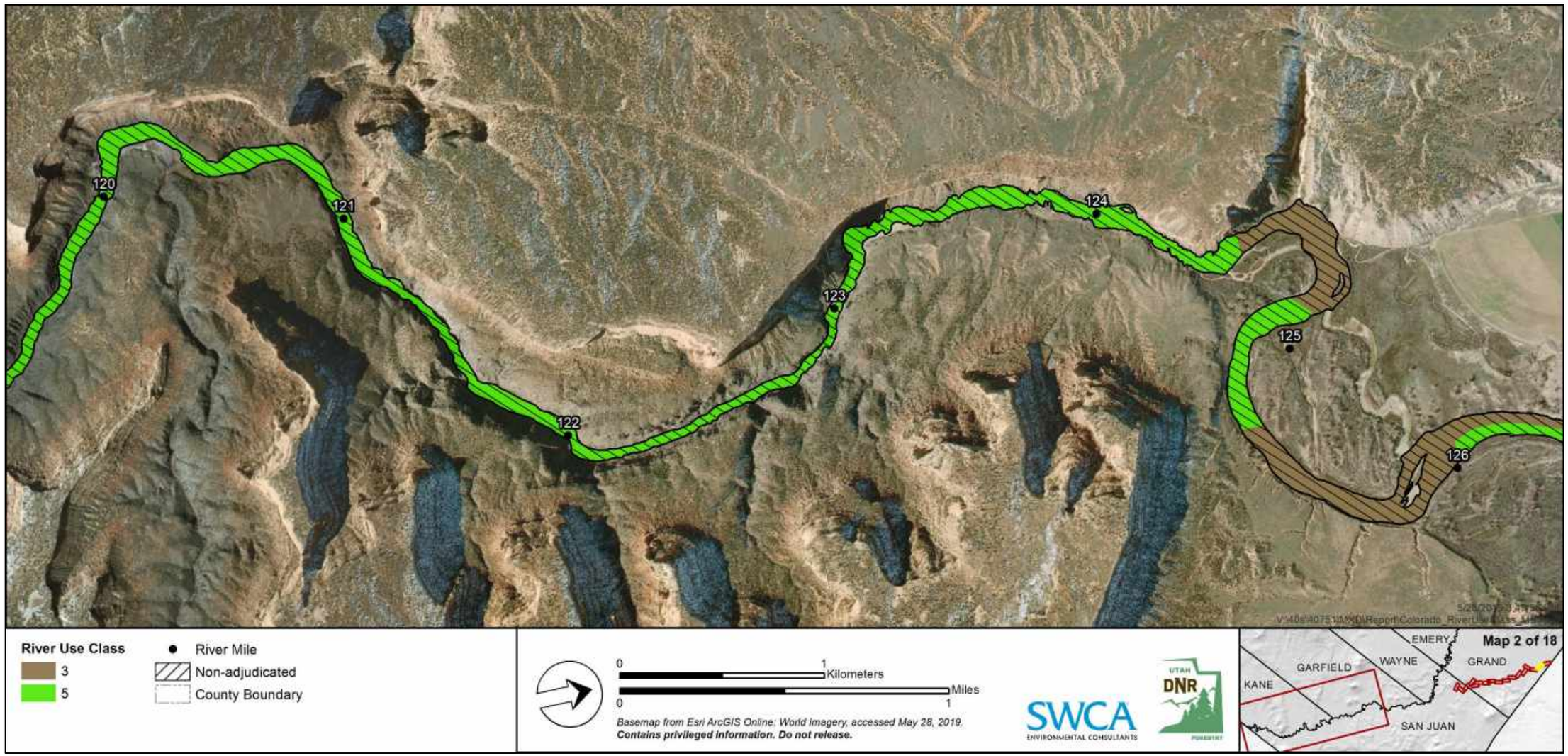


Figure 1.9. River use classes for the Colorado River, Map 2 of 18.

Figure 1.10. River use classes for the Colorado River, Map 3 of 18.

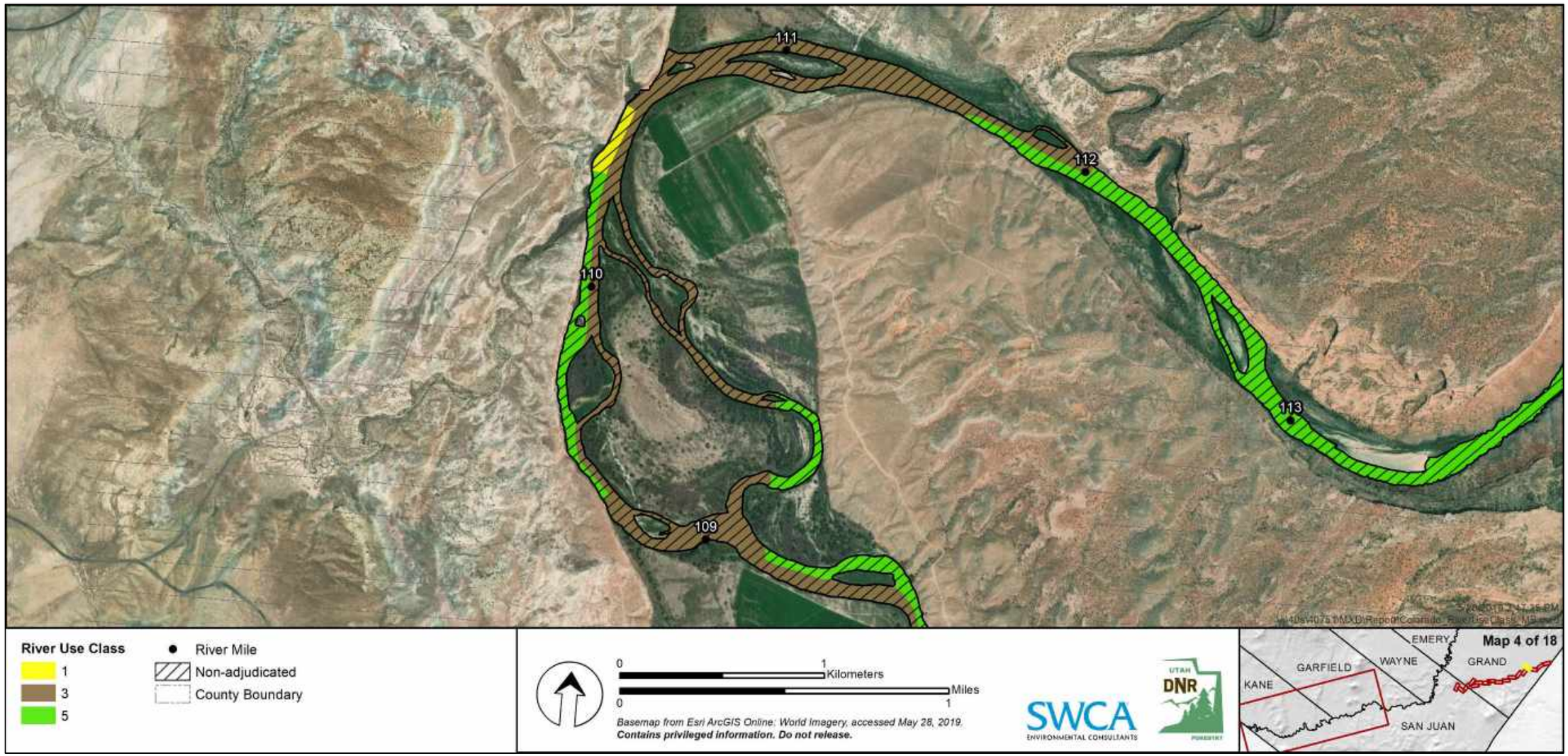


Figure 1.11. River use classes for the Colorado River, Map 4 of 18.

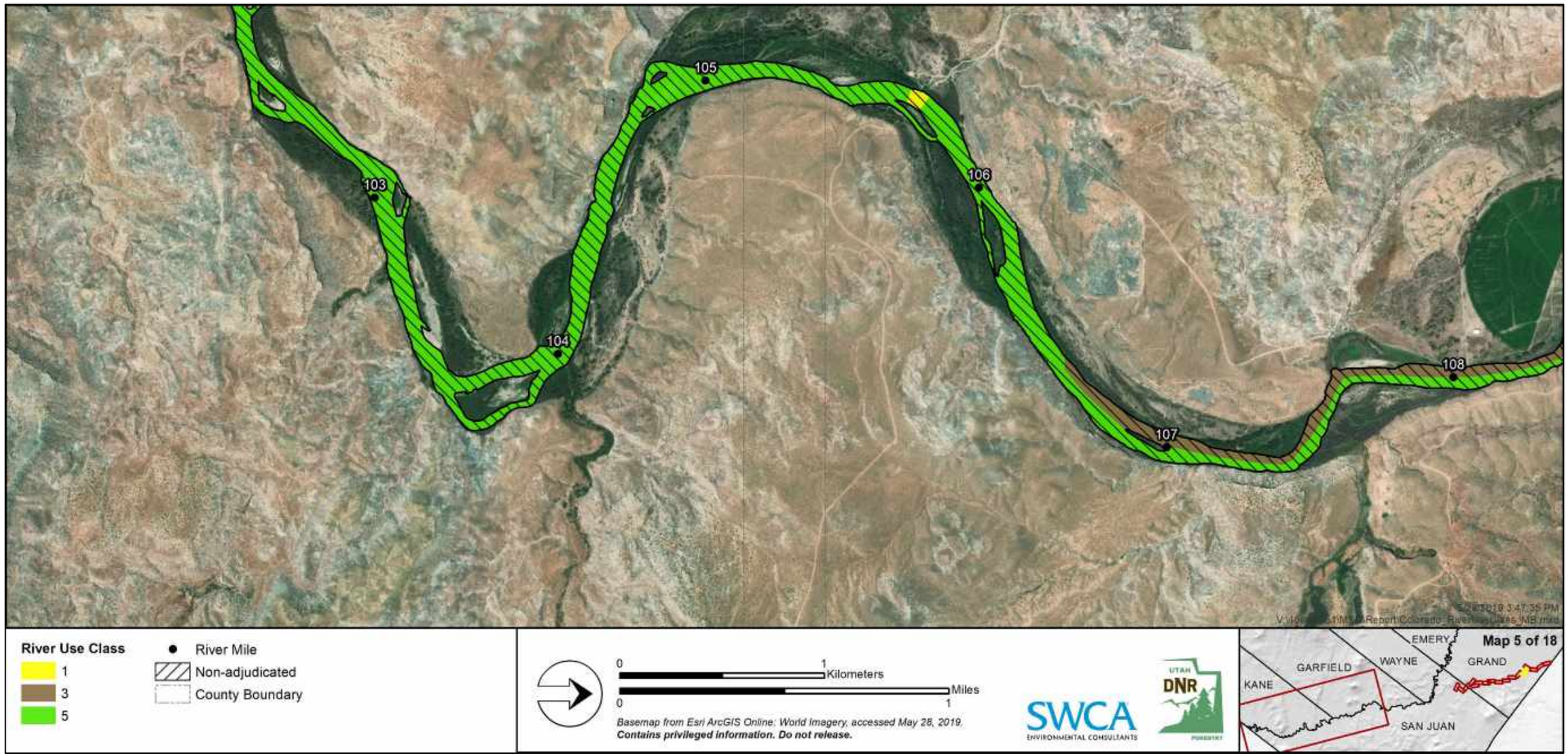


Figure 1.12. River use classes for the Colorado River, Map 5 of 18.

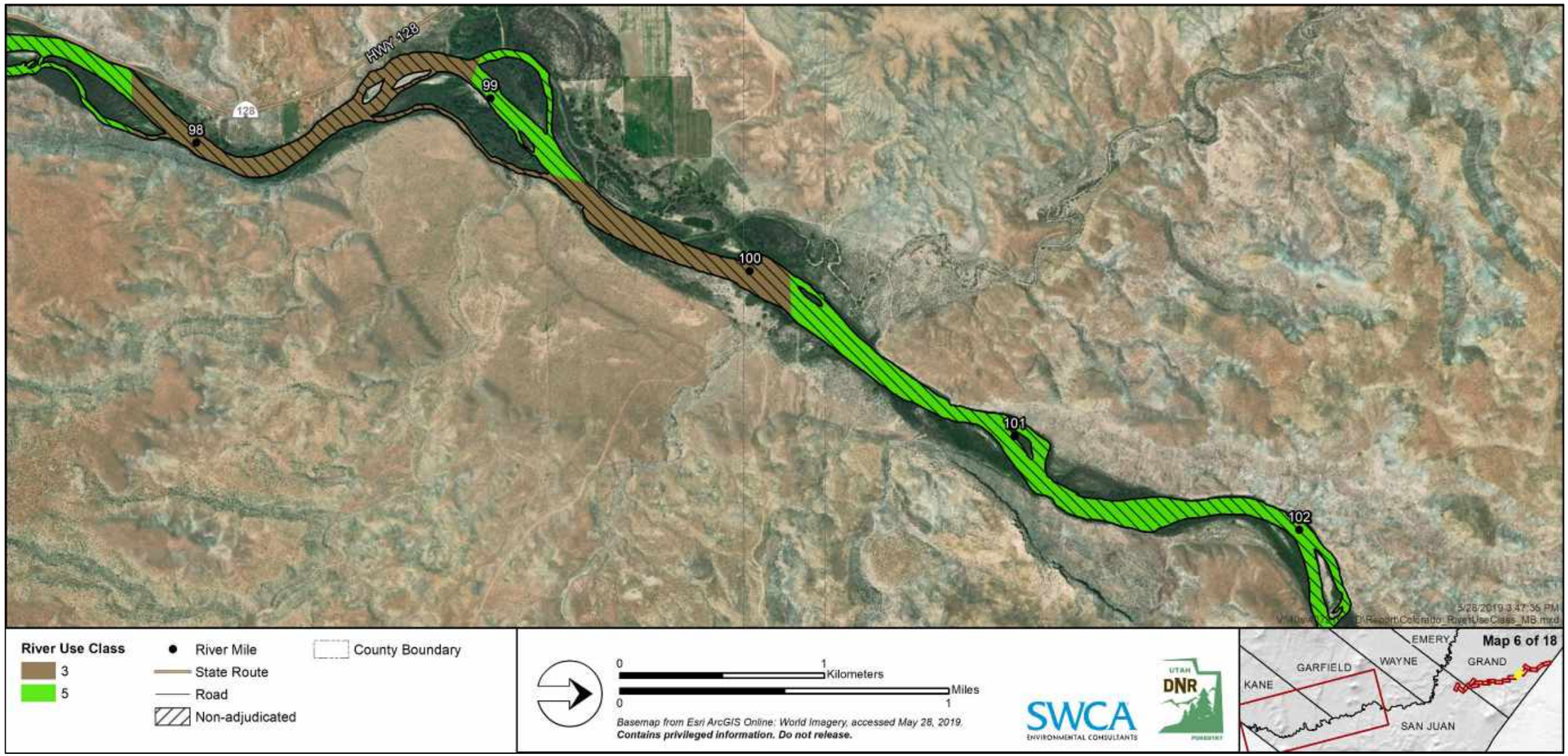


Figure 1.13. River use classes for the Colorado River, Map 6 of 18.

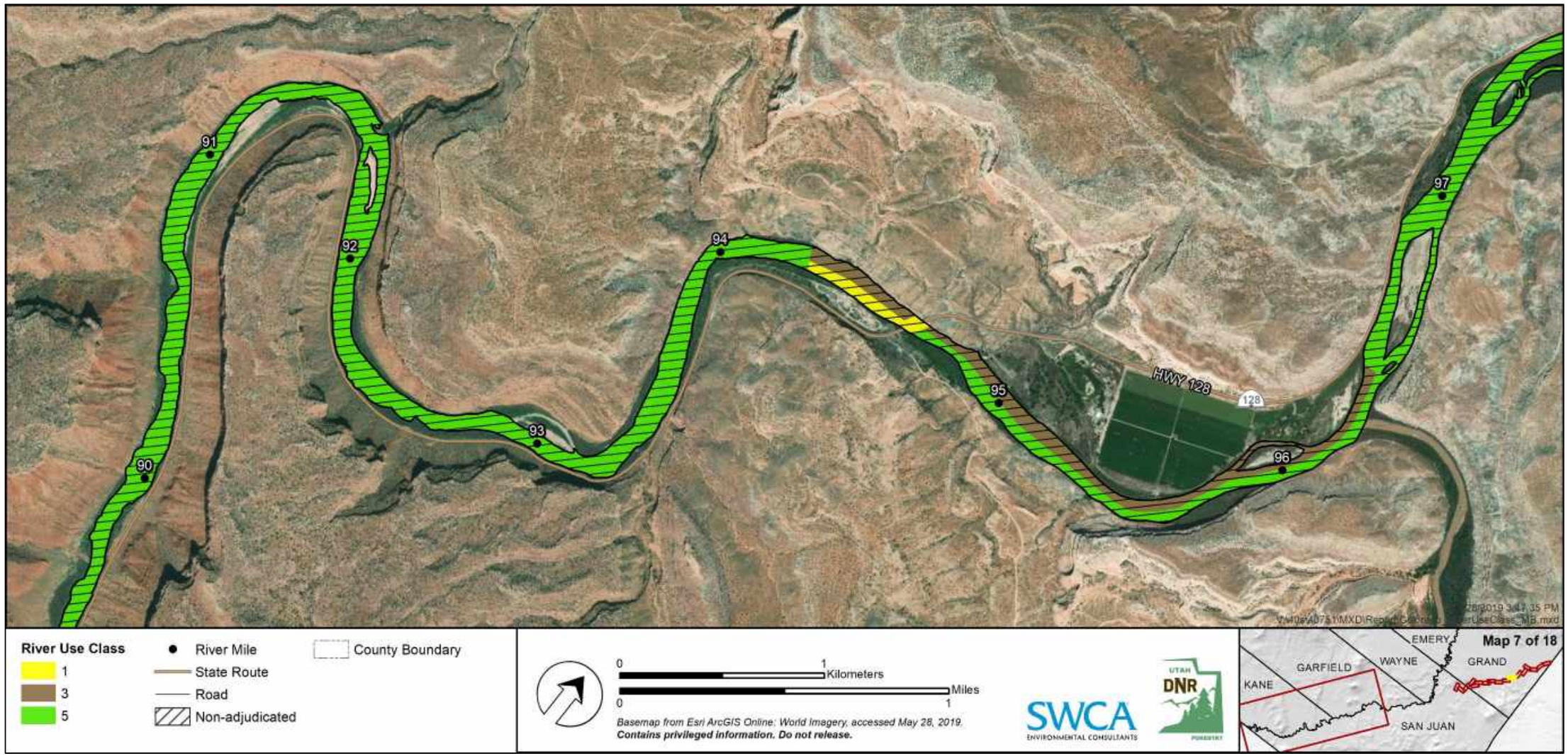


Figure 1.14. River use classes for the Colorado River, Map 7 of 18.

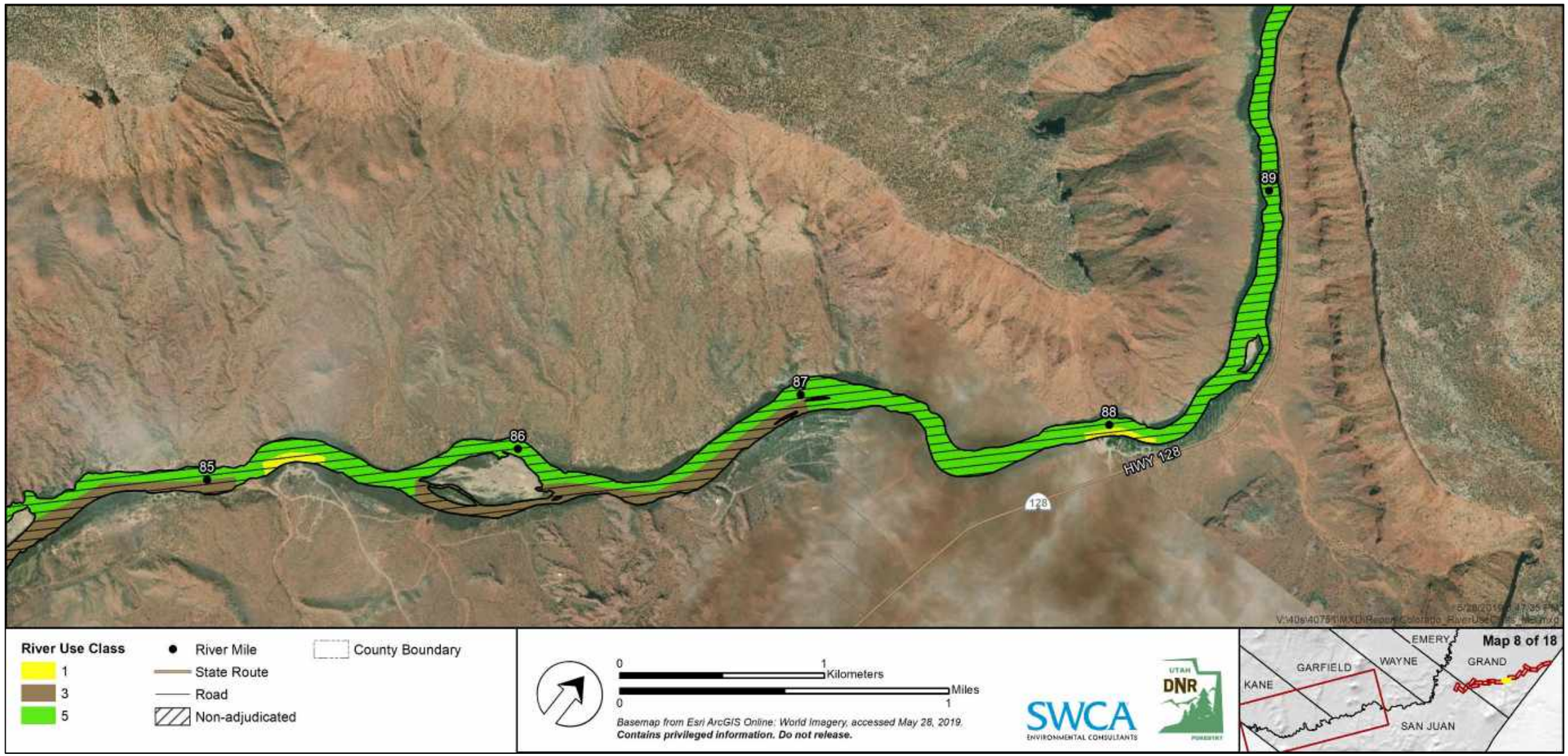


Figure 1.15. River use classes for the Colorado River, Map 8 of 18.

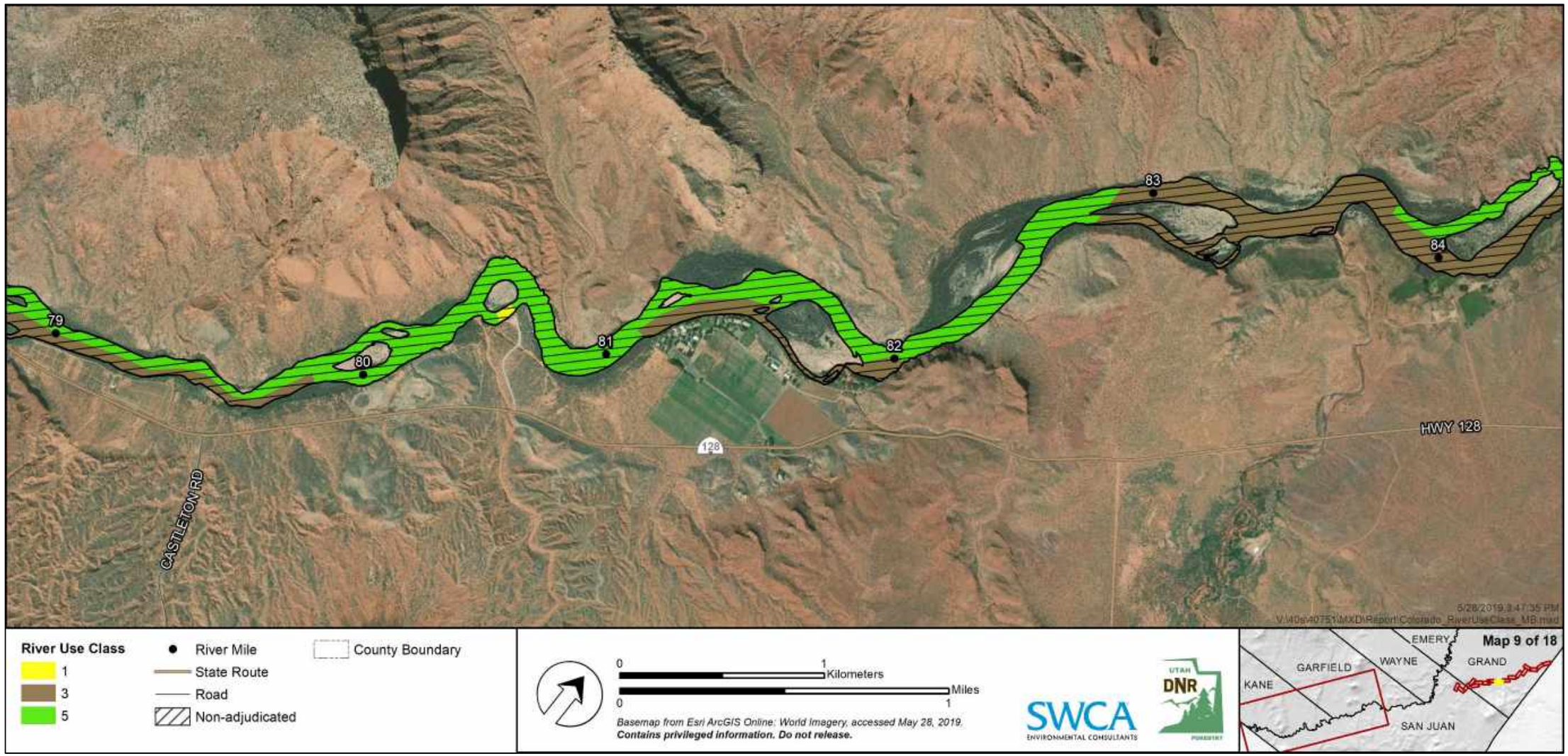


Figure 1.16. River use classes for the Colorado River, Map 9 of 18.

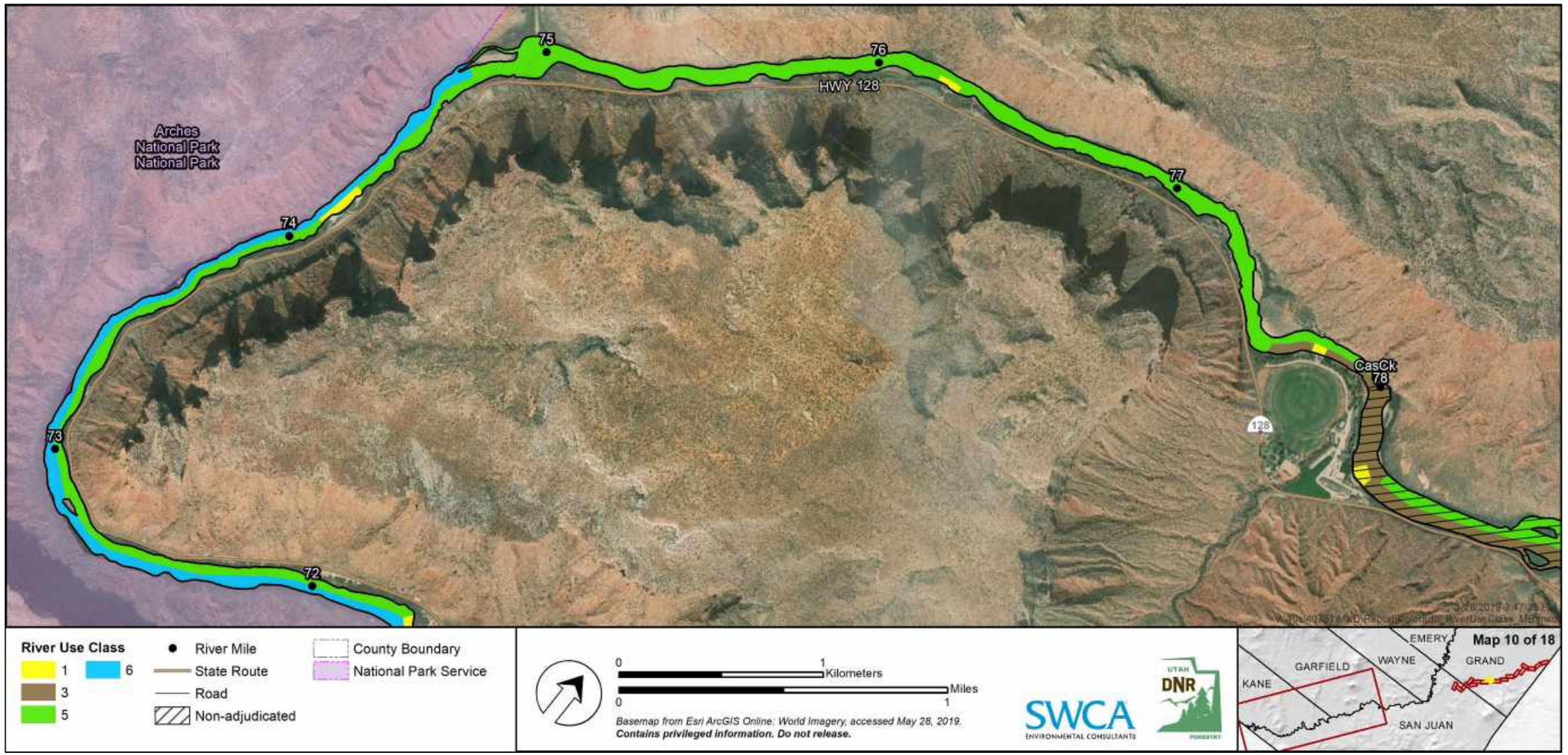


Figure 1.17. River use classes for the Colorado River, Map 10 of 18.

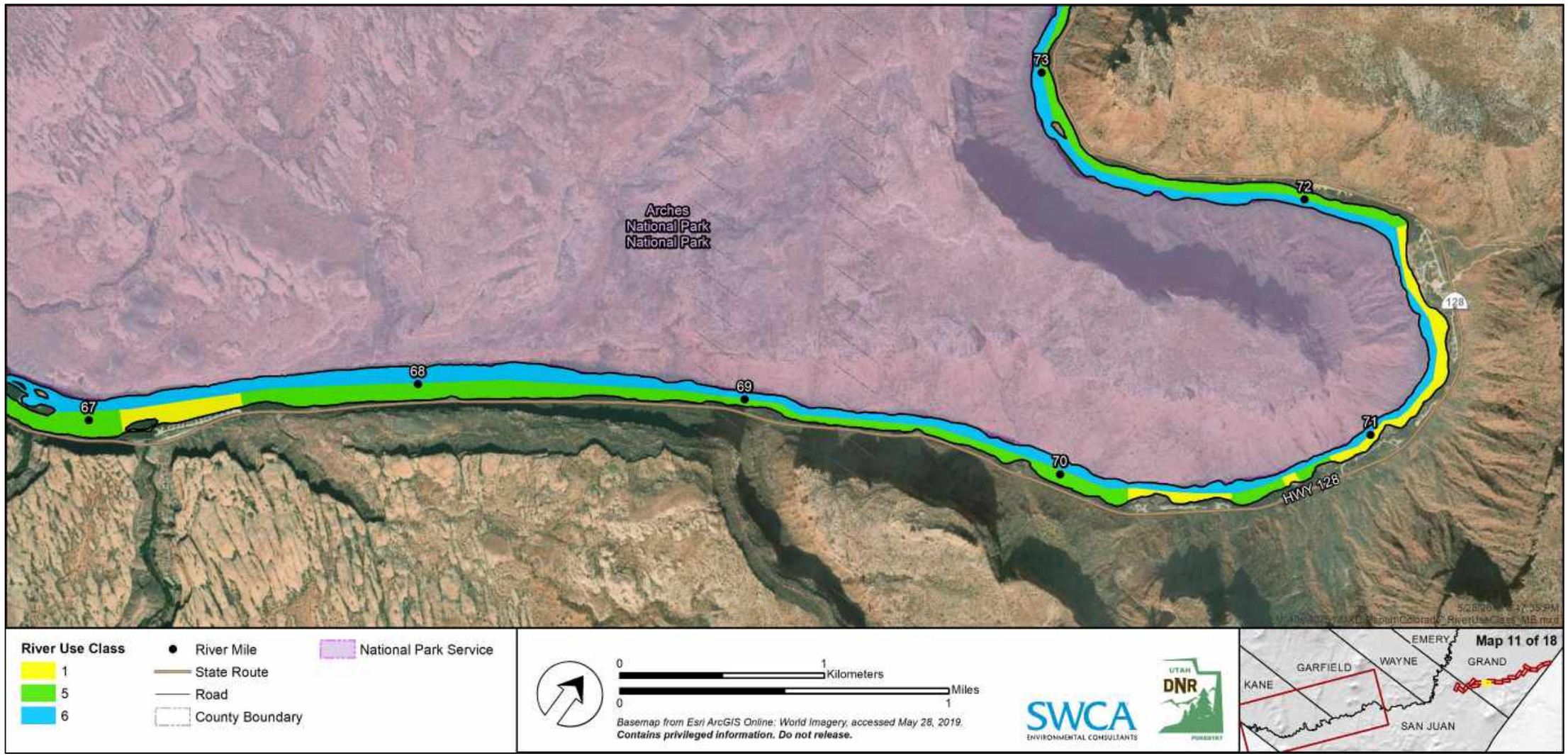


Figure 1.18. River use classes for the Colorado River, Map 11 of 18.

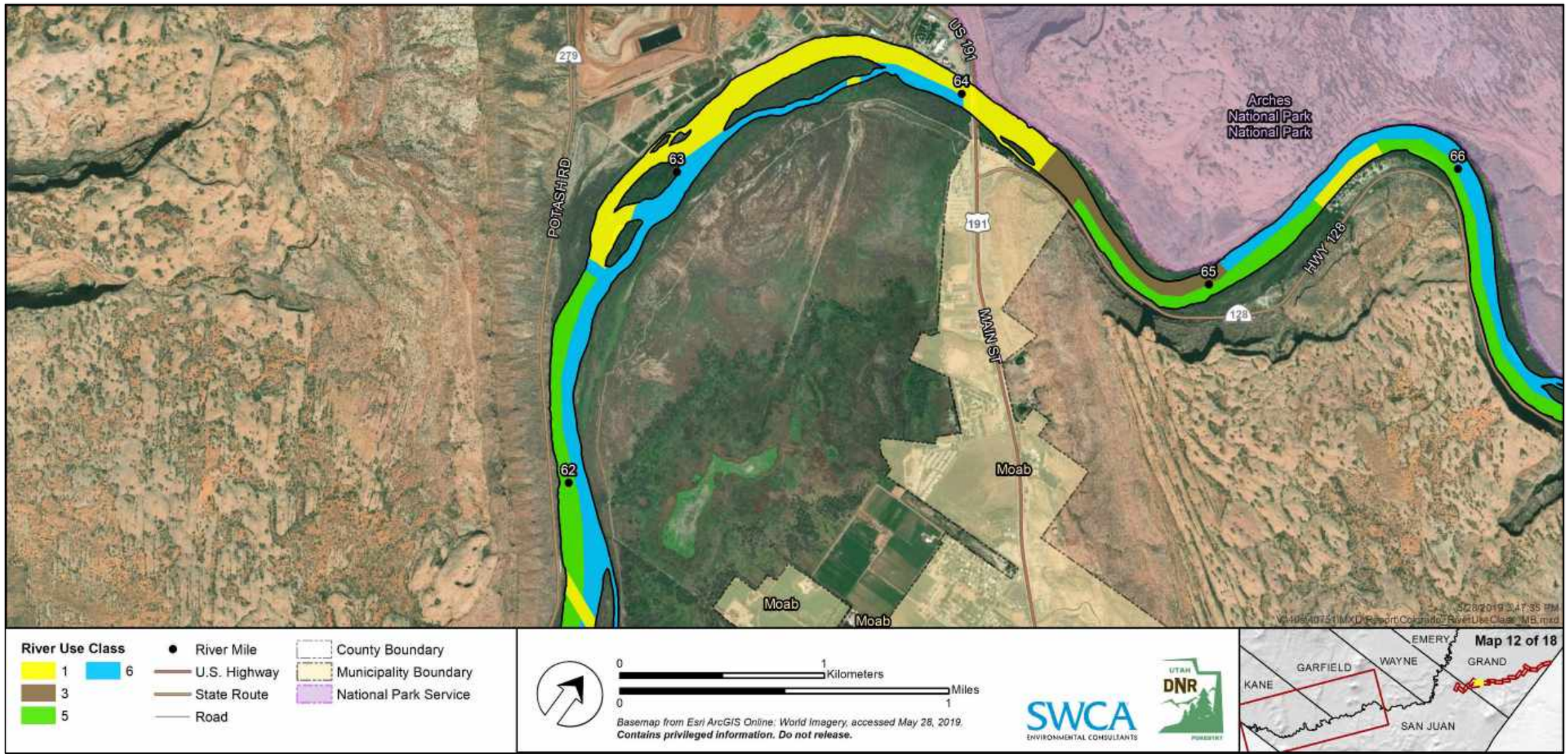


Figure 1.19. River use classes for the Colorado River, Map 12 of 18.

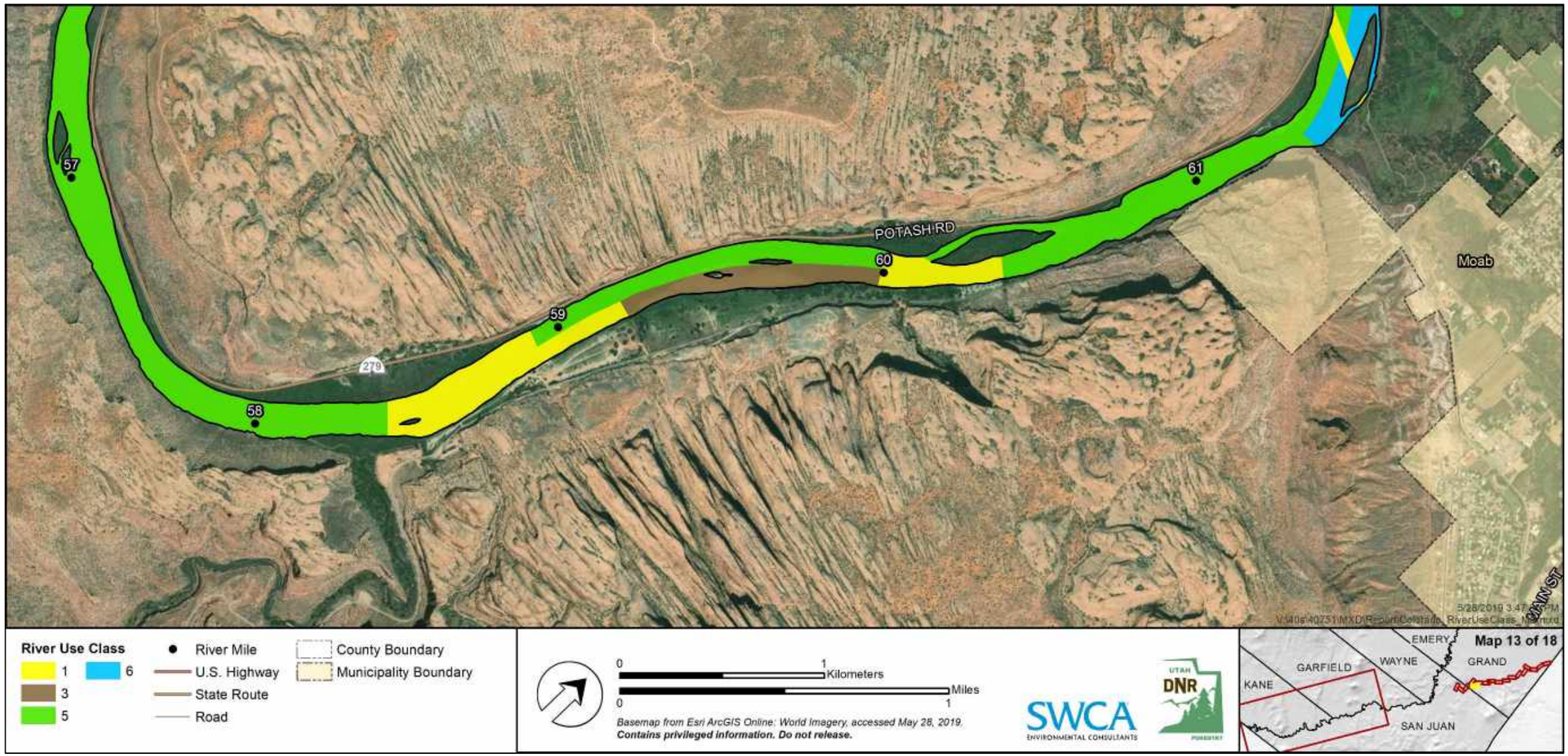


Figure 1.20. River use classes for the Colorado River, Map 13 of 18.

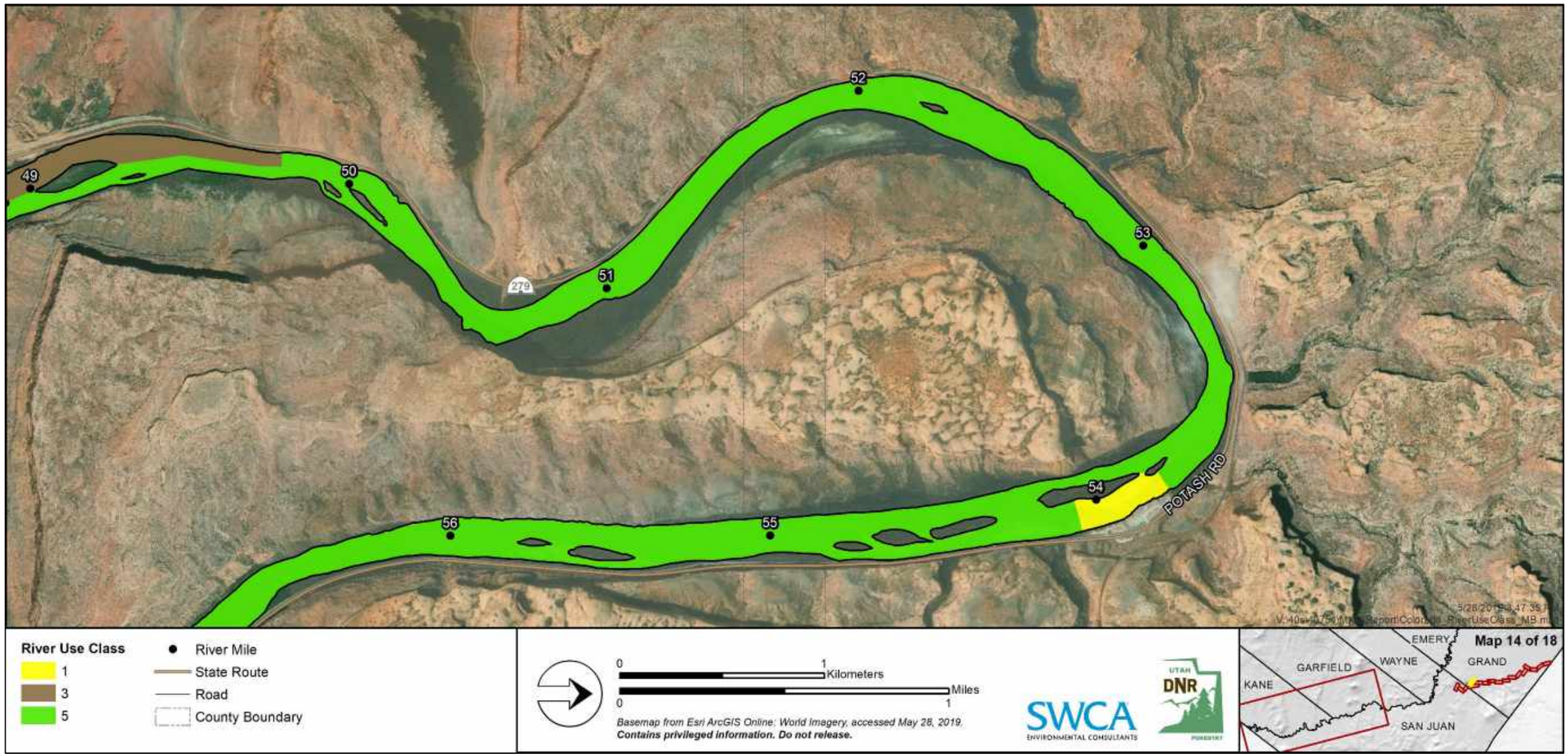


Figure 1.21. River use classes for the Colorado River, Map 14 of 18.

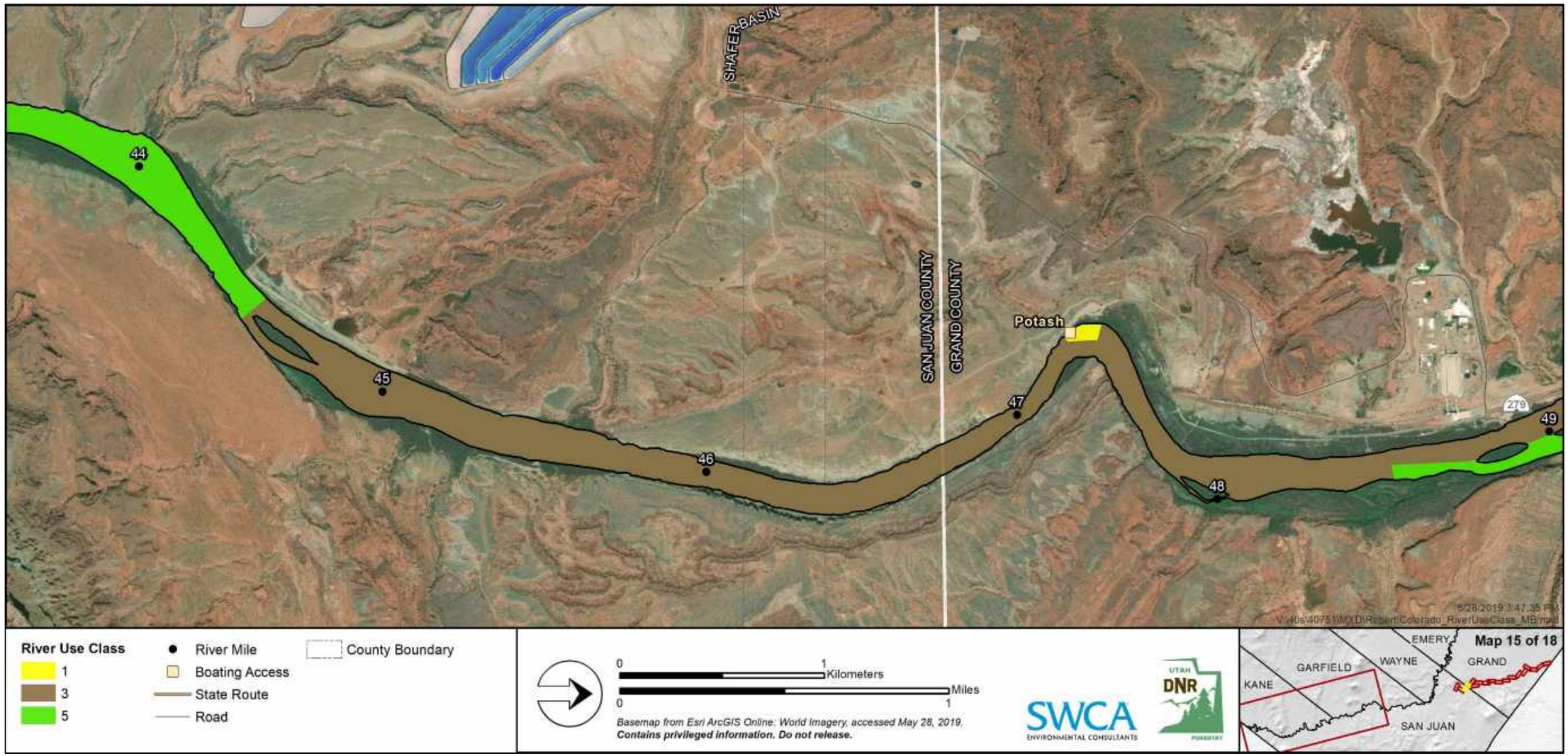


Figure 1.22. River use classes for the Colorado River, Map 15 of 18.

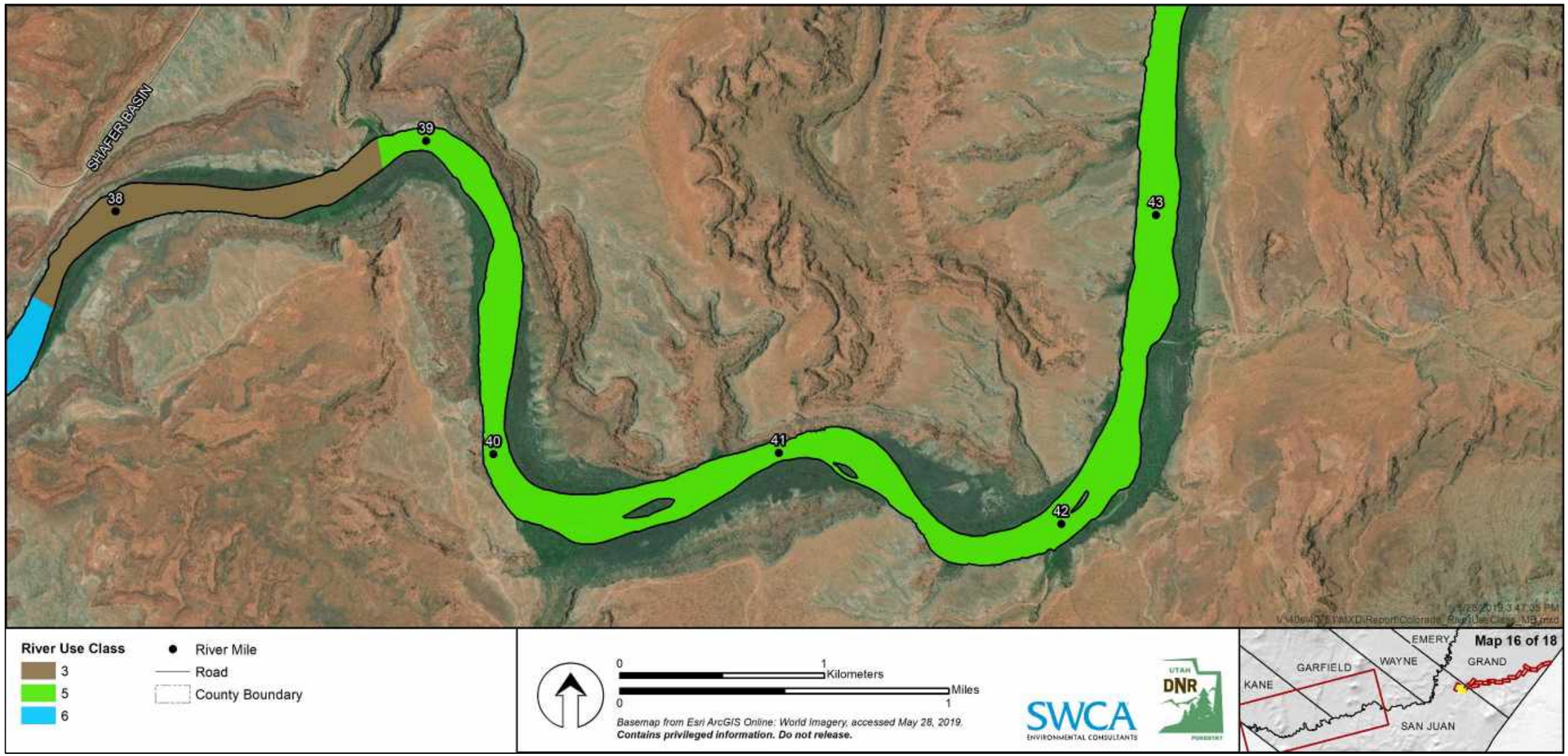


Figure 1.23. River use classes for the Colorado River, Map 16 of 18.

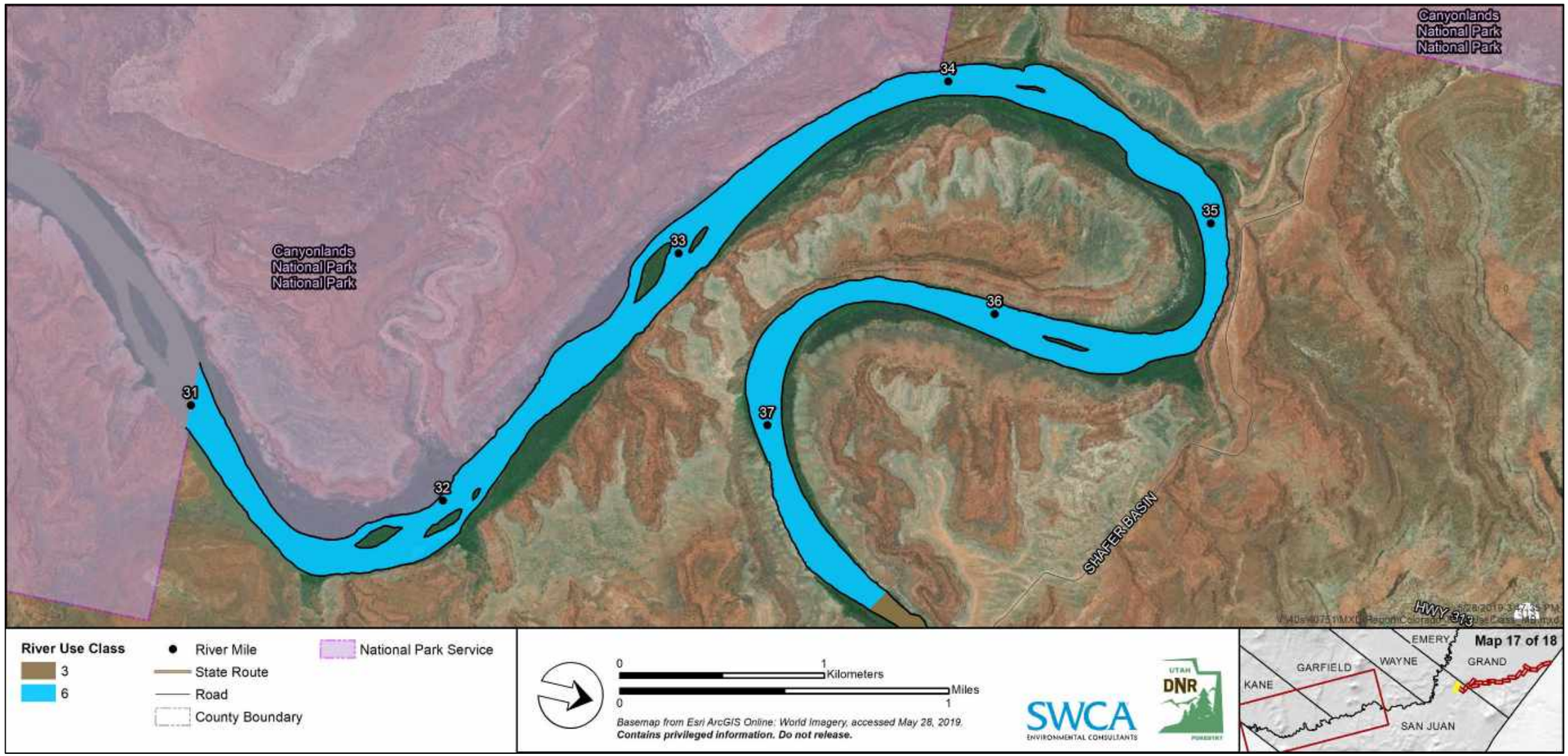


Figure 1.24. River use classes for the Colorado River, Map 17 of 18.

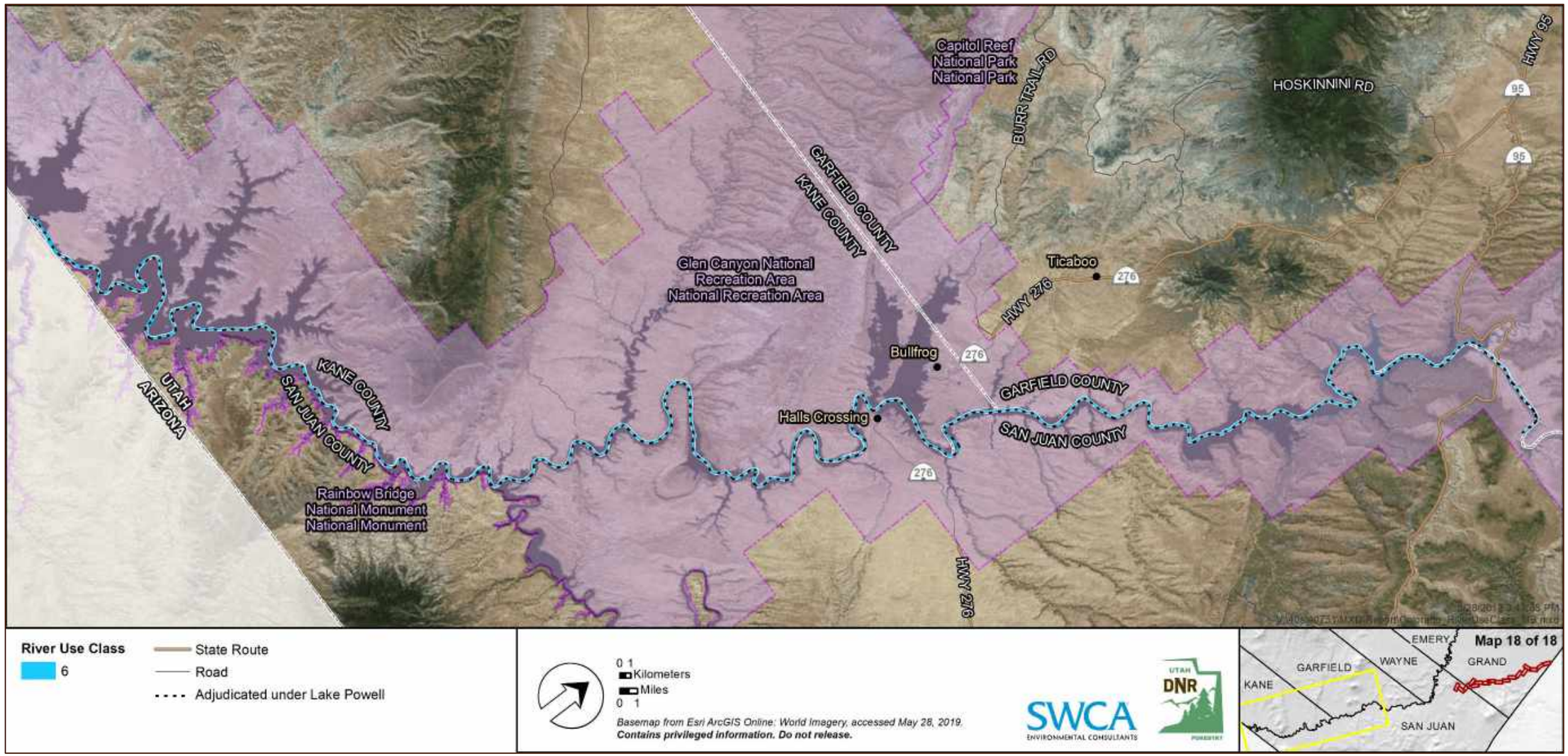
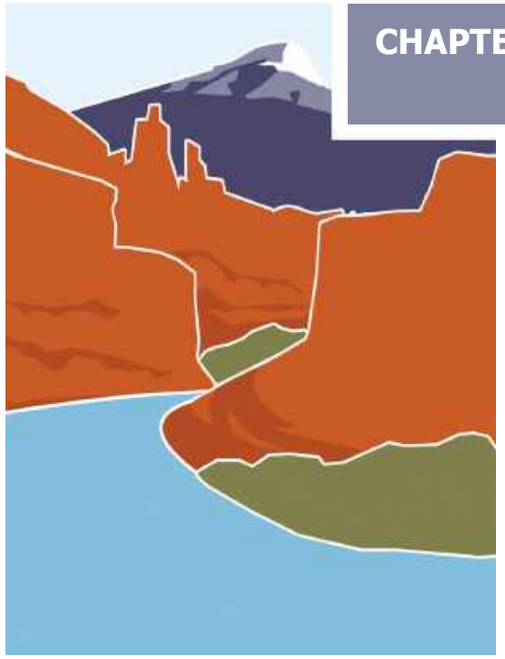


Figure 1.25. River use classes for the Colorado River, Map 18 of 18.



CHAPTER 2 – CURRENT CONDITIONS

2.1 Introduction

The Colorado River flows for approximately 1,450 miles from its headwaters in the Rocky Mountains of Colorado through Utah, Arizona, Nevada, and California, then south into Mexico where it empties into the Gulf of California (American Rivers 2017). As the sixth-longest river in the nation, the Colorado River flows through 11 national parks and monuments, including Grand Canyon National Park, which is on the United Nations Educational, Scientific and Cultural Organization list of world heritage sites (American Rivers 2017). The Colorado River is one of the siltiest rivers in the world, with a drop of almost 13,000 feet, which is unparalleled in North America (Reisner 1987).

The Colorado River basin spans approximately 246,000 square miles and drains watersheds from seven western states (U.S. Geological Survey [USGS] 2016a). The river is a critical water supply for agriculture, industry, and many municipalities, and it is one of the most legislated, most debated, and most litigated rivers in the world (American Rivers 2017; Reisner 1987). The river supplies water to more than 30 million people and irrigates nearly 4 million acres of cropland in the United States and Mexico. It also supplies hydropower plants that generate more than 10 billion kilowatt-hours of energy annually (USGS 2016a). In addition, it supports a diversity of fish, wildlife, and their habitats, and is a recreational draw for fishing, whitewater paddling, boating, backpacking, hiking, and other activities (American Rivers 2017; USGS 2016b).

In Utah, the Colorado River runs in a southwesterly direction and has two major tributaries, the Green and the San Juan Rivers, with smaller sources flowing in from the east and west (e.g., the Dolores and Dirty Devil Rivers). In prehistoric times, the Colorado River formed a permeable boundary between the Ancestral Pueblo populations to the south and east and the Fremont and western Ancestral Pueblo populations to the northwest and west, respectively (McPherson 1994). Petroglyphs adjacent to the Colorado River that are believed to be made by the Fremont are shown in Figure 2.1. The Ancestral Pueblo farmed tributary canyons and alluvial bottom lands and created a system of trails that crossed the San Juan and Colorado Rivers. Some of these trails were later used by Spanish and Anglo-Americans during the exploration and settlement of the West. Historic Native American groups living along the Colorado River include the Paiute in southwestern Utah, the Ute in southeastern Utah, and the Navajo south and east of the confluence of the San Juan and Colorado Rivers (McPherson 1994).

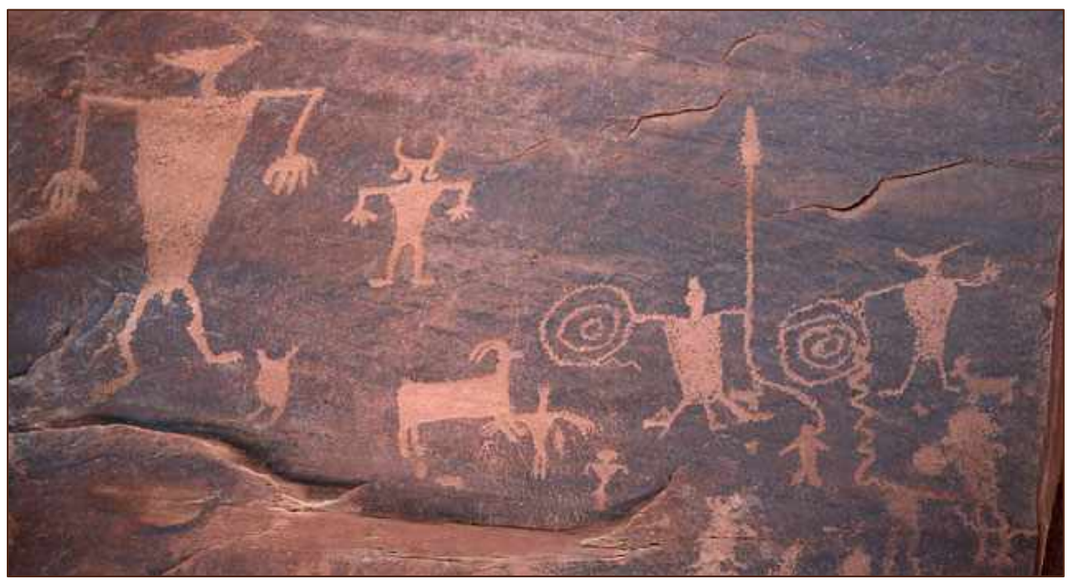


Figure 2.1. Petroglyphs believed to be made by the Fremont people along the Potash Road adjacent to the Colorado River.

Photograph by Robert Riberia. Used with permission.

The Spaniards provide the first documented information about the Colorado River, giving it names such as El Rio de Cosninas, de San Rafael, and de Tizon. Various Spanish parties encountered the river, including the Dominguez-Escalante expedition in Utah in 1776 (McPherson 1994). In the 1820s and 1830s, Euro-American mountain men such as Jedediah Smith trapped parts of the Colorado. Although these men explored sections of the river, it was not until 1869 that John Wesley Powell's expedition mapped the water's course from Green River, Wyoming, through the current Grand Canyon, to the confluence of the Colorado and Virgin Rivers in present-day Nevada (McPherson 1994). Despite a series of setbacks, including losses of boats and supplies, near-drownings, and the eventual departures of several expedition members, Powell's journey produced the first detailed descriptions of much of the previously unexplored Colorado Plateau canyon country. In an excerpt from *The Exploration of the Colorado River and Its Canyons*, John Wesley Powell (shown in Figure 2.2) recounts exploring a section of the Colorado River in 1869:

> July 23 - On starting, we come at once to difficult rapids and falls, that in many places are more abrupt than in any of the canyons through which we have passed, and we decide to name this Cataract Canyon. From morning until noon the course of the river is to the west; the scenery is grand, with rapids and falls below, and walls above, beset with crags and pinnacles…Our way after dinner is through a gorge, grand beyond description. The walls are nearly vertical, the river broad and swift, but free from rocks and falls. From the edge of the water to the brink of the cliffs it is 1,600 to 1,800 feet. At this great depth the river rolls in solemn majesty. (Powell 1961)

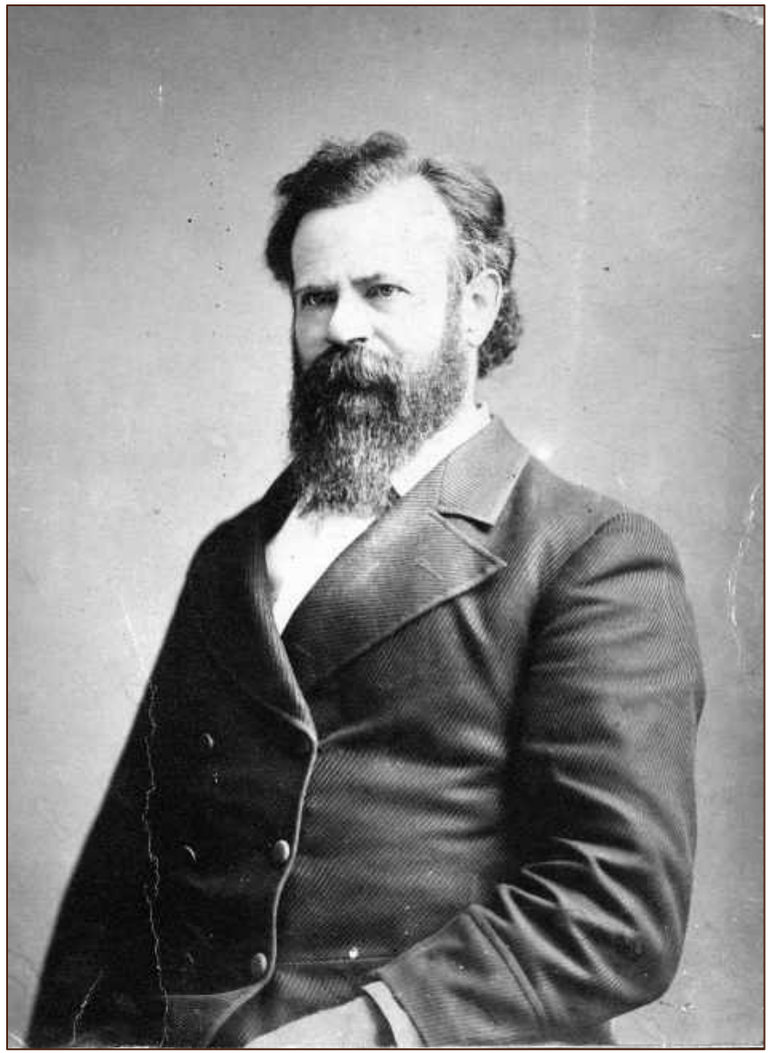


Figure 2.2. John Wesley Powell at age 40.

Photograph public domain.

Many early Utahns crossed or visited the Colorado River; however, few stayed, with the exception of Moab where calm waters and wide floodplains prevailed. In the 1890s, individual miners and companies with dredges attempted to mine gold out of the San Juan and Colorado Rivers with little success (McPherson 1994). Figure 2.3 shows the Colorado River near Moab in the early twentieth century.

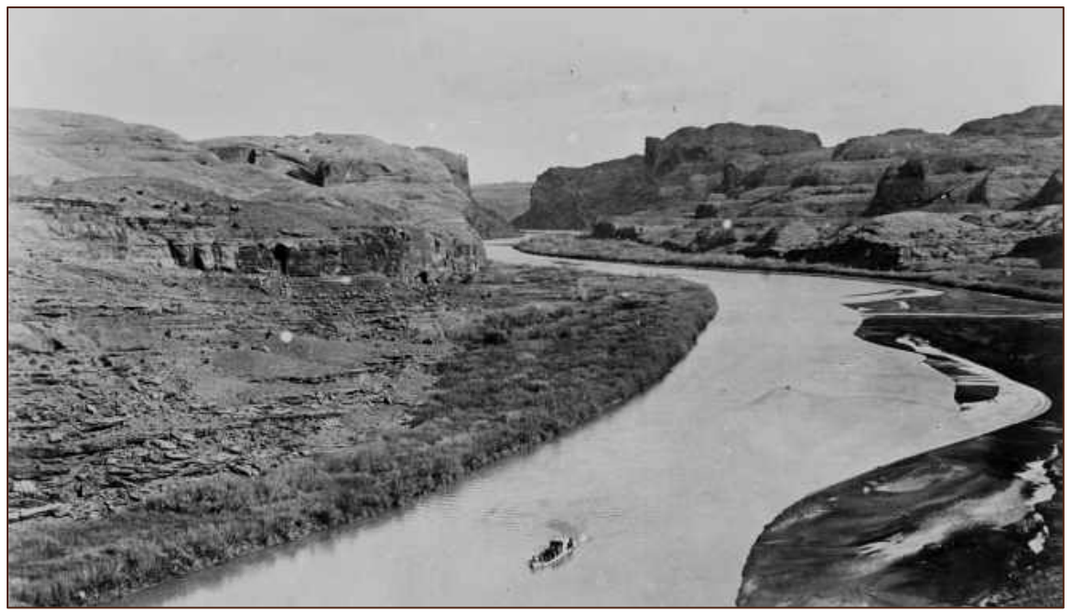


Figure 2.3. Barge or stern-wheel craft used by the Moab Garage Company on the Colorado River during the 1920s to haul freight or passengers. Photograph taken near Moab, Utah.

Photograph from the Multimedia Archives, Special Collections, J. Willard Marriott Library, University of Utah. Used with permission.

In 1922, the Colorado River Compact was completed by the seven states in the Colorado River basin to establish an equitable apportionment of Colorado River waters and to facilitate federal investment in dams and reclamation (Wescoat and Loeffler 2017). The river was divided at Lee's Ferry, Arizona, into the Upper Division states (Wyoming, Utah, Colorado, and New Mexico) and the Lower Division states (Arizona, Nevada, and California). The total annual flow of the Colorado River at Lee's Ferry was estimated to be 17 million acre-feet (the volume of water that would cover 1 acre to a depth of 1 foot), of which 15 million acre-feet was divided between the Upper and Lower Division states. In addition, a treaty in 1944 allocated 1.5 million acre-feet of water per year to Mexico. However, the initial estimate of Colorado River annual flow was based on an abnormally wet period, and substantially less water is actually available than the amounts specified in the agreements (Wescoat and Loeffler 2017).

The 1930s and 1940s saw the introduction of river running and tourism on the Colorado River. Norm Nevills pioneered commercial river running on the San Juan and Colorado Rivers with his company, Nevills Expedition, out of Mexican Hat, Utah (Figure 2.4) (McPherson 1994). Figure 2.5 shows the Colorado River near Moab in 1950.

The 1930s also saw the beginning of the construction of dams and other impoundments on the Colorado River and its tributaries. Boulder Dam, a multipurpose water storage project later renamed Hoover Dam, was completed in 1936 and created Lake Mead. The Colorado River system was the first in which the concept of a multipurpose dam (e.g., hydroelectric power development, irrigation, flood control, recreation, and navigation) was employed. Many development projects have since been undertaken on the Colorado River and its tributaries, including Glen Canyon (Figure 2.6), Parker, Imperial, Davis, and Morelos Dams on the Colorado; Flaming Gorge Dam on the Green River; Aspinall Unit on the Gunnison River; Navajo Dam on the San Juan River; and water diversion projects such as the Colorado-Big Thompson Project in the upper basin of the Colorado River (Wescoat and Loeffler 2017). Dams have had direct impacts on the biological, chemical, and physical properties of the Colorado River, including the alteration of sediment transport and changes to water temperatures and flows.

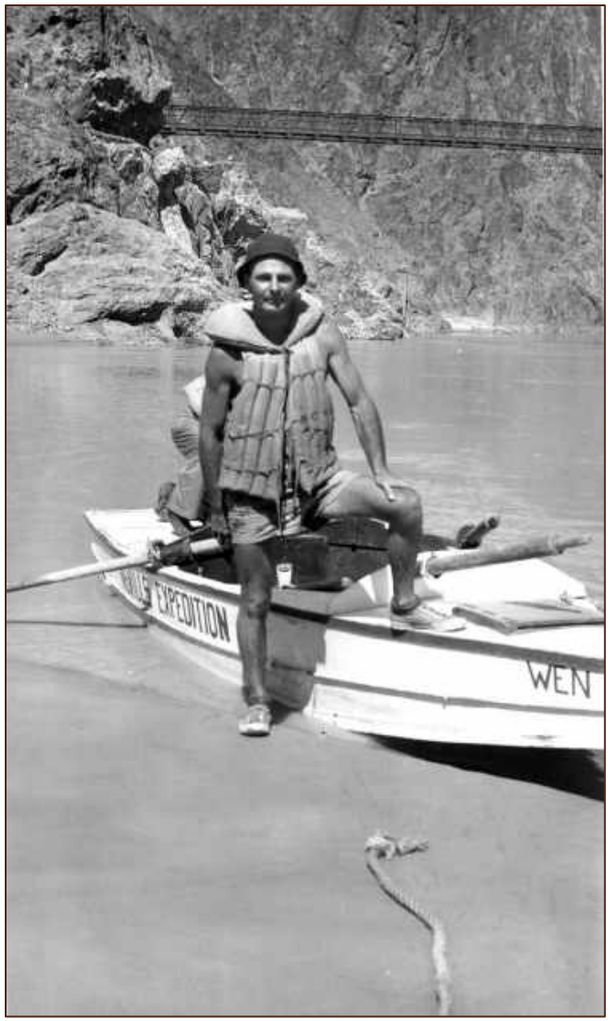


Figure 2.4. Norman Nevills, July 1947.

Photograph from the National Park Service.

Figure 2.5. The Colorado River in 1950 near the present-day location of the U.S. Route 191 crossing at the north end of Moab.

Photograph from Herb Ringer. Used with permission by Jim Stiles.

Figure 2.6. Glen Canyon Dam and Lake Powell reservoir.
Photograph from the U.S. Bureau of Reclamation.

The Colorado River where it empties into the Gulf of California in Mexico is often dry. The river is heavily managed and stressed from over-allocation and other human impacts. Tensions continue among the Upper and Lower Division states over issues such as water allocation, interstate water marketing, drought management, the potential effects of climate change, Native American water rights, and reservoir management (Wescoat and Loeffler 2017).

The Plan

The CRCMP focuses specifically on FFSL's mandate to manage state sovereign lands associated with the Colorado River, but it implicitly includes recognition of the national and international value of the larger Colorado River corridor and watershed.

This chapter provides a description of current conditions on Colorado River sovereign lands and is divided into four resource sections: Ecosystem Resources; Water Resources; Geology, Paleontology, Oil and Gas, and other Mineral Resources; and Community Resources. The current conditions reported here are based on best available data. FFSL recognizes that a management document cannot be a complete inventory of all information, and that there are still gaps in our understanding of the Colorado River. Where applicable, the CRCMP calls out additional reading under each specific section in "Further Reading" boxes. For example, stakeholders who wish to know more about important habitats can reference the *Utah Wildlife Action Plan* (Utah Wildlife Action Plan Joint Team 2015), whereas readers interested in the effects of land use on water quality can review the *Riparian Buffer Design Guidelines for Water Quality and Wildlife Habitat Functions on Agricultural Landscapes in the Intermountain West* (Johnson and Buffler 2008).

Information in this chapter offers a framework for developing management goals and objectives and, in that sense, is more relevant than other available information. As new data appear and management strategies change, the CRCMP can be updated accordingly. Planning documents like this typically provide comprehensive maps illustrating the resources and data presented. Because of the length of the planning area, the number of resources, and the number of data layers, including a map book in the planning document itself for each individual resource is too cumbersome. Instead, these data are included in two online formats on the FFSL website: 1) an Esri story map and 2) GIS spatial data viewer. Both formats are discussed in detail in Chapter 1.

Finally, as an organizational construct, the Colorado River is divided into five segments. The segments are described in detail in Chapter 1 and are shown on the GIS spatial data viewer on the FFSL website. However, FFSL management decisions are more closely associated with river use classes rather than river segments. Ultimately, river segments provide a format to discuss similarities and differences in river condition, use, and local government programs such as weed management and restoration efforts. Table 2.1 provides the distribution of river use classes by segment, expressed as percentages of the total area of each segment.

Table 2.1. River Use Class Percentages by River Segment

Segment	Class 1	Class 2	Class 3	Class 5	Class 6
Above Westwater	3%	0%	52%	45%	0%
Westwater Canyon Wilderness Study Area	0%	0%	30%	70%	0%
The Moab Daily	7%	0%	21%	63%	8%
Meander Canyon	0%	0%	23%	37%	40%
Glen Canyon	0%	0%	0%	0%	100%

Note: Class 4 is not applied to the planning area.

Further Reading

A Colorado River Reader (Fleck 2000)

Cadillac Desert: The American West and Its Disappearing Water (Reisner 1987)

Colorado River. Utah History Encyclopedia (McPherson 1994)

High Wide and Handsome (Nevills 2005)

The Exploration of the Colorado River And Its Canyons (Powell 1961)

GIS Data Layers

Land Management, Landownership, Political Boundaries, River Miles, River Segments, River Use Classes, Sovereign Lands of the Colorado River

2.2 Ecosystem Resources

Wildlife Habitat

Introduction

For the purposes of the plan, the term *habitat* refers to wildlife habitat. Wildlife habitat constitutes a complex system of physical and chemical features that are necessary for a species' persistence. This complex system includes geography, elevation, water, plant and animal communities, and other environmental components that provide food and cover for individual species. The Colorado River and its adjacent lands and tributaries form a corridor that provides wildlife species with food and cover and facilitates their movement throughout the landscape. A healthy river corridor provides migration routes for wildlife to move through contiguous habitats and between fragmented habitats.

This section discusses wildlife habitats, habitat location and condition, vegetation, and restoration in the planning area. Vegetation is a critical element of wildlife habitat because healthy plant communities support the ecological integrity of wildlife habitats. Restoration is the primary management activity for enhancing, improving, and rehabilitating impaired habitats.

Habitats

The *Utah Wildlife Action Plan* was created to manage native wildlife species in Utah and their habitats to help prevent them from being listed under the ESA (Utah Wildlife Action Plan Joint Team 2015). The Colorado River planning area contains five DWR key habitats for species of greatest conservation need (SGCN) according to the *Utah Wildlife Action Plan* (Utah Wildlife Action Plan Joint Team 2015). These key habitats are aquatic-forested, aquatic-scrub/shrub, emergent aquatic, riverine, and open water. Identification of these key habitats allows river stakeholders to prioritize conservation and restoration focus areas. However, to more broadly understand the landscape context and what DWR considers to be threats to habitats, the CRCMP uses Southwest Regional Gap Analysis Project (SWReGAP) data to define the variety of cover types through which the Colorado River flows. It should be noted that SWReGAP data are intended to be used at a scale of 1:100,000 and may be less accurate for linear landscape features like the Colorado River. Using SWReGAP data, vegetation in the planning area was classified with the major land cover types predicted to occur in the planning area. Land cover types are defined as recurring groups of biological communities found in similar physical environments and influenced by similar ecological processes, such as fire or flooding (USGS 2005). Similar land cover types have been grouped together into more generic habitats, resulting in a total of nine wildlife habitats (Table 2.2).

Table 2.2. Percentages of Habitat Types Adjacent to the Planning Area by Segment

Habitat Type	Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Aquatic (DWR key habitat)*	38%	59%	57%	61%	99%
Wetland (DWR key habitat)†	9%	< 1%	3%	< 1%	0%
Riparian (DWR key habitat) ‡	24%	8%	20%	20%	0%
Agriculture	18%	< 1%	2%	0%	0%
Barren lands	2%	21%	8%	11%	1%
Developed (open space to low-intensity and medium- to high-intensity)	1%	0%	< 1%	0%	0%
Grassland	0%	0%	0%	0%	< 1%
Invasive forbland	0%	<1%	< 1%	< 1%	0%
Shrubland	8%	11%	9%	8%	< 1%

* Aquatic habitat consists of the five segments of the Colorado River planning area and adjacent open water habitat and is comparable to DWR's riverine and open water aquatic key habitats.

† Wetland habitat is comparable to DWR's emergent aquatic key habitat.

‡ Riparian habitat is comparable to DWR's aquatic-forested and aquatic-scrub/shrub key habitats.

Aquatic wildlife habitat is associated with the Colorado River itself. The remaining habitat types in the planning area were derived from SWReGAP data and National Wetlands Inventory data (USFWS 2018a), and percentages were calculated based on the cumulative length of each habitat type along the boundary the Colorado River planning area, i.e., bed and banks of the river.

Physical features and characteristic species of the nine habitats in the planning area are described and illustrated below in Figures 2-7 through 2-15. Characteristic species are listed alphabetically by common name and were developed with assistance from the CRCMP planning team. Scientific names for each characteristic species are provided in Table 2.3.

AQUATIC

Physical Features

Comprises the riverine habitat in the five segments of the planning area.

Comparable to DWR's riverine and open water aquatic key habitats.

Plant Species

Submerged aquatic vegetation includes pondweed species. Floating vegetation includes vernal water-starwort and duckweed species.

Mammal Species

Muskrat and North American beaver.

Bird Species

American coot, American white pelican, bald eagle, bank swallow, barn swallow, belted kingfisher, bufflehead, cackling goose, Canada goose, canyon wren, cliff swallow, common goldeneye, common loon, common merganser (shown here), double-crested cormorant, eared grebe, gadwall, great blue heron, green-winged teal, horned grebe, lesser black-backed gull, mallard, northern pintail, northern rough-winged swallow, northern shoveler, red-breasted merganser, ring-billed gull, rock wren, ruddy duck, snow goose, spotted sandpiper, western grebe, and white-faced ibis.

Fish Species

Nonnative fish species channel catfish, common carp, fathead minnow, largemouth bass, red shiner, sand shiner, smallmouth bass, walleye, and white sucker.

Native fish species bluehead sucker, bonytail, Colorado pikeminnow, flannelmouth sucker, humpback chub, razorback sucker, roundtail chub, and speckled dace.

Reptile and Amphibian Species

Black-necked garter snake, Great Basin spadefoot, Great Plains toad, northern leopard frog, red-spotted toad, tiger salamander, western terrestrial garter snake, and Woodhouse's toad.

Figure 2.7. Physical features and characteristic species of aquatic habitat in the planning area.

WETLAND

Physical Features

Covers approximately 1% of the length of the planning area.

Includes emergent marsh, wet meadow, and shrubby wetlands.

Comparable to DWR's emergent aquatic key habitat.

Plant Species

Common emergent and floating vegetation includes bulrush species, broadleaf cattail, arctic rush, pondweed species, knotweed species, duckweed species, common reed, and reed canarygrass.

Shrubby wetland areas typically dominated or co-dominated by willow species, mainly narrowleaf willow, and tamarisk. If an herbaceous layer is present, it is usually dominated by graminoids (grass species, sedge species, and rush species).

Mammal Species

Common raccoon, deer mouse, muskrat, western jumping mouse, and western pipistrelle.

Bird Species

American avocet, bank swallow, barn swallow, Canada goose, cliff swallow, great blue heron, killdeer, lesser black-backed gull, northern harrier, northern rough-winged swallow, northern shoveler, red-winged blackbird, ring-billed gull, savannah sparrow, snow goose, snowy egret, song sparrow (shown here), spotted sandpiper, Virginia rail, white-faced ibis, Wilson's phalarope, yellow warbler, and yellow-headed blackbird.

Fish Species

Fathead minnow and green sunfish.

Reptile and Amphibian Species

Black-necked garter snake, Great Basin spadefoot, Great Plains toad, northern leopard frog, red-spotted toad, smooth greensnake, tiger salamander, western terrestrial garter snake, and Woodhouse's toad.

Figure 2.8. Physical features and characteristic species of wetland habitat in the planning area.

RIPARIAN

Physical Features

Covers approximately 8% of the length of the planning area.

Commonly occurs as a mosaic of multiple vegetation types that are dominated by trees and have a diverse shrub component.

Comparable to DWR's aquatic-forested and aquatic-scrub/shrub key habitats.

Disturbance-driven system that requires annual to episodic flooding.

Plant Species

Dominant native trees include boxelder, Gambel oak, and cottonwood (e.g., Fremont cottonwood). Introduced tree species such as Russian olive and tamarisk are also common.

Shrubs include narrowleaf willow, skunkbush sumac, and Woods' rose. Herbaceous layers are often dominated by annual and perennial grass species, and mesic forbs, sedge species, and rush species may also be present.

Mammal Species

Big free-tailed bat, brown (Norway) rat, brush mouse, California myotis, coyote, deer mouse, desert cottontail, fringed myotis, gray fox, least chipmunk, little brown bat, long-tailed weasel (shown here), mule deer, Ord's kangaroo rat, pallid bat, raccoon, spotted bat, Townsend's big-eared bat, western harvest mouse, and western pipistrelle.

Bird Species

American goldfinch, American robin, ash-throated flycatcher, bald eagle, black-billed magpie, black-chinned hummingbird, black-headed grosbeak, broad-tailed hummingbird, Bullock's oriole, cedar waxwing, common raven, Cooper's hawk, dark-eyed junco, Eurasian collared-dove, great blue heron, great horned owl, lazuli bunting, lesser goldfinch, lesser goldfinch, mourning dove, northern flicker, olive-sided flycatcher, peregrine falcon, red-tailed hawk, snowy egret, song sparrow, tree swallow, warbling vireo, western tanager, willow flycatcher, Wilson's warbler, yellow warbler, yellow-breasted chat, and yellow-rumped warbler**.**

Reptile and Amphibian Species

Canyon tree frog, cornsnake, Great Basin spadefoot, Great Plains toad, midget faded rattlesnake, red-spotted toad, smooth greensnake, tiger salamander, tree lizard, western terrestrial garter snake, western whiptail, and Woodhouse's toad.

Figure 2.9. Physical features and characteristic species of riparian habitat in the planning area.

AGRICULTURE

Physical Features

Covers approximately 1% of the length of the planning area.

Plant Species

Areas of grasses, legumes, or grass-legume mixtures planted for the production of seed or hay crops, or planted for livestock grazing.

Mammal Species

American badger, Botta's pocket gopher, coyote , deer mouse, mule deer, pronghorn, striped skunk, and western harvest mouse.

Bird Species

American crow, American kestrel (shown here), American robin, barn swallow, black-billed magpie (shown here), Brewer's blackbird, California quail, Canada goose, common raven, Eurasian collared-dove, horned lark, killdeer, mourning dove, red-tailed hawk, ring-billed gull, sandhill crane, turkey vulture, western kingbird, western meadowlark, white-faced ibis, and wild turkey.

Reptile and Amphibian Species

Midget faded rattlesnake, western rattlesnake, and western terrestrial garter snake.

Figure 2.10. Physical features and characteristic species of agriculture habitat in the planning area.

BARREN LANDS

Physical Features

Covers approximately 5% of the length of the planning area.

Areas of open tablelands and steep cliff faces of predominantly sedimentary rocks, and active and stabilized dunes, typically with sparse vegetation.

Plant Species

Tree and shrub species include junipers, sagebrush species, rubber rabbitbrush, fourwing saltbush, blackbrush, antelope bitterbrush, Greenleaf manzanita, horsebrush knotweed, and jointfir knotweed. Dwarf shrub species include mat saltbush, Gardner's saltbush, and birdfoot sagebrush. Herbaceous layers are often dominated by annual and perennial grasses such as Indian ricegrass, alkali sacaton, and cheatgrass.

Mammal Species

American badger, big free-tailed bat, coyote, deer mouse, desert bighorn sheep, desert woodrat, fringed myotis, least chipmunk, little brown bat, mule deer, pallid bat, pronghorn, rock squirrel, spotted bat, and western pipistrelle.

Bird Species

Bank swallow, black-billed magpie, canyon wren, cliff swallow, common nighthawk, common raven, ferruginous hawk, golden eagle, great horned owl, horned lark, northern harrier, peregrine falcon, rock wren, rough-legged hawk, Say's phoebe, turkey vulture, vesper sparrow, violet-green swallow, white-crowned sparrow, white-throated swift, and Woodhouse's scrub-jay.

Reptile and Amphibian Species

Cornsnake, desert night snake, greater short-horned lizard (shown here), long-nosed leopard lizard, midget faded rattlesnake, and western rattlesnake.

Figure 2.11. Physical features and characteristic species of barren lands habitat in the planning area.

DEVELOPED

Physical Features

Covers less than 1% of the length of the planning area.

Includes SWReGAP land cover classifications for Open Space to Low-Intensity Development and Medium- to High-Intensity Development.

Developed, open space to low-intensity includes areas with a mixture of constructed materials and vegetation, with impervious surfaces accounting for < 20% to 49% of total cover. This habitat includes open spaces, golf courses, preserves, parks, natural areas, parkways, gardens, and single-family housing units.

Developed, medium- to high-intensity includes areas with a mixture of constructed materials and vegetation, with impervious surfaces accounting for 50% to 100% of total cover. This habitat includes single-family housing units; apartment complexes; and commercial, industrial, and disturbed areas.

Plant Species

Dominated by turf grass species and landscape or ornamental trees and shrubs. Common weed species include cheatgrass, common mallow, field bindweed, lambsquarter, and weedy mustard species.

Mammal Species

Black rat, brown (Norway) rat, California myotis, common raccoon, coyote, deer mouse, house mouse, least chipmunk, little brown bat, mule deer, northern pocket gopher, rock squirrel, and striped skunk.

Bird Species

American crow, American goldfinch, American robin, barn swallow (shown here), black-billed magpie, black-capped chickadee, black-chinned hummingbird, black-headed grosbeak, broad-tailed hummingbird, brown-headed cowbird, Bullock's oriole, California quail, Canada goose, Cooper's hawk, downy woodpecker, Eurasian collared-dove, European starling, house finch, house sparrow, killdeer, lesser goldfinch, mallard, mourning dove, northern flicker, red-tailed hawk, rock pigeon, song sparrow, and Woodhouse's scrub-jay.

Reptile Species

Western terrestrial garter snake.

Figure 2.12. Physical features and characteristic species of developed habitat in the planning area.

GRASSLAND

Physical Features

Covers less than 1% of the length of the planning area.

Includes SWReGAP land cover classifications for Inter-Mountain Basins Semi-Desert Grassland.

Plant Species

Annual and perennial grass species include cheatgrass, Indian ricegrass, needle and thread, blue grama, threeawn species, James' galleta, and muhly species. Scattered shrub species may also be present.

Mammal Species

American badger, Botta's pocket gopher, coyote, deer mouse, desert woodrat, mule deer, Ord's kangaroo rat, pronghorn, western harvest mouse, and western spotted skunk.

Bird Species

American kestrel, Brewer's blackbird, California quail, chipping sparrow, common nighthawk, gray catbird, horned lark, killdeer, lark sparrow, lazuli bunting, mourning dove, northern harrier, orange-crowned warbler, prairie falcon, red-tailed hawk, rough-legged hawk, savannah sparrow, Say's phoebe, Swainson's hawk, vesper sparrow, western kingbird (shown here), and western meadowlark.

Reptile and Amphibian Species

Greater short-horned lizard, midget faded rattlesnake, western rattlesnake, and western terrestrial garter snake.

Figure 2.13. Physical features and characteristic species of grassland habitat in the planning area.

INVASIVE FORBLAND

Physical Features

Covers less than 1% of the length of the planning area.

Includes SWReGAP land cover classifications for Invasive Annual and Biennial Forbland.

Plant Species

Areas dominated by introduced annual and/or biennial forb species such as burningbush, halogeton, and Russian thistle species.

Mammal Species

American badger, Botta's pocket gopher, coyote, deer mouse, desert woodrat, Ord's kangaroo rat, pronghorn, western harvest mouse, and western spotted skunk.

Bird Species

California quail (shown here), chipping sparrow, gray catbird, horned lark, killdeer, lark sparrow, lazuli bunting, mourning dove, northern harrier, red-tailed hawk, savannah sparrow, Say's phoebe, vesper sparrow, western kingbird, and western meadowlark.

Reptile and Amphibian Species

Greater short-horned lizard, midget faded rattlesnake, western rattlesnake, and western terrestrial garter snake.

Figure 2.14. Physical features and characteristic species of invasive forbland habitat in the planning area.

SHRUBLAND

Physical Features

Covers approximately 4% of the length of the planning area.

Plant Species

Areas that are dominated or co-dominated by Utah juniper and two-needle pinyon, sagebrush species [basin big sagebrush, Wyoming big sagebrush, black sagebrush], rabbitbrush species [rubber rabbitbrush and yellow rabbitbrush], blackbrush, saltbush species [fourwing saltbush, shadscale saltbush, mat saltbush, Gardner's saltbush], greasewood, and jointfir species [Mormon tea and Torrey's jointfir]. Other shrub species may include spiny hopsage, winterfat, greenleaf manzanita, and sand sagebrush. The herbaceous layer is composed of annual and perennial grasses.

Mammal Species

Black-tailed jackrabbit, brush mouse, coyote, deer mouse, desert cottontail, gray fox, least chipmunk, mule deer, Ord's kangaroo rat, pallid bat, pronghorn, spotted bat, and white-tailed antelope squirrel.

Bird Species

Black-billed magpie, black-chinned hummingbird, Brewer's sparrow (shown here), Brewer's blackbird, California quail, chipping sparrow, common nighthawk, common raven, horned lark, lazuli bunting, mountain bluebird, mourning dove, northern harrier, red-tailed hawk, sagebrush sparrow, savannah sparrow, spotted towhee, Townsend's solitaire, vesper sparrow, western kingbird, white-crowned sparrow, Woodhouse's scrub-jay, and yellow-breasted chat.

Reptile and Amphibian Species

Desert night snake, desert striped whipsnake, greater short-horned lizard, long-nosed leopard lizard, midget faded rattlesnake, sagebrush lizard, and western whiptail.

Figure 2.15. Physical features and characteristic species of shrubland habitat in the planning area.

Table 2.3. Common and Scientific Names of Characteristic Species in the Planning Area

Common Name	Scientific Name
PLANTS	
Alkali sacaton	*Sporobolus airoides*
Antelope bitterbrush	*Purshia tridentata*
Arctic rush	*Juncus arcticus* var. *balticus*
Basin big sagebrush	*Artemisia tridentata* ssp. *tridentata*
Birdfoot sagebrush	*Artemisia pedatifida*
Black sagebrush	*Artemisia nova*
Blackbrush	*Coleogyne ramosissima*
Blue grama	*Bouteloua gracilis*
Boxelder	*Acer negundo*
Broadleaf cattail	*Typha latifolia*
Bulrush species	*Schoenoplectus acutus, S. americanus, and S. pungens*
Burningbush	*Bassia scoparia*
Cheatgrass	*Bromus tectorum*
Common mallow	*Malva neglecta*
Common reed	*Phragmites australis*
Duckweed species	*Lemna* spp.
Field bindweed	*Convolvulus arvensis*
Fourwing saltbush	*Atriplex canescens*
Fremont cottonwood	*Populus fremontii*
Gambel oak	*Quercus gambelii*
Gardner's saltbush	*Atriplex gardneri*
Greasewood	*Sarcobatus vermiculatus*
Greenleaf manzanita	*Arctostaphylos patula*
Halogeton	*Halogeton glomeratus*
Horsebrush species	*Tetradymia* spp.
Indian ricegrass	*Achnatherum hymenoides*
James' galleta	*Pleuraphis jamesii*
Jointfir species	*Ephedra* spp.
Juniper species	*Juniperus* spp.
Knotweed species	*Polygonum* spp.
Lambsquarter	*Chenopodium album*
Mat saltbush	*Atriplex corrugata*
Mormon tea	*Ephedra viridis*
Muhly species	*Muhlenbergia* spp.
Narrowleaf willow	*Salix exigua*
Needle and thread	*Hesperostipa comata*
Pondweed species	*Potamogeton* spp. and *Stuckenia* spp.
Reed canarygrass	*Phalaris arundinacea*
Rubber rabbitbrush	*Ericameria nauseosa*
Rush species	*Juncus* spp.
Russian olive	*Elaeagnus angustifolia*
Russian thistle species	*Salsola* spp.
Sagebrush species	*Artemisia* spp.
Sand sagebrush	*Artemisia filifolia*

Common Name	Scientific Name
Sedge species	*Carex* spp.
Shadscale saltbush	*Atriplex confertifolia*
Skunkbush sumac	*Rhus trilobata*
Spiny hopsage	*Grayia spinosa*
Tamarisk	*Tamarix ramosissima*
Threeawn species	*Aristida* spp.
Torrey's jointfir	*Ephedra torreyana*
Two-needle pinyon	*Pinus edulis*
Utah juniper	*Juniperus osteosperma*
Vernal water-starwort	*Callitriche palustris*
Weedy mustard species	*Lepidium* spp.
Willow species	*Salix* spp.
Winterfat	*Krascheninnikovia lanata*
Woods' rose	*Rosa woodsii*
Wyoming big sagebrush	*Artemisia tridentata* ssp. *wyomingensis*
Yellow rabbitbrush	*Chrysothamnus viscidiflorus*
MAMMALS	
American badger	*Taxidea taxus*
Big free-tailed bat	*Nyctinomops macrotis*
Black rat	*Rattus rattus*
Black-tailed jackrabbit	*Lepus californicus*
Botta's pocket gopher	*Thomomys bottae*
Brown (Norway) rat	*Rattus norvegicus*

Common Name	Scientific Name
Brush mouse	*Peromyscus boylii*
California myotis	*Myotis californicus*
Common raccoon	*Procyon lotor*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Desert bighorn sheep	*Ovis canadensis nelsoni*
Desert cottontail	*Sylvilagus audubonii*
Desert woodrat	*Neotoma lepida*
Fringed myotis	*Myotis thysanodes*
Gray fox	*Urocyon cinereoargenteus*
House mouse	*Mus musculus*
Least chipmunk	*Neotamias minimus*
Little brown bat	*Myotis lucifugus*
Long-tailed weasel	*Mustela frenata*
Mule deer	*Odocoileus hemionus*
Muskrat	*Ondatra zibethicus*
North American beaver	*Castor canadensis*
Northern pocket gopher	*Thomomys talpoides*
Ord's kangaroo rat	*Dipodomys ordii*
Pallid bat	*Antrozous pallidus*
Pronghorn	*Antilocapra americana*
Raccoon	*Procyon lotor*
Rock squirrel	*Spermophilus variegatus*

Common Name	Scientific Name
Spotted bat	*Euderma maculatum*
Striped skunk	*Mephitis mephitis*
Townsend's big-eared bat	*Corynorhinus townsendii*
Western harvest mouse	*Reithrodontomys megalotis*
Western jumping mouse	*Zapus princeps*
Western pipistrelle	*Pipistrellus hesperus*
Western spotted skunk	*Spilogale gracilis*
White-tailed antelope squirrel	*Ammospermophilus leucurus*
BIRDS	
American avocet	*Recurvirostra americana*
American coot	*Fulica americana*
American crow	*Corvus Brachyrhynchos*
American goldfinch	*Spinus tristis*
American kestrel	*Falco sparverius*
American robin	*Turdus migratorius*
American white pelican	*Pelecanus erythrorhynchos*
Ash-throated flycatcher	*Myiarchus cinerascens*
Bald eagle	*Haliaeetus leucocephalus*
Bank swallow	*Riparia riparia*
Barn swallow	*Hirundo rustica*
Belted kingfisher	*Megaceryle alcyon*
Black-billed magpie	*Pica hudsonia*
Black-capped chickadee	*Poecile atricapillus*

Common Name	Scientific Name
Black-chinned hummingbird	*Archilochus alexandri*
Black-headed grosbeak	*Pheucticus melanocephalus*
Brewer's sparrow	*Spizella breweri*
Brewer's blackbird	*Euphagus cyanocephalus*
Broad-tailed hummingbird	*Selasphorus platycercus*
Brown-headed cowbird	*Molothrus ater*
Bufflehead	*Bucephala albeola*
Bullock's oriole	*Icterus bullockii*
Cackling goose	*Branta hutchinsii*
California quail	*Callipepla californica*
Canada goose	*Branta canadensis*
Canyon wren	*Catherpes mexicanus*
Cedar waxwing	*Bombycilla cedrorum*
Chipping sparrow	*Spizella passerina*
Cliff swallow	*Petrochelidon pyrrhonota*
Common goldeneye	*Bucephala clangula*
Common loon	*Gavia immer*
Common merganser	*Mergus merganser*
Common nighthawk	*Chordeiles minor*
Common raven	*Corvus corax*
Cooper's hawk	*Accipiter cooperii*
Dark-eyed junco	*Junco hyemalis*
Double-crested cormorant	*Phalacrocorax auritus*

Common Name	Scientific Name
Downy woodpecker	*Picoides pubescens*
Eared grebe	*Podiceps nigricollis*
Eurasian collared-dove	*Streptopelia decaocto*
European starling	*Sturnus vulgaris*
Ferruginous hawk	*Buteo regalis*
Gadwall	*Anas strepera*
Golden eagle	*Haliaeetus leucocephalus*
Gray catbird	*Dumetella carolinensis*
Great blue heron	*Ardea Herodias*
Great horned owl	*Bubo virginianus*
Green-winged teal	*Anas crecca*
Horned grebe	*Podiceps auritus*
Horned lark	*Eremophila alpestris*
House finch	*Haemorhous mexicanus*
House sparrow	*Passer domesticus*
Killdeer	*Charadrius vociferus*
Lark sparrow	*Chondestes grammacus*
Lazuli bunting	*Passerina amoena*
Lesser black-backed gull	*Larus fuscus*
Lesser goldfinch	*Spinus psaltria*
Mallard	*Anas platyrhynchos*
Mountain bluebird	*Sialia currucoides*
Mourning dove	*Zenaida macroura*

Common Name	Scientific Name
Northern flicker	*Colaptes auratus*
Northern harrier	*Circus cyaneus*
Northern pintail	*Anas acuta*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Northern shoveler	*Anas clypeata*
Olive-sided flycatcher	*Contopus cooperi*
Orange-crowned warbler	*Oreothlypis celata*
Peregrine falcon	*Falco peregrinus*
Prairie falcon	*Falco mexicanus*
Red-breasted merganser	*Mergus serrator*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Ring-billed gull	*Larus delawarensis*
Rock pigeon	*Columba livia*
Rock wren	*Salpinctes obsoletus*
Rough-legged hawk	*Buteo lagopus*
Ruddy duck	*Oxyura jamaicensis*
Sagebrush sparrow	*Artemisiospiza nevadensis*
Sandhill crane	*Grus canadensis*
Savannah sparrow	*Passerculus sandwichensis*
Say’s phoebe	*Sayornis saya*
Snow goose	*Chen caerulescens*
Snowy egret	*Egretta thula*

Common Name	Scientific Name
Song sparrow	*Melospiza melodia*
Spotted sandpiper	*Actitis macularius*
Spotted towhee	*Pipilo maculatus*
Swainson's hawk	*Buteo swainsoni*
Townsend's solitaire	*Myadestes townsendi*
Tree swallow	*Tachycineta bicolor*
Turkey vulture	*Cathartes aura*
Vesper sparrow	*Pooecetes gramineus*
Violet-green swallow	*Tachycineta thalassina*
Virginia rail	*Rallus limicola*
Warbling vireo	*Vireo gilvus*
Western grebe	*Aechmophorus occidentalis*
Western kingbird	*Tyrannus verticalis*
Western meadowlark	*Sturnella neglecta*
Western tanager	*Piranga ludoviciana*
White-crowned sparrow	*Zonotrichia leucophrys*
White-faced ibis	*Plegadis chihi*
White-throated swift	*Aeronautes saxatalis*
Wild turkey	*Meleagris gallopavo*
Willow flycatcher	*Empidonax traillii*
Wilson's phalarope	*Phalaropus tricolor*
Wilson's warbler	*Cardellina pusilla*
Woodhouse's scrub-jay	*Aphelocoma woodhouseii*

Common Name	Scientific Name
Yellow warbler	*Setophaga petechia*
Yellow-breasted chat	*Icteria virens*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Yellow-rumped warbler	*Setophaga coronata*
FISHES	
Bluehead sucker	*Catostomus discobolus*
Bonytail	*Gila elegans*
Channel catfish	*Ictalurus punctatus*
Colorado pikeminnow	*Ptychocheilus lucius*
Common carp	*Cyprinus carpio*
Fathead minnow	*Pimephales promelas*
Flannelmouth sucker	*Catostomus latipinnis*
Green sunfish	*Lepomis cyanellus*
Humpback chub	*Gila cypha*
Largemouth bass	*Micropterus salmoides*
Razorback sucker	*Xyrauchen texanus*
Red shiner	*Cyprinella lutrensis*
Roundtail chub	*Gila robusta*
Sand shiner	*Notropis stramineus*
Smallmouth bass	*Microterus dolomieu*
Speckled dace	*Rhinichthys osculus*
Walleye	*Sander vitreus*
White sucker	*Catostomus commersonii*

Common Name	Scientific Name
REPTILES AND AMPHIBIANS	
Black-necked garter snake	*Thamnophis cyrtopsis*
Canyon tree frog	*Hyla arenicolor*
Cornsnake	*Elaphe guttata*
Desert night snake	*Hypsiglena torquata deserticola*
Desert striped whipsnake	*Masticophis taeniatus taeniatus*
Great Basin spadefoot	*Spea intermontana*
Great plains toad	*Anaxyrus cognatus*
Greater short-horned lizard	*Phrynosoma hernandesi*
Long-nosed leopard lizard	*Gambelia wislizenii*
Midget faded rattlesnake	*Crotalus oreganus concolor*
Northern leopard frog	*Lithobates pipiens*
Red-spotted toad	*Anaxyrus punctatus*
Sagebrush lizard	*Sceloporus graciosus*
Smooth greensnake	*Opheodrys vernalis*
Tiger salamander	*Ambystoma tigrinum*
Tree lizard	*Urosaurus ornatus*
Western rattlesnake	*Crotalus viridis*
Western terrestrial garter snake	*Thamnophis elegands*
Western whiptail	*Cnemidophorus tigris*

HABITAT LOCATION AND CONDITION

Figure 2.16 lists the habitat types in the planning area by river segment. This figure also provides information on proposed and designated critical habitats for bird species and important bird areas (IBAs). IBAs are areas identified for conservation and management because they contain habitat vital to birds and other biodiversity. IBAs may provide important migratory stop-over, foraging, nesting, and/or wintering habitat. The IBA program, administered by BirdLife International and its United States partner, the National Audubon Society, is an international effort to identify, monitor, and protect areas that provide essential habitat for bird populations (Wells et al. 2005).

Using a cross section of the river, Figure 2.17 shows specific aquatic and riverbank habitats along the planning area. The condition and quality of habitat in the planning area can be negatively affected through habitat degradation, fragmentation, and loss. Such effects can stem from development (e.g., dams), the introduction and spread of invasive species, the presence of noise and light, and pollution (e.g., sedimentation, sewage, fertilizer runoff, and mining contaminants). Habitat in the planning area has been altered from its pre-settlement condition from the draining and filling of wetlands, construction of dams, diversion of water for irrigation, and the degradation of water quality from municipal, industrial, and agricultural sources. Section 2.3 of the CRCMP discusses in more detail the impacts of dams on Colorado River sediment and flow regimes. In general, human disturbances have in many places fragmented contiguous grasslands, shrublands, and woodlands, and have altered the riparian corridor species composition along the river. In addition, invasive species have been introduced to river habitats. More recently, a concerted effort has been taken to protect and restore wildlife habitat associated with the Colorado River, including tamarisk (*Tamarix ramosissima*) treatment projects, and stream and riparian corridor restoration projects to benefit native fishes and other aquatic and riparian-dependent species.

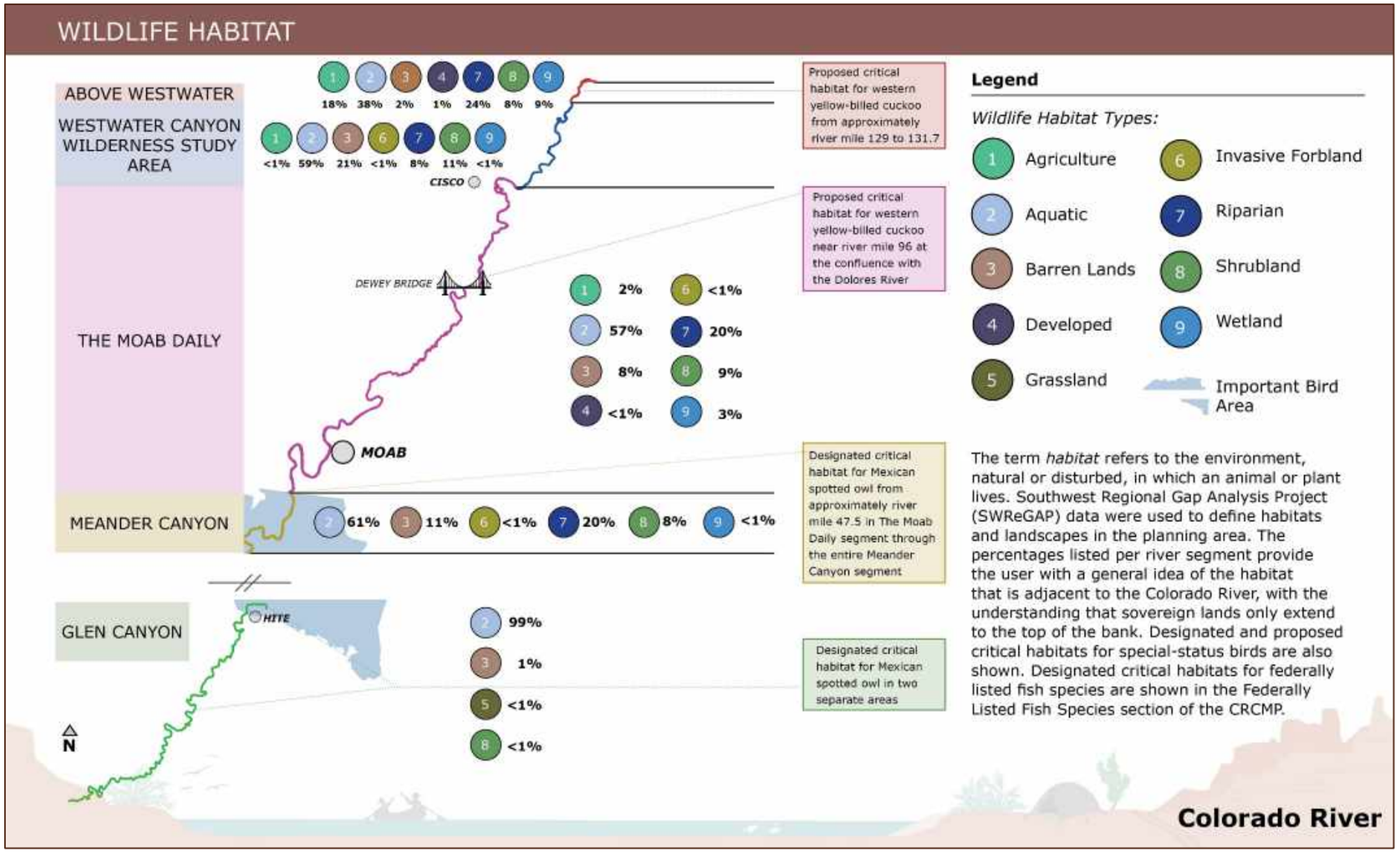


Figure 2.16. Habitat types, proposed and designated critical habitats for bird species, and important bird areas in the planning area by river segment.

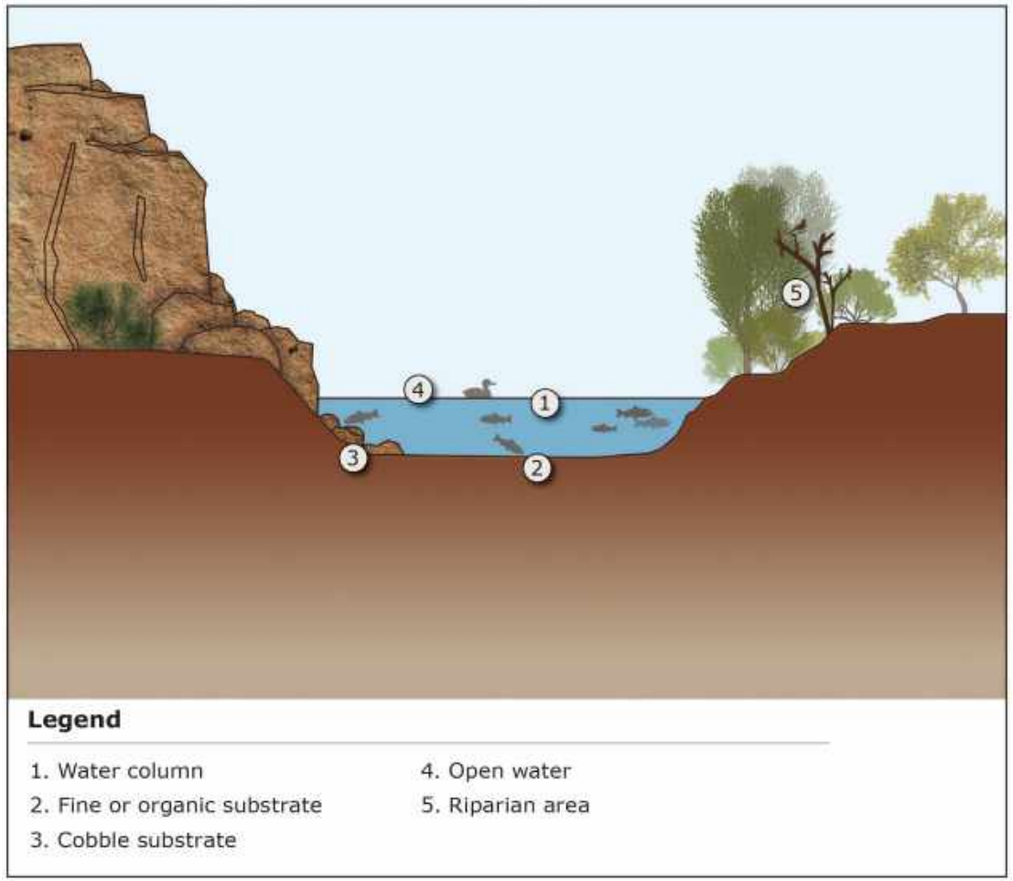


Figure 2.17. Cross section showing aquatic and riverbank habitats in the planning area.

Vegetation

A major structural component of habitat is vegetation. Vegetation is often classified by vertical structure or layers such as grasses and forbs (herbaceous), shrubs, and trees. Vegetation in the planning area can also be categorized in terms of native or desirable, special-status species, and invasive and noxious weed species. These categories are not mutually exclusive but are helpful when making management decisions regarding restoration, regulations, and weed management. The distribution and abundance of plant species can be influenced by disturbance; the proximity of disturbance to the river; and seed dispersal by wildlife, wind, water, and recreation activities.

NATIVE PLANT SPECIES

A native plant species is one that has evolved and occurs naturally in a particular region, ecosystem, or habitat (U.S. Forest Service [USFS] 2018). Native plant communities provide a range of ecological functions such as increased native wildlife habitat and species diversity, erosion control, flood moderation, water filtration, and development and enrichment of soil. Table 2.4 lists native plant species in the planning area (along with their wetland indicator status) that are recommended for restoration and revegetation projects. The wetland indicator status of a plant reflects the likelihood of its presence in a wetland and influences where a particular plant species is planted during restoration and revegetation projects. For example, a plant with an upland wetland indicator status almost never occurs in wetlands and would therefore be planted in an upland area rather than a wetland area. This plant list should serve as a guide for planning restoration or revegetation projects, but is not meant to be an exhaustive list and does not reflect current seed or plant stock availability.

Table 2.4. Native Plant Species in the Planning Area Recommended for Restoration and Revegetation Projects

Common Name	Scientific Name	Wetland Indicator Status*
AQUATIC AND WETLAND PLANTS		
Bulrush species	*Schoenoplectus* spp.	OBL
Duckweed species	*Lemna* spp.	OBL
Fineleaf pondweed	*Stuckenia filiformis*	OBL
Longleaf pondweed	*Potamogeton nodosus*	OBL
Sago pondweed	*Stuckenia pectinata*	OBL
Spiral ditchgrass	*Ruppia cirrhosa*	OBL
RIPARIAN TREES		
Box elder	*Acer negundo*	FACW
Chokecherry	*Prunus virginiana*	FACU
Fremont cottonwood	*Populus fremontii*	FACW
Narrowleaf cottonwood	*Populus angustifolia*	FACW
Peachleaf willow	*Salix amygdaloides*	FACW
Whiplash willow	*Salix lucida*	FACW
SHRUBS		
Big sagebrush	*Artemisia tridentata*	FACU
Broom snakeweed	*Gutierrezia sarothrae*	NI
Fourwing saltbush	*Atriplex canescens*	UPL
Golden currant	*Ribes aureum*	FAC
Greasewood	*Sarcobatus vermiculatus*	FAC
Narrowleaf willow	*Salix exigua*	FACW
Rubber rabbitbrush	*Ericameria nauseosa*	UPL
Silver buffaloberry	*Shepherdia argentea*	FACU
Skunkbush sumac	*Rhus trilobata*	FACU
Spearleaf rabbitbrush	*Chrysothamnus linifolius*	FAC
Stretchberry	*Forestiera pubescens*	FACU
Woods' rose	*Rosa woodsii*	FACU
FORBS		
Alkali buttercup	*Ranunculus cymbalaria*	OBL
Blanket flower species	*Gaillardia* spp.	FACU
Hoary tansyaster	*Machaeranthera canescens*	UPL
Lewis flax	*Linum lewisii*	UPL
Milkvetch species	*Astragalus* spp.	Varies by species
Milkweed species	*Asclepias* spp.	Varies by species
Rocky Mountain beeplant	*Cleome serrulata*	NI
Scarlet globemallow	*Sphaeralcea coccinea*	UPL
Small-leaf globemallow	*Sphaeralcea parviflora*	NI
Western white clematis	*Clematis ligusticifolia*	FAC
White sagebrush	*Artemisia ludoviciana*	FACU
Yellow beeplant	*Cleome lutea*	FACU

Common Name	Scientific Name	Wetland Indicator Status*
GRASSES		
Alkali sacaton	*Sporobolus airoides*	FAC
Arctic rush	*Juncus arcticus*	FACW
Common spikerush	*Eleocharis palustris*	OBL
Indian ricegrass	*Achnatherum hymenoides*	UPL
Inland saltgrass	*Distichlis spicata*	FAC
Nuttall's alkaligrass	*Puccinellia nuttalliana*	FACW
Sand dropseed	*Sporobolus cryptandrus*	FACU
Sandberg bluegrass	*Poa secunda*	FACU
Western wheatgrass	*Pascopyrum smithii*	FAC

* UPL = upland (almost never occurs in wetlands), FACU = facultative upland (usually occurs in non-wetlands, but may occur in wetlands), FACW = facultative wetland (usually occurs in wetlands), FAC = facultative (occurs in wetlands and non-wetlands), OBL = obligate (almost always occurs in wetlands), NI = non-indicator (Lichvar et al. 2016).

SPECIAL-STATUS PLANT SPECIES

Special-status species are species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. The presence of potential habitat in the planning area for federally listed plant species was determined by comparing individual species habitat requirements to the SWReGAP land cover types predicted to occur in the planning area and to local elevation. Table 2.5 provides a list of federally listed plant species, their location per county in the planning area, and their potential to occur in the planning area by segment.

Table 2.5. Special-Status Plant Species and their Potential to Occur in the Planning Area by River Segment

Common and Scientific Name	Status*	Habitat	County	Potential to Occur in the Planning Area by Segment†				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Autumn buttercup *Ranunculus aestivalis*	E-ESA	Endemic to the Sevier River Valley in sedge-grass meadows.	Garfield	None				None; this species is only known to occur in the Sevier River Valley.
Barneby reed-mustard *Schoenocrambe barnebyi*	E-ESA	On soils derived from the Chinle Formation; in mixed shadscale (*Atriplex confertifolia*), buckwheat (*Eriogonum* spp.), and jointfir (*Ephedra* spp.) communities.	Garfield	None				
Jones cycladenia *Cycladenia humilis* var. *jonesii*	T-ESA	On soils derived from Chinle, Cutler, and Summerville Formations; grows in cool desert shrub, juniper (*Juniperus* spp.), buckwheat, and jointfir communities.	Garfield, Grand, Kane, and San Juan	None		High; this species has been documented adjacent to this river segment.	None	
Kodachrome bladderpod *Lesquerella tumulosa*	E-ESA	On fine-textured, shallow soils with shale fragments derived from the Winsor Member of the Carmel Formation; in scattered pinyon-juniper communities.	Kane	None				
Navajo sedge *Carex specuicola*	T-ESA	Restricted to seeps-springs, hanging gardens, or pockets in Navajo sandstone.	Garfield, Grand, Kane, and San Juan	Low; this species has the potential to occur in seeps, springs, and hanging gardens where Navajo sandstone is found.				
Shivwits milkvetch *Astragalus ampullarioides*	E-ESA	On gypsiferous substrates derived from the Chinle Formation; in juniper, creosote bush (*Larrea tridentata*), and warm desert shrub communities.	Kane	None				

Common and Scientific Name	Status*	Habitat	County	Potential to Occur in the Planning Area by Segment†				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Siler pincushion cactus *Pediocactus sileri*	T-ESA	On soils and shale derived from the Moenkopi Formation; in salt desert shrub communities.	Kane	None				
Ute ladies'-tresses *Spiranthes diluvialis*	T-ESA	In moist to wet meadows; along streams; in abandoned stream meanders; near lake shores, seeps, and springs; and in loamy or sandy soils that are typically mixed with gravel.	Garfield	None				
Welsh's milkweed *Asclepias welshii*	T-ESA	On sand dunes in ponderosa pine (*Pinus ponderosa*), juniper, and sagebrush (*Artemisia* spp.) communities.	Kane	None				
Winkler cactus *Pediocactus winkleri*	T-ESA	In salt desert shrub and pinyon-juniper communities; on alkaline hills, desert pavements, small gravel barrens, or clay.	Garfield	None				

Sources: USFWS (2018b, 2018c, 2018d, 2018e); DWR (2018a); Utah Rare Plants (2018).

* E-ESA = endangered under the ESA, T-ESA = threatened under the ESA.

† "None" = there are no records of this species in this river segment and/or there is no suitable habitat for this species in this river segment.

INTRODUCED, INVASIVE, AND NOXIOUS WEED SPECIES

A weed is any plant that is not desired in a particular location and may be introduced, invasive, and/or noxious. Weedy plant species terminology and definitions are provided in Figure 2.18.

As defined by Title 4, Chapter 17 of the Utah Noxious Weed Act, a *noxious weed* is "any plant the commissioner determines to be especially injurious to public health, crops, livestock, land, or other property" and a county-declared noxious weed is, "any plant that is: a) not on the state noxious weed list; b) especially troublesome in a particular county; and c) declared by the county legislative body to be a noxious weed within the county" (Utah Code 4-17-102). Invasive plant species, including most noxious weeds, are early successional species that possess numerous adaptations for rapid colonization and spread in disturbed habitats. These adaptations include high reproductive rates; rapid germination and growth; and annual life histories in which the plant grows, flowers, sets seed, and dies in a single season. Noxious plant species may also have superior abilities to use soil and water resources, possess allelopathic mechanisms to suppress competing species, and have been removed from their native predators and pathogens in their new environment (Coombs et al. 2004; Mack et al. 2000; Sperry et al. 2006). These factors can result in a shift in the plant community toward dominance of nonnative, invasive plant species (Mack et al. 2000). In general, nonnative and invasive plants do not provide the same habitat function as native plants. In addition, nonnative or invasive species can displace native vegetation, resulting in a reduction of plant diversity and a decrease in overall habitat structure and function.

Introduced Plant Species

A plant species living outside of its native range because of deliberate or accidental transport by human activities.

Shown here is halogeton.

Invasive Plant Species

An introduced plant species that adversely affects native species, habitats, or ecosystems.

Shown here is cheatgrass.

Noxious Weed Species

An introduced, invasive plant species that has been designated as injurious to native species, habitats, ecosystems, crops, or the health of humans or livestock.

Shown here is tamarisk.

Figure 2.18. Weedy plant species terminology and definitions.

Four noxious weed species of particular concern in the planning area are tamarisk, Russian olive (*Elaeagnus angustifolia*), Russian knapweed (*Acroptilon repens*), and purple loosestrife (*Lythrum salicaria*). Brief descriptions of these four species are provided in Figure 2.19. Concerns about these specific species include the high potential for spreading, impeded access to the river, degradation to wildlife habitat, impairment of the viewshed, and fire safety concerns related to stands of dead and defoliated tamarisk.

Weed management in the planning area is often done by individual county weed departments in cooperation with FFSL. In addition, Utah has 20 Cooperative Weed Management Areas (CWMAs) that are partnerships of federal, state, and local government agencies, tribes, and private landowners that set common goals and pool resources to effectively manage noxious weeds across Utah. The BLM in Utah provides financial assistance to most counties in the state for weed control. CWMAs operating in the planning area are the Middle Colorado River Watershed CWMA in Grand County, the Color Country CWMA in Kane and Garfield Counties, and the South Central Utah CWMA in Garfield County.

Another organization involved in weed management in the planning area is The Southeast Utah Riparian Partnership, which was formed in March 2006 to coordinate restoration efforts along the Colorado River and its tributaries. The partnership is composed of local, state, and federal agencies; businesses; non-profit organizations; and individuals with the goal of protecting and maintaining a healthy riparian ecosystem in the watershed. This group's focus area includes all five segments of the Colorado River planning area, along with the river's tributaries. Their website offers numerous resources for weed management and restoration.

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a noxious weed that can create a monoculture in wet meadows, ditches, and along the banks of rivers and lakes. It reproduces by prolific seed production and a creeping rootstock. It can rapidly outcompete native vegetation and is difficult to remove once established. This species is a Class 2 declared noxious weed in Utah. Class 2 weeds pose a threat to the state, should be considered a high priority for control, and are known to exist in varying populations throughout the state. Class 2 weed populations are at levels where control or eradication may be possible (UDAF 2018).

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Russian Olive (*Elaeagnus angustifolia*)

Russian olive originated in Europe and has been used as an ornamental tree in the United States. The fruits can be a valuable food source, and the tree often provides habitat for birds and wildlife. It grows well in meadows, pasturelands, and along waterways. Reproduction is from seed and rootstock, and thick stands can develop if left unchecked (Lowry et al. 2017). Russian olive often outcompetes native vegetation, altering the plant community structure and reducing wildlife habitat for some species (Zouhar 2005). It avoids drought stress by tapping into groundwater. Some suggest that Russian olive can alter nutrient cycling and stream hydrology (Tu 2003). Russian olive is a common tree throughout all Utah counties. This species is a Class 4 declared noxious weed in Utah. Class 4 prohibited noxious weeds are annual, biennial, or perennial designated plants that pose a threat to the state through the propagation and retail sale in the greenhouse and plant nursery industry (UDAF 2018).

Russian Knapweed (*Acroptilon repens* [synonym: *Rhaponticum repens*, *Centaurea repens*])

Russian knapweed is a deep-rooted perennial that forms large, dense monotypic stands from widely spreading horizontal roots. It originated in Eurasia and was initially introduced to North America in the early 1900s as a contaminant of seed (Zouhar 2001). Russian knapweed degrades forage quality and reduces plant diversity on rangelands and occurs in all Utah counties. Russian knapweed releases allelopathic compounds into the soil that suppress the growth of competing vegetation (Lowry et al. 2017). Russian knapweed can cause "chewing disease" or equine nigropallidal encephalomalacia in horses that consume it (Lowry et al. 2017). This species is a Class 3 declared noxious weed in Utah. Class 3 weeds are found extensively throughout Utah, and statewide efforts are aimed at containment of smaller infestations (UDAF 2018).

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Tamarisk (*Tamarix ramosissima*)

Tamarisk, also known as saltcedar, is an aggressive, woody noxious plant that has become established on more than 1 million acres of the western United States. Tamarisk crowds out native stands of riparian and wetland vegetation. It increases the salinity of surface soil, rendering the soil inhospitable to native plant species, and avoids drought stress by tapping into groundwater. Tamarisk provides generally lower wildlife habitat value, but can provide vital shade in hot, arid climates. These plants can widen floodplains by clogging stream channels and increase sediment deposition because of the abundance of tamarisk stems in dense stands (Colorado State University 2000). This species is a Class 3 declared noxious weed in Utah.

Figure 2.19. Weed species of particular concern in the planning area.

Introduced, invasive, and/or noxious weed plant species that are common in and adjacent to the planning area and that should be considered as part of integrated weed management are listed in Table 2.6.

Table 2.6. Introduced, Invasive, and/or Noxious Weed Plant Species Present in or Adjacent to the Planning Area.

Common Name	Scientific Name
Bull thistle	*Cirsium vulgare*
Burdock	*Arctium minus*
Burningbush	*Bassia scoparia*
Canada thistle	*Cirsium arvense*
Cheatgrass	*Bromus tectorum*
Cocklebur	*Xanthium strumarium*
Common ragweed	*Ambrosia artemisiifolia*
Common reed	*Phragmites australis*
Common teasel	*Dipsacus fullonum*
Field bindweed	*Convolvulus arvensis*
Halogeton	*Halogeton glomeratus*
Hoary cress (whitetop)	*Cardaria draba*
Houndstongue	*Cynoglossum officinale*
Mullein	*Verbascum thapsus*
Pepperweed species	*Lepidium* spp.
Perennial pepperweed	*Lepidium latifolium*
Poison hemlock	*Conium maculatum*
Puncturevine	*Tribulus terrestris*
Purple loosestrife	*Lythrum salicaria*
Ravenna grass	*Saccharum ravennae*
Reed canarygrass	*Phalaris arundinacea*
Russian knapweed	*Acroptilon repens*
Russian olive	*Elaeagnus angustifolia*
Russian thistle	*Salsola tragus*
Tamarisk	*Tamarix ramosissima*
Spotted knapweed	*Centaurea stoebe*
Yellow sweetclover	*Melilotus officinalis*

Restoration

Human encroachment on a river corridor can have a negative impact on the natural functionality of the waterway and its surrounding habitat. Negative effects from human encroachment near portions of the planning area specifically include habitat fragmentation, erosion, changes to the river channel and water flows, sedimentation, increased salinity, a reduction in species diversity, and the proliferation of invasive species. The restoration of species diversity and habitats can combat the negative impacts of these effects and provide important ecosystem services to the surrounding areas and the waterway itself. Restoring native plant diversity and improving fish and wildlife habitats throughout the planning area can reduce erosion, sedimentation, and flooding hazards, increase pollination for adjacent environments, reduce water pollution, help establish natural hydro-morphological processes, benefit wildlife, improve visual aesthetics, and create recreational opportunities for the general public.

Past and current restoration projects involving state, federal, county, private, and non-profit organizations are targeting tamarisk, Russian olive, and other noxious and invasive species throughout the Colorado River watershed.

An example of weed management along the Colorado River system is tamarisk control. In 2001, the tamarisk leaf beetle (*Diorhabda* spp.) was released as a biological control to help manage tamarisk (RiversEdge West 2016). The beetle damages tamarisk through repeated leaf defoliation. Since the release of the tamarisk leaf beetle on the Colorado Plateau, tamarisk leaf beetle populations have widely expanded and can be found in all segments of the planning area, as well as portions of California, Arizona, Nevada, New Mexico, Texas, Oklahoma, Oregon, Idaho, and Wyoming (Tamarisk Coalition 2017). Restoration projects have incrementally removed dead tamarisk; conducted weed treatments for Russian olive, Russian knapweed, Ravenna grass (*Saccharum ravennae*), and other invasive species; and revegetated treatment areas with native species if passive regeneration of desirable species does not occur.

AREAS OF FOCUS

Restoration focus areas along the five segments of the Colorado River are native vegetation enhancement and bank and channel restoration (Figure 2.20).

Figure 2.21 illustrates the conceptual difference between a degraded riverbank with limited habitat value and limited stability and a restored riverbank with native vegetation communities that improve habitat and river function.

Native Vegetation Enhancement

Noxious plant species such as tamarisk (*Tamarix ramosissima*) form large monocultures that displace native plants and reduce habitat quality for wildlife. Since the release of the tamarisk leaf beetle (*Diorhabda* spp.), much of the tamarisk along the Colorado River corridor has started to die. With tamarisk stands declining, noxious species such as Russian olive (*Elaeagnus angustifolia*) and Russian knapweed (*Acroptilon repens*), along with other invasive species like tree of heaven (*Ailanthus altissima*), Siberian elm (*Ulmus pumila*), and Ravenna grass (*Saccharum ravennae*), have become established. Not only do invasive species cause habitat degradation, they also decrease the aesthetic value of the river as a recreational resource. Revegetation with desirable, native plant species provides structured plant communities for quality wildlife habitat and bank stability. Controlling invasive species and revegetating with native plants comprise a major goal of restoration efforts along the Colorado River.

Bank and Channel Restoration

Some areas of the Colorado River experience significant bank erosion from flowing water, wave action, or adjacent land uses. In some locations, vertical cut banks are present that cannot support vegetation, making them more likely to erode. The lowering of the channel bottom can also cause major undercutting in places and significantly decrease bank stability. Other areas of the exhibit channel narrowing, the filling of secondary channels and side channels, and vegetation encroachment. Channel narrowing is likely the effect of a reduction in frequency of high flow events compromising sediment mobility in the main channel of the river and is more pronounced in the lower gradient reaches of the river. As channels narrow, they become disconnected from their floodplain. Narrowing channels and vegetation encroachment simplify and degrade habitats available to native fish. Physically restoring banks and channels and improving connections to floodplains and riparian areas are crucial to restoring habitats along the river.

Figure 2.20. Restoration focus areas in the planning area.

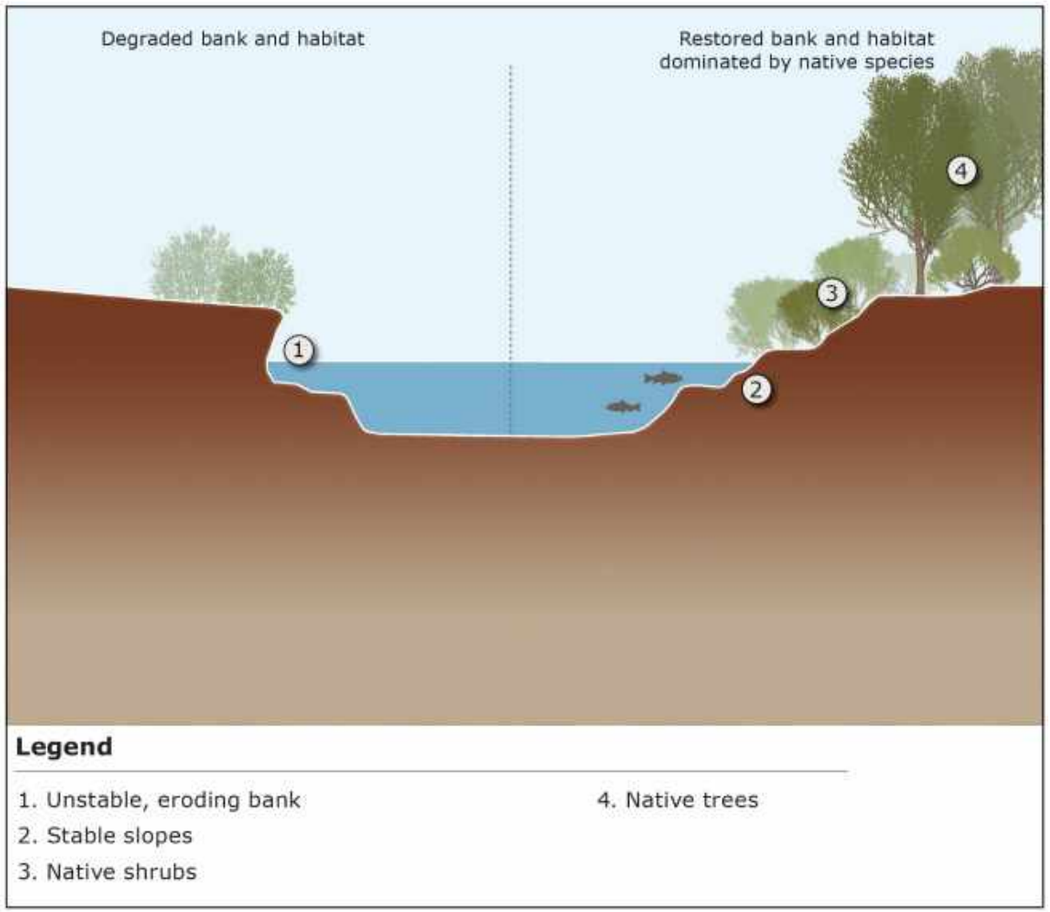


Figure 2.21. River restoration cross section showing degraded banks versus restored riverbank with diverse habitats.

Further Reading

Best Management Practices for Revegetation After Tamarisk Removal: In the Upper Colorado River Basin (Sher et al. 2010)

Colorado River Conservation Planning Project website (USGS 2016b)

Conservation Buffers: Design Guidelines for Buffers, Corridors, and Greenways (Bentrup 2008)

Conservation Planning for the Colorado River in Utah (Rasmussen and Shafroth 2016)

Field Guide for Managing Russian Olive in the Southwest (USFS 2014a)

Field Guide for Managing Saltcedar in the Southwest (USFS 2014b)

Natural Resources Conservation Service Stream Restoration website (Natural Resources Conservation Service 2018)

Prioritizing Management and Protection of the Colorado River's Environmental Resources (Colorado River Research Group 2016)

Riparian Buffer Design Guidelines: For Water Quality and Wildlife Habitat Functions on Agricultural Landscapes in the Intermountain West (Johnson and Buffler 2008).

Stream Corridor Restoration: Principles, Processes, and Practices (Federal Interagency Stream Restoration Working Group 2001)

The Practical Streambank Bioengineering Guide (Natural Resources Conservation Service 1998)

Utah's Perspective: The Colorado River (Utah Division of Water Resources 2002)

Why Are My Trees Brown? Tamarisk and the Tamarisk Beetle (Tamarisk Coalition 2016)

GIS Data Layers

Areas of Critical Concern, Cottonwood Bench Ranch Conservation Easement, Habitat Types, National Wetlands Inventory, Noxious Weeds, Restoration Projects, Soil Types, Vegetation Types (LANDFIRE), Vegetation Types (SWReGAP)

Wildlife Species

Introduction

Riparian areas generally support a range of wildlife species. This section provides information on populations of wildlife species known to occur in or adjacent to the planning area. It is intended to complement the Wildlife Habitat section by identifying priority wildlife species on which to base development of habitat restoration, enhancement, and/or preservation goals and to provide information regarding certain species of regulatory and management concern. The Colorado River corridor provides habitat for many native wildlife species and provides important nesting, stop-over areas, wintering areas, and foraging opportunities for migratory birds and raptors. Given anthropogenic disturbance in some areas, populations of nonnative wildlife species are also found. Habitat associations for particular wildlife can be found in the Wildlife Habitat section in Figures 2.7–2.15.

Agencies and stakeholders working in the planning area should understand that certain wildlife species are classified as special-status species, are legally protected, and may require special management under federal or state law. Agencies and stakeholders should also understand that certain wildlife species add to, or detract from, the overall health of the Colorado River ecosystem (e.g., native species versus invasive species). The invasive Quagga mussel (*Dreissena rostriformis*) was discovered in Lake Powell in 2013. Since then, the NPS shifted efforts from preventing the introduction of mussels to Lake Powell to a program focused on containing the spread of mussels to other waterbodies. Utah Code 23-27-101 (Aquatic Invasive Species Interdiction Act) requires boaters to clean, drain, and dry their watercrafts using a self-decontamination procedure when exiting Lake Powell. Boaters must complete a Decontamination Certification Form, available at the launch facility or online. More information on the NPS efforts to control aquatic invasive species at Lake Powell is available on the NPS Glen Canyon National Recreation Area website (NPS 2018), and the State of Utah has published common questions about boating on Lake Powell (DWR 2017a).

Planning area agencies and stakeholders may also be interested in wildlife species that have recreational value, such as birds. Not only does the presence of a variety of wildlife species provide recreational opportunities, it is also an indicator of a healthy ecosystem.

Figure 2.22 illustrates the abundant and common native and nonnative fish species along the five river segments, as well as eBird locations (hotspots) from which bird species data for Table 2.10 were obtained.

The sections that follow describe special-status species, fish species, bird species, and species of management concern found in the planning area.

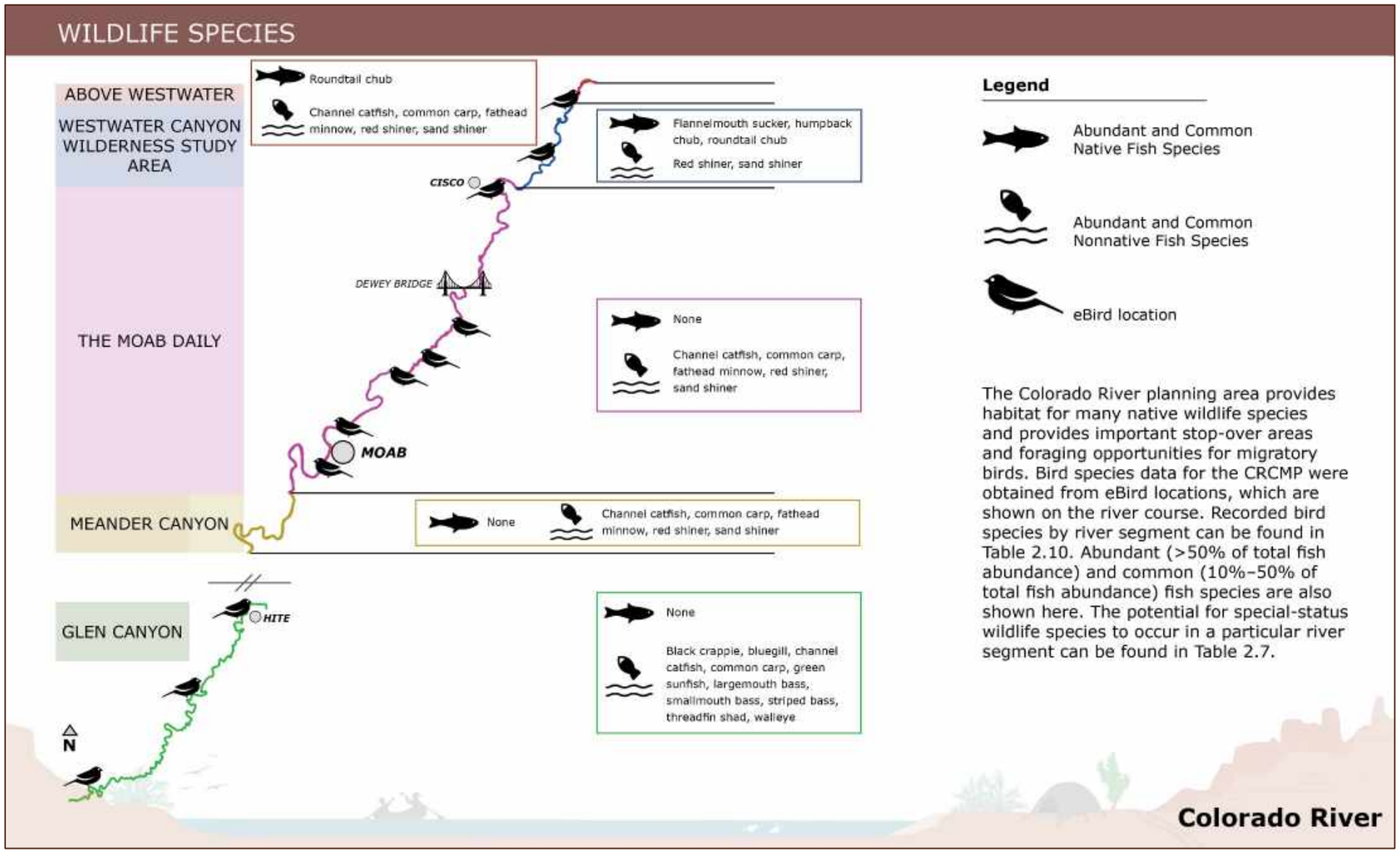


Figure 2.22. Abundant and common native and nonnative fish species and eBird locations (hotspots) in the planning area by river segment.

Special-Status Species

Special-status wildlife species include federally listed species that are protected under the ESA (threatened and endangered species), species considered candidates for such listing (candidate species), Utah wildlife species of concern (SPC), and species receiving special management under a conservation agreement to preclude the need for federal listing (CS).

Table 2.7 provides a list of special-status species, their location per county in the planning area, and their potential to occur in or adjacent to the planning area by segment. The table also includes each species' status and general habitat association. This list of special-status wildlife species was compiled from the Utah's state listed species by county list, which uses known species occurrences and observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (DWR 2017b) and the USFWS Information for Planning and Consultation for individual counties in the planning area (USFWS 2018b, 2018c, 2018d, 2018e). Fish species occurrence information was also obtained from Dr. Richard Valdez, fisheries subject matter expert, who has 46 years of experience in aquatic ecosystems of western North America (including the planning area).

Table 2.7. Special-Status Wildlife Species and their Potential to Occur in or Adjacent to the Planning Area by Segment

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
BIRDS								
American three-toed woodpecker *Picoides dorsalis*	SPC	This species inhabits mixed conifer and aspen forests. It is a cavity nester.	Garfield, Grand, Kane, San Juan	This species is not expected to occur in these river segments.				
American white pelican *Pelecanus erythrorhynchos*	SPC	Foraging sites for this species are often waterbodies less than 8 feet deep where they feed on small fish, generally less than half of their bill length.	Garfield, Grand, Kane, San Juan	This species is not expected to occur in these river segments.				This species has been documented along this river segment.
Bald eagle *Haliaeetus leucocephalus*	SPC	This species tends to nest within 650 feet of water. They eat mainly fish and carrion.	Garfield, Grand, Kane, San Juan	This species has been documented along these river segments.				
Bobolink *Dolichonyx oryzivorus*	SPC	This species nests in marshes, grasslands, and in hayfields.	San Juan	This species is not expected to occur in these river segments.				
Burrowing owl *Athene cunicularia*	SPC	This species nests in burrows made by prairie dogs, badgers, or ground squirrels in open grassland and desert environments.	Garfield, Grand, Kane, San Juan	This species may occur along these river segments during summer months.				This species is not expected to occur in this river segment.
California condor *Gymnogyps californianus*	E-ESA, EXPN-ESA	Foraging sites for this species are open grasslands, typically far from nesting sites. This species nests on cliffs in forested mountain regions.	Garfield, Grand, Kane, San Juan	This species is not expected to occur in these river segments.				This species has been documented along this river segment.

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Ferruginous hawk *Buteo regalis*	SPC	This species generally nests and forages in open country, primarily prairies, plains, and desert. It tends to nest on cliffs, trees, or in power poles.	Grand, Kane,	This species has been documented along these river segments and can be observed year-round.			This species may nest along these river segments and can be observed during the spring and fall migration.	
Greater sage-grouse *Centrocercus urophasianus*	SPC	This species inhabits sagebrush steppe and uses several types of sagebrush habitats during different times of the year.	Garfield, Grand, Kane, San Juan	This species is not expected to occur in these river segments.				
Gunnison sage-grouse *Centrocercus minimus*	T-ESA	This species uses sagebrush and sagebrush-grassland habitats. This species is restricted to western Colorado and eastern Utah where it is a year-round resident.	Grand, San Juan	This species is not expected to occur in these river segments.				
Lewis's woodpecker *Melanerpes lewis*	SPC	This species generally occurs in open woodland areas. It is a cavity nester.	Garfield, Grand, San Juan	This species may use riparian areas along these river segments for foraging.				
Mexican spotted owl *Strix occidentalis lucida*	T-ESA	In Utah, this species occupies steep rocky canyons and is non-migratory.	Garfield, Grand, Kane, San Juan	This species is not expected to occur in this river segment.	This species may use riparian areas along this river segment for foraging.	This species may use riparian areas along this river segment for foraging. A very small portion of this segment (southern end) is located within designated critical habitat for this species.	This species may use riparian areas along this river segment for foraging. This segment is located within designated critical habitat for this species.	This species has been documented along this river segment. Portions of this segment are located in designated critical habitat for this species.

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Northern goshawk *Accipiter gentilis*	CS	This species nests in mature forests and forages in forested areas and along riparian corridors.	Garfield, Grand, Kane, San Juan	This species is not expected to occur in these river segments.				
Short-eared owl *Asio flammeus*	SPC	This species nests and forages in open grasslands, shrublands, and other open habitats.	Garfield, San Juan	This species may use riparian areas along these river segments for foraging and wintering habitat.				This species may use adjacent areas along this river segment for foraging and wintering habitat.
Southwestern willow flycatcher *Empidonax traillii extimus*	E-ESA	This species is associated with riparian habitats, particularly in areas of dense willow and tamarisk.	Garfield, Grand, Kane, San Juan	This species is not expected to occur in these river segments.				The northern boundary of the range for this species extends just above Hite; however, suitable habitat for this species does not occur in this river segment, and there are no records of this species in this river segment.
Western yellow-billed cuckoo *Coccyzus americanus*	T-ESA	This species is a late migrant, arriving in Utah in late May or early June and breeding in late June through July. This species nests in patches of multi-layered riparian vegetation that are at least 12 acres or greater in extent and are separated from other patches of suitable habitat by at least 980 feet.	Garfield, Grand, Kane, San Juan	This species has been documented along this river segment during summer months. Proposed critical habitat for this species is located along a 3-mile-long continuous segment of the Colorado River straddling the Utah-Colorado state line.	This species may use riparian areas along this river segment for foraging and nesting.	This species has been documented along this river segment during summer months. Proposed critical habitat for this species is located along a 2-mile-long continuous segment of the lower Dolores River and the confluence with the Colorado River in Grand County, Utah.	This species may use riparian areas along this river segment for foraging and nesting.	This species may be seen during fall and spring migration in this river segment.

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
MAMMALS								
Allen's big-eared bat *Idionycteris phyllotis*	SPC	This species occurs in the southern portion of Utah and uses riparian and rocky areas in scrub-shrub and wooded habitats. It roosts in caves and rock crevices.	Garfield, Grand, Kane, San Juan	This species is likely to occur at least sporadically along these river segments.				
Big free-tailed bat *Nyctinomops macrotis*	SPC	This species is migratory. It occurs in rocky and woodland habitats and roosts in mines, caves, rock crevices, and buildings.	Grand, Kane, San Juan	This species is likely to occur at least sporadically along these river segments.				
Fringed myotis *Myotis thysanodes*	SPC	This species is migratory. It occurs in desert and woodland areas. It roosts in caves, mines, and buildings.	Garfield, Grand, Kane, San Juan	This species is likely to occur at least sporadically along these river segments.				
Gunnison's prairie dog *Cynomys gunnisoni*	SPC	This species forms colonies and lives in underground burrows, often hibernating during the winter months. This species is found in the southeastern part of Utah.	Grand, San Juan	This species is not expected to occur in any of these river segments; however, this species is likely to use adjacent areas.				
Kit fox *Vulpes macrotis*	SPC	This species occurs in desert, open prairie, and plains habitats in the western portion of Utah.	Garfield, Grand, Kane, San Juan	This species may occur along these river segments.				
Pygmy rabbit *Brachylagus idahoensis*	SPC	This species prefers areas with tall, dense sagebrush and loose soils in northern and western Utah.	Garfield	This species is not expected to occur in any of these river segments.				

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Silky pocket mouse *Perognathus flavus*	SPC	This species prefers sagebrush, woodland, and arid grassland areas with sandy soils. In Utah, this species occurs only in the southern part of San Juan County.	San Juan	This species is not known to occur in these river segments.				This species is not expected to occur in this river segment.
Spotted bat *Euderma maculatum*	SPC	This species roosts and hibernates in rock crevices and caves and can be found in a variety of habitats including forested mountains and deserts.	Garfield, Grand, Kane, San Juan	This species is likely to occur at least sporadically along these river segments.				
Townsend's big-eared bat *Corynorhinus townsendii*	SPC	This species is often found near forested and riparian areas and uses caves, mines, and buildings for day roosting and winter hibernation.	Garfield, Grand, Kane, San Juan	This species is likely to occur at least sporadically along all these river segments.				
Utah prairie dog *Cynomys parvidens*	T-ESA	This species forms colonies and lives in underground burrows, often hibernating during the winter months. This species is endemic to Utah.	Garfield, Kane	This species is not known to occur in any of these river segments.				
White-tailed prairie dog *Cynomys leucurus*	SPC	This species forms colonies and lives in underground burrows, often hibernating during the winter months. This species is endemic to Utah.	Grand	This species may occur along these river segments.			This species is not known to occur in these river segments.	

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
FISHES								
Bluehead sucker *Catostomus discobolus*	CS	This species is a bottom dweller that feeds primarily on algae that it scrapes from the surface of rocks. It occurs in the upper Colorado River system, the Snake River system, and the Lake Bonneville basin.	Garfield, Grand, Kane	This species has been documented in these river segments.				This species is not known to occur in this river segment.
Bonneville cutthroat trout *Oncorhynchus clarkii utah*	CS	This species occupies a variety of habitats from low-elevation streams to high-elevation mountain lakes and streams.	Garfield, Kane	This species is not known to occur in any of these river segments.				
Bonytail *Gila elegans*	E-ESA	This species prefers backwaters, pools, and eddies near swift current in the Colorado River system.	Garfield, Grand, Kane, San Juan	This species has been documented in these river segments. Designated critical habitat for this species is located in the segment.		This species has been documented in this river segment. Designated critical habitat for this species is located in the northernmost portion of the segment.	This species has been documented in these river segments.	
Colorado pikeminnow *Ptychocheilus Lucius*	E-ESA	Young of this species prefer slow-moving backwaters of the Colorado River system, whereas adults inhabit a range of habitats from flooded lowlands to turbid rapids.	Garfield, Grand, Kane, San Juan	This species has been documented in these river segments. Designated critical habitat for this species is located in these segments.				This species has been documented in this river segment. Designated critical habitat for this species is located in the northernmost portion of the segment.

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Colorado River cutthroat trout *Oncorhynchus clarkii pleuriticus*	CS	This species historically occurred throughout the colder waters of the Colorado River basin, mainly in Colorado, Utah, and Wyoming. This species inhabits pools and small riffles in relatively steep, coldwater streams and rivers.	Garfield	This species is not known to occur in any of these river segments.				
Desert sucker *Catostomus clarkii*	SPC	In Utah, this species only occurs in the Virgin River system in southwestern Utah.	Kane	This species is not known to occur in any of these river segments.				
Flannelmouth sucker *Catostomus latipinnis*	CS	In Utah, this species occurs in deep pools of slow-flowing, low-gradient reaches of the mainstem of the Colorado River and its larger tributaries.	Garfield, Grand, Kane	This species has been documented in these river segments.				For all practical purposes, this species is considered absent from this segment. The flannelmouth sucker is a riverine sucker and is not known to inhabit or survive in lakes or reservoirs. However, the State of Utah has reported catching this species in their gill nets in this segment in past years.
Greenback cutthroat trout *Oncorhynchus clarkii stomias*	T-ESA	This species' historical range consists of the headwaters of the South Platte and Arkansas Rivers in eastern Colorado. In Utah, this species is known to occur in a tributary of La Sal Creek.	San Juan	This species is not known to occur in any of these river segments.				

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Humpback chub *Gila cypha*	E-ESA	This species spawns in shallow, backwater areas containing cobble substrate. Adults use rapids and whitewater areas of the Colorado, Green, and White Rivers.	Garfield, Grand, Kane, San Juan	This species has been documented in these river segments. Designated critical habitat for this species is located in these segments.		This species has been documented in this river segment. Designated critical habitat for this species is located in the northernmost portion of the segment.	This species is not known to occur in this river segment. However, DWR indicates that this segment may be a movement corridor for this species.	This species is not known to occur in this river segment.
Razorback sucker *Xyrauchen texanus*	E-ESA	This species uses impoundments and slow-moving backwater habitats in the Colorado River system.	Garfield, Grand, Kane, San Juan	This species has been documented in these river segments. Designated critical habitat for this species is located in these segments.				This species has been documented in this river segment. Designated critical habitat for this species is located in the northernmost portion of the segment.
Roundtail chub *Gila robusta*	CS	This species uses murky pools near fast currents in the mainstem of the Colorado River and its larger tributaries.	Garfield, Grand, Kane	This species has been documented in these river segments.				This species is not known to occur in this river segment.
Southern leatherside chub *Lepidomeda aliciae*	SPC	This species prefers backwaters and slow-flowing pools of small to medium sized rivers.	Garfield, Kane	This species is not known to occur in these river segments.				
Virgin River chub *Gila seminude*	E-ESA	In Utah, this species is restricted to the mainstem of the Virgin River.	Kane	This species is not known to occur in these river segments.				

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Virgin spinedace *Lepidomeda mollispinis*	CS	This species prefers slow-moving water in small creeks and streams.	Kane	This species is not known to occur in these river segments.				
Woundfin *Plagopterus argentissimus*	E-ESA	In Utah, this species is restricted to the Virgin River system in the southwestern portion of the state.	Kane	This species is not known to occur in these river segments.				
AMPHIBIANS								
Arizona toad *Bufo microscaphus*	SPC	This species prefers reservoirs, washes, streams, and upland areas that are adjacent to water, and irrigated agricultural areas in southwestern Utah.	Garfield, Kane, San Juan	This species is not known to occur in these river segments.				This species has been documented in this river segment.
Great Plains toad *Anaxyrus cognatus*	SPC	This species prefers grassland, desert, and agricultural habitats. This species burrows underground and becomes inactive during the cold winter months.	Grand, Kane, San Juan	This species may occur in areas adjacent to these river segments.				
Western (boreal) toad *Anaxyrus* (syn. *Bufo*) *boreas*	SPC	This species is generally a high-elevation species that occurs in wetlands surrounded by a variety of habitats.	Garfield, Kane	This species is not known to occur in these river segments.				

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
REPTILES								
Common chuckwalla *Sauromalus ater*	SPC	This species occurs in the southern portion of Utah and is typically found near rocky slopes, cliffs, or boulders.	Garfield, Kane, San Juan	This species is not known to occur in these river segments.				This species has been documented in this river segment.
Cornsnake *Elaphe guttata*	SPC	This species occurs in forested or rocky habitats or near streams in eastern Utah.	Grand	This species may occur adjacent to these river segments.		This species has been documented adjacent to this river segment.	This species may occur adjacent to this river segment.	This species is not known to occur in this river segment.
Desert night lizard *Xantusia vigilis*	SPC	This secretive species spends much of its time hiding under Joshua tree (*Yucca brevifolia*) limbs or other similar cover.	Garfield, Kane, San Juan	This species is not known to occur in these river segments.				This species has been documented in areas adjacent to this river segment.
Desert tortoise *Gopherus agassizii*	T-ESA	This species spends most of its time in burrows or rock shelters in canyon bottoms, rocky hillsides, or grasslands.	Kane	This species is not known to occur in these river segments.				
Smooth greensnake *Opheodrys vernalis*	SPC	This species prefers meadows and moist grassy areas and is known to occur in the Uinta, La Sal, Abajo, and Wasatch Mountains in Utah.	Grand, San Juan	This species is not known to occur in these river segments.		This species has been documented in this river segment.	This species is not known to occur in these river segments.	

Common Name and Scientific Name	Status*	General Habitat Association	County	Potential to Occur in or Adjacent to the Planning Area by Segment				
				Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
INVERTEBRATES								
Black Canyon pyrg *Pyrgulopsis plicata*	SPC	This species is only found in a complex of springs in Black Canyon, Garfield County, Utah.	Garfield	This species is not known to occur in these river segments.				
Eureka mountainsnail *Oreohelix eurekensis*	SPC	This species is endemic to Utah and has been reported from six localities that represent four widely separated populations in northern Utah.	Grand	This species is not known to occur in these river segments.				
Kanab ambersnail *Oxyloma haydeni kanabensis*	E-ESA	This species occurs in Kane County, Utah, near marshy areas and along Kanab Creek.	Kane	This species is not known to occur in these river segments.				
Utah physa *Physella utahensis*	SPC	This species has been reported from several sites in northern Utah in large shallow pools and springs.	Garfield	This species is not known to occur in any of these river segments.				
Yavapai mountainsnail *Oreohelix Yavapai*	SPC	This species was historically known to occur in rocky areas in the Abajo Mountains and Navajo Mountain.	San Juan	This species is not known to occur in any of these river segments.				

* E-ESA = ESA endangered, EXPN-ESA = experimental, non-essential under the ESA, T-ESA = ESA threatened, SPC = Utah wildlife species of concern, CS = species receiving special management under a Conservation Agreement to preclude the need for federal listing.

The *Utah Wildlife Action Plan* identifies 141 SGCN in Utah and provides a summary of the distribution and abundance information on these species and a threat-assessment for some species and their habitats. Many SGCN, such as the white-faced ibis (*Plegadis chihi*), olive-sided flycatcher (*Contopus cooperi*), ferruginous hawk (*Buteo regalis*), peregrine falcon (*Falco peregrinus*), bald eagle (*Haliaeetus leucocephalus*), and golden eagle (*Aquila chrysaetos*), are found in the planning area and adjacent habitats. The planning area provides habitat for SGCN bat species such as Allen's big-eared bat (*Idionycteris phyllotis*), big free-tailed bat (*Nyctinomops macrotis*), fringed myotis (*Myotis thysanodes*), spotted bat (*Euderma maculatum*), and Townsend's big-eared bat (*Corynorhinus townsendii*). Additionally, SGCN fish species such as bluehead sucker (*Catostomus discobolus*), bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), flannelmouth sucker (*Catostomus latipinnis*), humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), and roundtail chub (*Gila robusta*) are found in various segments of the planning area.

Fish Species

The Colorado River provides fish spawning, rearing, and nursery habitat. Figure 2.23 provides a plan view and accompanying cross sections showing examples of this habitat in the planning area.

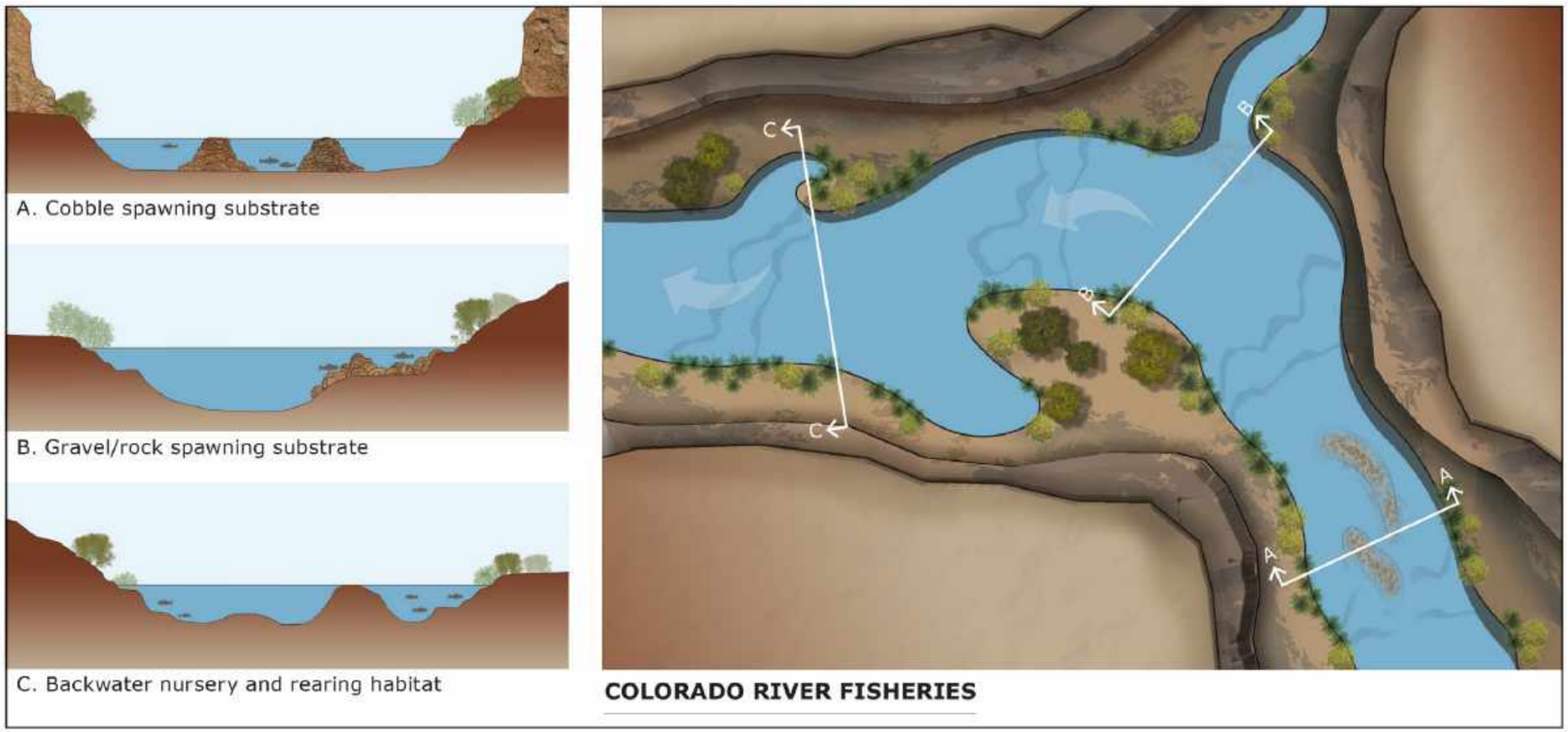


Figure 2.23. Colorado River plan view and cross sections of fish spawning, rearing, and nursery habitats.

In total, 29 species of fish inhabit the Colorado River planning area. These comprise 21 nonnative species and eight native species (Table 2.8). Four of the native species are listed as endangered under the ESA (i.e., bonytail, Colorado pikeminnow, humpback chub, and razorback sucker), and three native species are included in a range-wide species conservation plan (i.e., flannelmouth sucker, bluehead sucker, and roundtail chub). These seven species are discussed in more detail in this section.

Table 2.8. Approximate Relative Abundance of Fish Species in the Planning Area by Segment

Common Name	Scientific Name	Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
NATIVE FISHES						
Bluehead sucker	*Catostomus discobolus*	R	R	R	R	–
Bonytail	*Gila elegans*	R	R	R	R	R
Colorado pikeminnow	*Ptychocheilus lucius*	R	R	R	R	R
Flannelmouth sucker	*Catostomus latipinnis*	R	C	R	R	–
Humpback chub	*Gila cypha*	R	A	R	–	–
Roundtail chub	*Gila robusta*	C	C	R	R	–
Razorback sucker	*Xyrauchen texanus*	R	R	R	R	R
Speckled dace	*Rhinichthys osculus*	R	R	R	R	–
NONNATIVE FISHES						
Black bullhead	*Ameiurus melas*	R	–	R	R	R
Black crappie	*Pomoxis nigromaculatus*	R	R	–	–	C
Bluegill	*Lepomis macrochirus*	R	R	–	–	C
Brassy minnow	*Hybognathus hankinsoni*	R	–	–	–	–
Channel catfish	*Ictalurus punctatus*	C	R	C	C	A
Common carp	*Cyprinus carpio*	C	R	C	C	A
Fathead minnow	*Pimephales promelas*	C	R	C	C	R
Gizzard shad	*Dorosoma cepedianum*	R	–	R	R	R
Grass carp	*Ctenopharyngodon idella*	R	R	R	R	R
Green sunfish	*Lepomis cyanellus*	R	R	R	R	C
Largemouth bass	*Micropterus salmoides*	R	R	R	R	C
Mosquitofish	*Gambusia affinis*	R	R	–	–	–
Plains killifish	*Fundulus zebrinus*	R	R	–	–	–
Red shiner	*Cyprinella lutrensis*	A	A	A	A	R
Sand shiner	*Notropis stramineus*	C	C	C	C	R

Common Name	Scientific Name	Above Westwater	Westwater Canyon Wilderness Study Area	The Moab Daily	Meander Canyon	Glen Canyon
Smallmouth bass	*Micropterus dolomieu*	R	R	R	R	C
Striped bass	*Morone saxatilis*	R	–	–	–	C
Threadfin shad	*Dorosoma petenense*	R	–	–	–	C
Walleye	*Sander vitreus*	R	R	R	R	C
White sucker	*Catostomus commersonii*	R	R	R	R	R
Yellow perch	*Perca flavescens*	R	–	–	–	R

Source: Valdez (2018).

Notes: A = abundant, > 50% of total fish abundance; C = common, 10%–50% of total fish abundance; R = rare, < 10% of total fish abundance; Dash = the species is not found in that segment. Trout are extremely rare in the planning area and are therefore not included in this table.

Section 7 of the ESA requires federal agencies to ensure that the effects of actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of endangered species. These determinations are made through ESA Section 7 consultations that include a biological assessment or a biological opinion. Federally endangered and threatened species are also protected from "take" under Section 9 of the ESA. The ESA defines *take* as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct" (USFWS 2013). In addition, the ESA requires the designation of critical habitat for listed species when "prudent and determinable" (USFWS 2013).

Conservation species are included in a range-wide conservation agreement intended to implement conservation and management actions to avert federal listing. The conservation agreement for the three conservation species discussed in this section is signed by six western states: Arizona, Nevada, Utah, New Mexico, Colorado, and Wyoming (DWR 2006).

FEDERALLY LISTED FISH SPECIES

Bonytail

The bonytail is a large cyprinid (minnow) fish (Figure 2.24) endemic to the Colorado River basin. Adults live up to 40 years and attain a maximum size of approximately 550 millimeters (mm) total length (TL) and a weight of 1.1 kilograms (kg). The bonytail was listed as endangered under the ESA in 1980 (45 *Federal Register* 27710, April 23, 1980). A recovery plan was approved on September 4, 1990 (USFWS 1990a), and recovery goals were approved on August 1, 2002 (USFWS 2002a). Critical habitat was designated in 1994 (59 *Federal Register* 13374, April 20, 1994).

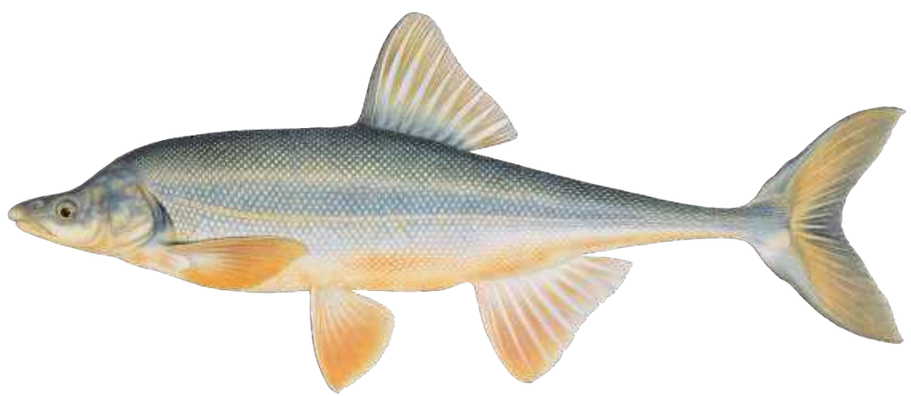


Figure 2.24. Adult bonytail.

Illustration © Joseph R. Tomelleri. Used with permission.

The bonytail is the rarest native fish in the Colorado River basin. Few wild bonytail have been collected in the last 35 years, and wild fish are rarely found in the upper basin (USFWS 2002a). Reasons for decline include habitat alteration and destruction, disruption of natural flow and temperature, disruption of sediment regimes by mainstem dams and diversions, and competition and predation from nonnative fishes.

Because of their streamlined body and because many individuals were historically caught in swift stretches of the Colorado River, the bonytail was originally thought to be a canyon-dweller like the humpback chub. The reaches of designated critical habitat are in canyon-bound areas (Figure 2.25). However, recent releases of large numbers of hatchery-reared bonytail indicate that the species may be more reliant on floodplain habitats and not necessarily canyon-bound reaches.

To assist with species recovery, hatchery propagation of bonytail began in 1981 with 11 wild adults that were captured from Lake Mohave. Hatchery-reared bonytail have been stocked in both upper and lower basins of the Colorado River system. More than 500,000 bonytail were released in the upper basin from 2000 to 2016, with 63% stocked in the Green River subbasin and the balance stocked in the Colorado River subbasin. Between 16,000 and 35,000 bonytail have been stocked annually in the upper basin since the 2000.

Stocking in the upper basin has occurred in a variety of habitats, including high-gradient, canyon-bound reaches as well as low-gradient, alluvial sections, often at sites where last-known wild individuals were captured or where floodplain wetlands exist. Use of floodplain wetlands and selected riverine backwaters was in response to successful stocking of bonytail in isolated off-channel ponds of the lower Colorado River. Recently, successful reproduction of bonytail was documented in inundated floodplains (i.e., Stewart Lake and Johnson Bottom) of the middle Green River (Bestgen et al. 2017). Because successful reproduction by bonytail in the wild has only been recently documented, the habitat used and behavior of the adults are still unknown. Nevertheless, the evidence is compelling that the bonytail appear to use a variety of habitats but seem to survive as young fish in inundated floodplains of reaches like the middle Green River.

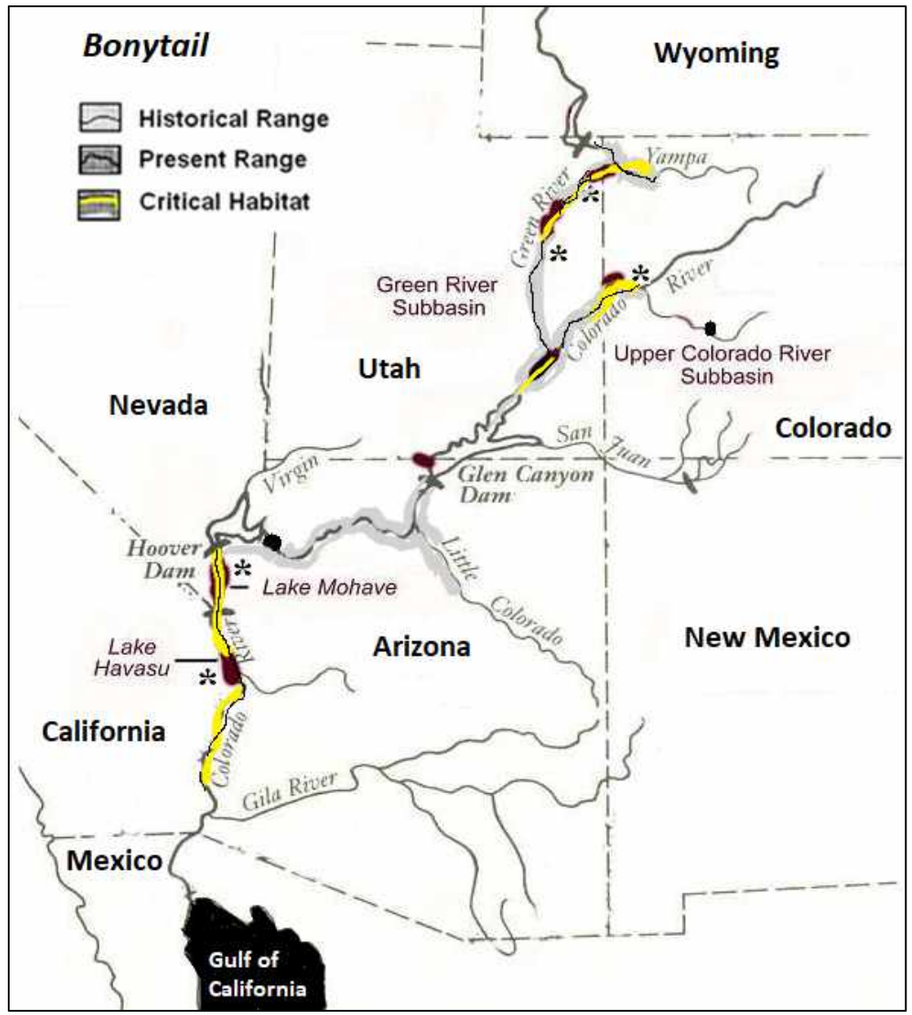


Figure 2.25. Historical and present distribution of the bonytail with designated critical habitat in the Colorado River system.

Source: Valdez et al. (2012). Used with permission.

COLORADO PIKEMINNOW

The Colorado pikeminnow is a large cyprinid (minnow) fish species (Figure 2.26) and is the largest cyprinid in North America. The species attains a maximum size of approximately 1.8 meters (m) TL and a weight of 36 kg. Adults mature at 5 to 7 years of age and can live for 40 years.

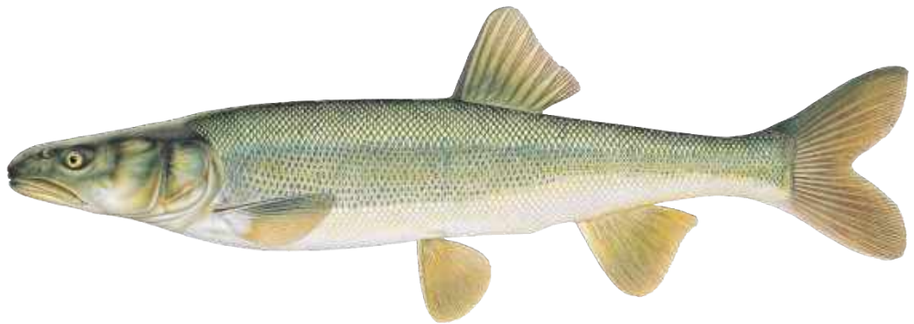


Figure 2.26. Adult Colorado pikeminnow.

The Colorado pikeminnow is listed as endangered under the ESA (32 *Federal Register* 4001, March 11, 1967; 50 *Federal Register* 30194, July 24, 1985). The latest revised Colorado squawfish (pikeminnow) recovery plan was approved on August 6, 1991 (USFWS 1991) and recovery goals were approved on August 1, 2002 (USFWS 2002b). The final rule for designation of critical habitat became effective in 1994 (59 *Federal Register* 13374, April 20, 1994).

The Colorado pikeminnow was once distributed throughout much of the Colorado River and its tributaries. Today, wild, reproducing populations occur in the Green River and upper Colorado River subbasins of the upper basin (i.e., upstream of Glen Canyon Dam, Arizona), and there are small numbers of wild individuals (with limited reproduction) in the San Juan River subbasin (Miller 2014, 2018; Figure 2.27). The species was extirpated from the lower basin in the 1970s but was reintroduced into the Gila and Verde Rivers in 1985 as a nonessential, experimental population (*Federal Register* Vol. 50. No. 142, 30188–30195, July 24, 1985), where it persists in small numbers today.

The Colorado pikeminnow is a long-distance migrator, moving hundreds of kilometers to and from spawning areas. Spawning occurs in late June and July after spring runoff at water temperatures of 18 degrees Celsius (°C) to 23°C. Spawning in the Green River subbasin occurs in primarily two rocky canyon areas, the lower Yampa River (i.e., Cleopatra's Couch) and lower Gray Canyon (i.e., Fish Ford rapid). Eggs are broadcast and fertilized over cobble and gravel substrates. The eggs incubate in 5 to 7 days, and the newly hatched larvae remain in the substrate for a few days before emerging and becoming transported downstream. The larval and post-larval fish become entrained in warm productive backwaters where they remain for the rest of the summer and winter, until the following spring runoff. Juveniles and subadults use a variety of habitats in sandy reaches of river and adults require pools, deep runs, and eddy habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, form gravel and cobble deposits used for spawning, and rejuvenate backwater nursery habitats.

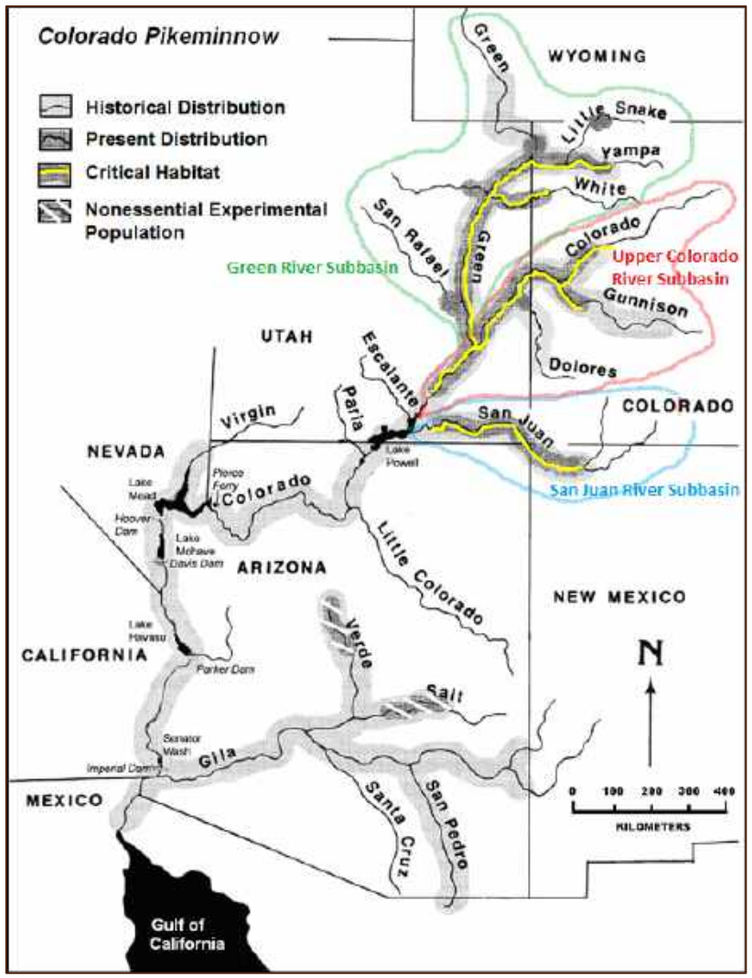


Figure 2.27. Historical and present distribution of the Colorado pikeminnow with designated critical habitat in the Colorado River system.

Source: Miller (2018). Used with permission.

Humpback Chub

The humpback chub is a warm-water cyprinid (minnow) fish species (Figure 2.28) endemic to the Colorado River system of the southwestern United States. The species attains a maximum size of 480 mm TL and a weight of 1.2 kg.

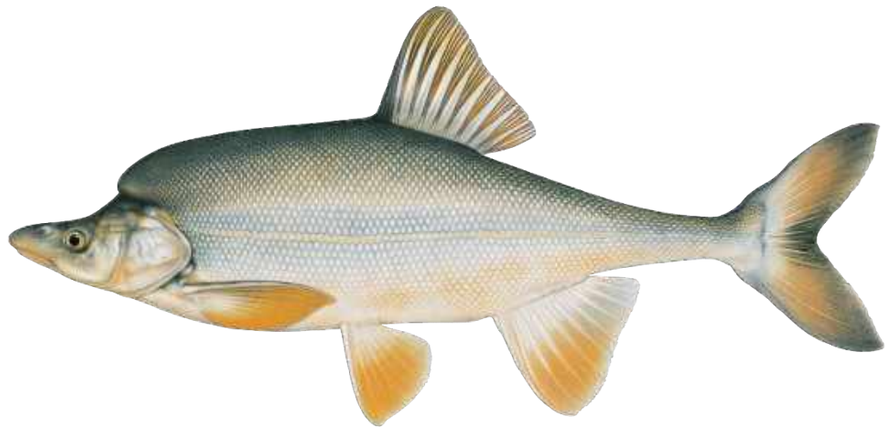


Figure 2.28. Adult humpback chub.

Illustration © Joseph R. Tomelleri. Used with permission.

The humpback chub is listed as endangered under the ESA (32 *Federal Register* 4001, March 11, 1967; 50 *Federal Register* 30194, July 24, 1985). The latest revised humpback chub recovery plan was approved on September 19, 1990 (USFWS 1990b) and recovery goals were approved on August 1, 2002 (USFWS 2002c). The final rule for designation of critical habitat became effective in 1994 (59 *Federal Register* 13374, April 20, 1994).

The humpback chub is native to Arizona, Colorado, Utah, and Wyoming. Its current range is approximately 1,353 kilometers (km), or 62% of its historical range (Figure 2.29). Range reduction has occurred largely from inundation by large human-made reservoirs, including Lake Mead, Lake Powell, and Flaming Gorge (USFWS 2018f).

The species is currently found as five populations, comprising four in the upper basin (Black Rocks, Westwater Canyon, Desolation and Gray Canyons, and Cataract Canyon), and one in the lower basin in the Grand Canyon. A sixth upper basin population in Dinosaur National Monument is below detection level and is now considered functionally extirpated. The five populations occupy 598 km of river, or approximately 78% of the historically occupied habitat of 764 km. Each population consists of a discrete, geographically separate group of fish, with a few individuals moving among populations at a decadal scale, based on genetic evidence. The lower basin population became isolated from the five upper basin populations with completion of Glen Canyon Dam in 1963.

Humpback chub mature at 3 to 5 years of age and live up to 40 years. They spawn from April through June, during and shortly after the peak of spring runoff at water temperatures of 16°C to 22°C. Aggregations of adults release and fertilize eggs over rubble, cobble, and gravel substrates along channel margins or on large submerged mid-channel cobble bars. The eggs incubate in interstitial spaces and hatch in approximately 5 days. The larvae remain for several days before drifting short distances to shallow, protected shoreline habitats. Timing and magnitude of runoff can influence habitat conditions and temperature for reproduction and incubation of eggs; although there is evidence that humpback chub can spawn in a wide range of flows and temperatures (USFWS 2018f).

Humpback chub larvae do not appear to drift great distances. Larvae are commonly found along warm sheltered shoreline habitats, and they may be found in backwaters, although these habitat features are rare in canyon reaches and particularly during spring runoff when the larvae are emerging. Young-of-year continue to use shallow, warm, productive, sheltered habitats that they entered as larvae. They may use backwaters if available, although this habitat feature is not common in canyon-bound reaches where population centers occur. A major controlling factor of humpback chub populations is predation on young by a variety of nonnative fish species.

Humpback chub dramatically shift habitats in their second or third years of life and move from shallow, sheltered shorelines to large mid-channel recirculating eddies. These eddies provide large entrainment zones for food and low-velocity regions for resting. Adult humpback chub are uniquely suited to live in the swift canyon reaches of the Colorado River system. High spring flows create severe hydrologic conditions that preclude most other fish species from these habitats, but prolonged year-round low flows and periods of drought can break down these isolating mechanisms and disrupt food production and allow for invasion by competing or hybridizing fish species.

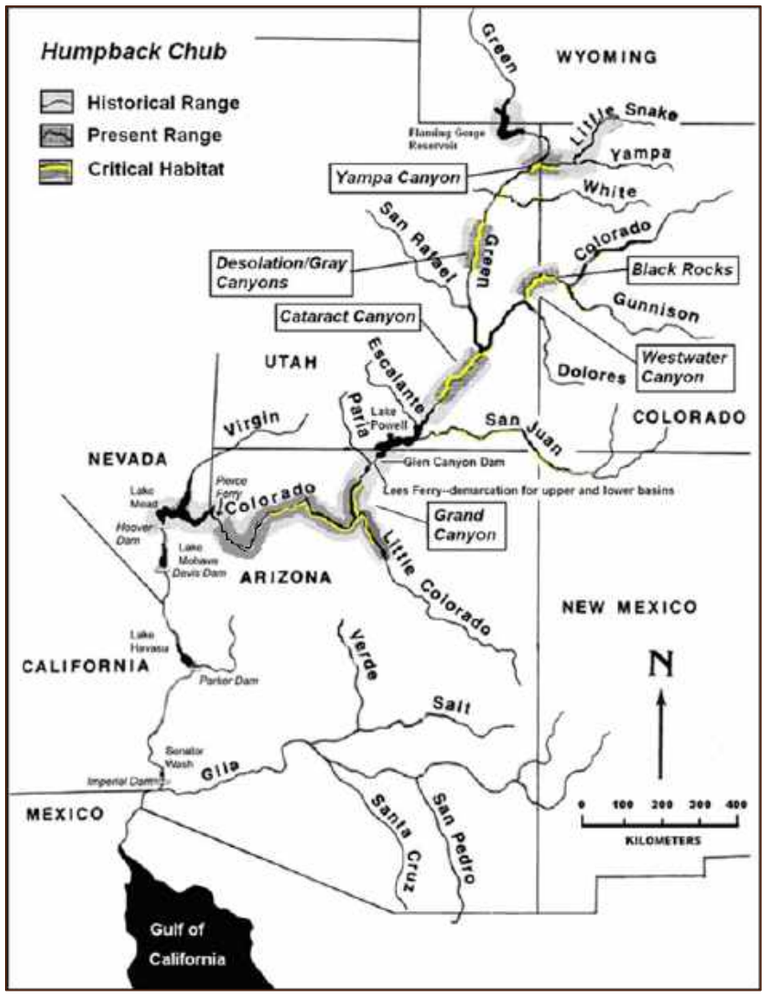


Figure 2.29. Historical and present distribution of the humpback chub with designated critical habitat in the Colorado River system.

Source: USFWS (2018f). Used with permission.

Razorback Sucker

The razorback sucker is a large catostomid fish (Figure 2.30) endemic to the Colorado River basin. Adults live approximately 40 years and attain a maximum size of approximately 1 m TL and a weight of 5 to 6 kg.

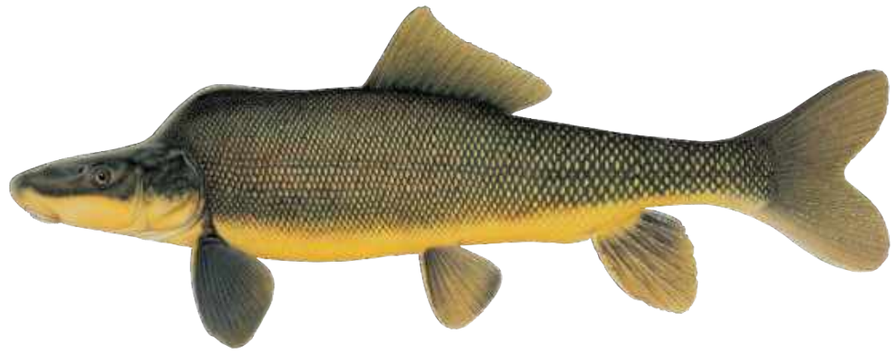


Figure 2.30. Adult razorback sucker.

Illustration © Joseph R. Tomelleri. Used with permission.

The razorback sucker was listed as endangered under the ESA in 1991 (56 *Federal Register* 54957, October 23, 1991). A recovery plan was approved on December 23, 1998 (USFWS 1998), and recovery goals were approved on August 1, 2002 (USFWS 2002d). Critical habitat was designated in 1994 (59 *Federal Register* 13374, April 20, 1994).

Historically, the razorback sucker occupied the mainstem Colorado River and many of its tributaries from northern Mexico through Arizona and Utah into Wyoming, Colorado, and New Mexico. Distribution and abundance of razorback sucker declined throughout the twentieth century over all of its historic range, and by the beginning of the twenty-first century, the species was reduced to a few small, discontinuous populations or as dispersed individuals. Recovery efforts throughout the basin helped restore reproducing populations in the Green River, upper Colorado River, San Juan River, and in Lake Mead and the lower Grand Canyon (Figure 2.31).

Spawning occurs on mid-channel cobble and gravel bars in May and June at temperatures of 6°C to 21°C. The razorback sucker is a broadcast spawner that releases and fertilizes its eggs near the river bottom so that incubation can take place in protected interstitial spaces of cobble and gravel substrates. The eggs incubate in 6 to 7 days in the spaces between cobble and gravel substrate, and the larvae emerge and become transported downstream, where they become entrained in floodplains that become inundated during spring runoff. These floodplains are rich, productive nursery habitats where the young feed on plankton, insects, crustaceans, and detritus. The young suckers may spend an extended time in these floodplains, or they may move back to the main channel with receding spring flows. Juvenile razorback suckers have been collected in very warm-water temperature (21.7°C–34.0°C), at shallow depth (0.1–0.2 m), in zero-velocity current, and over silt substrate. In riverine environments, adults are generally found in deep water, but can be found in a range of depths (0.18–3.40 m), with no consistent seasonal pattern (USFWS 2002d).

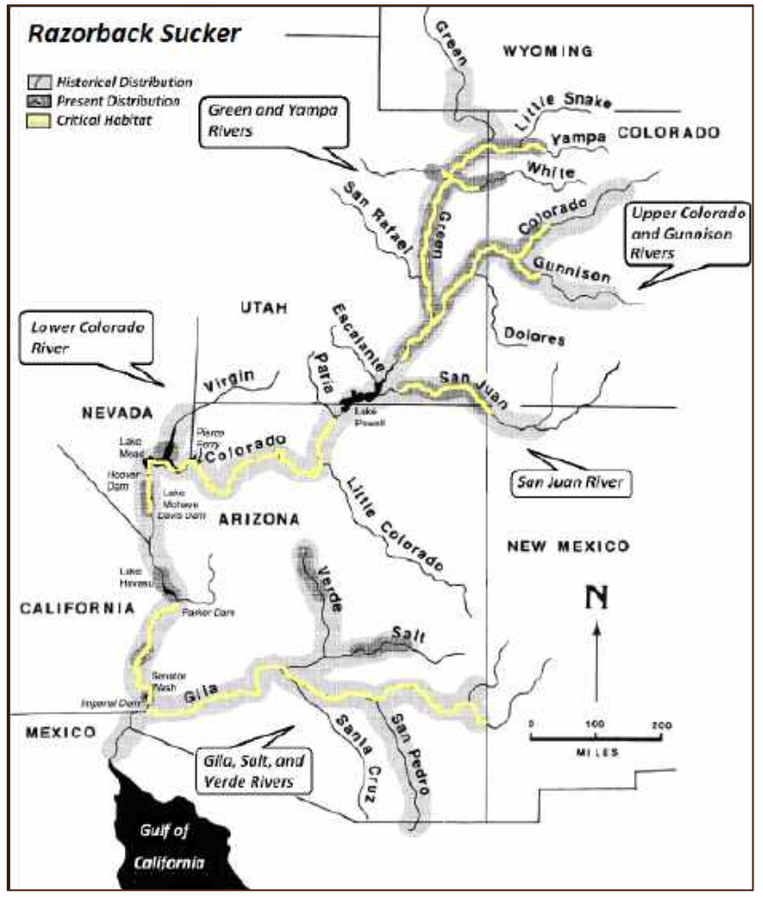


Figure 2.31. Historical and present distribution of the razorback sucker with designated critical habitat in the Colorado River system.

Source: Valdez et al. (2012). Used with permission.

CONSERVATION AGREEMENT FISH SPECIES

Bluehead Sucker

The bluehead sucker is a medium-size sucker (Figure 2.32) native to the Colorado River system. It can reach a size of approximately 360 mm TL. In 1991, the species was included as a category 2 candidate species for federal listing (56 *Federal Register* 225:58604–58836, November 21, 1991), but no action was pursued to list the species. A category 2 species is possibly appropriate to list as endangered or threatened, but lacks conclusive data on biological vulnerability and threats to support a proposed rule. The last time the status of the bluehead sucker was reviewed was in 1994, and it remains a candidate category 2 species (59 *Federal Register* 219:58982–59028, November 15, 1994). In Utah, the bluehead sucker is a species receiving special management under a conservation agreement in order to preclude the need for federal listing (DWR 2009).

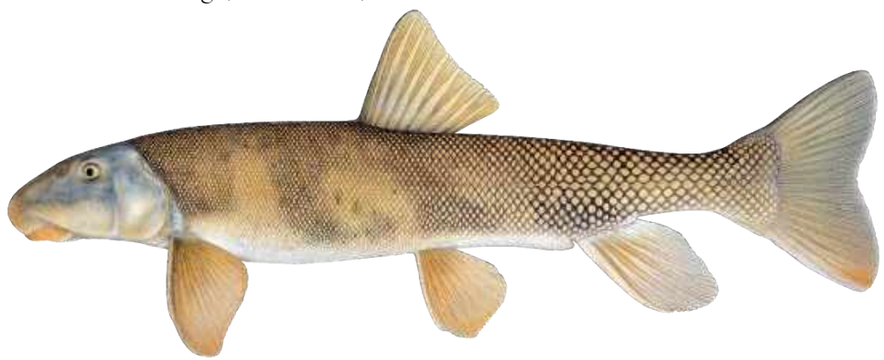


Figure 2.32. Adult bluehead sucker.

Illustration © Joseph R. Tomelleri. Used with permission.

The bluehead sucker was historically common in most small, medium, and large, middle to low elevation rivers of the upper basin (upstream of Lee's Ferry). It was found in similar habitats of the lower basin (downstream of Lee's Ferry), but in fewer numbers. Unlike the flannelmouth sucker, the bluehead sucker is related to the mountain suckers and is capable of living at higher elevations than the former and at cooler temperatures.

The bluehead sucker is associated with large rivers, but also occurs in small tributaries (Bestgen et al. 2017; Bezzerides and Bestgen 2002). The species is still widely distributed in small, medium, and large streams of the upper basin, including the mainstem Colorado River; numerous tributaries that drain a large portion of Colorado, Wyoming, and Utah; and the San Juan River drainage in New Mexico. The bluehead sucker is still found in most of its historical range in Colorado and Wyoming but is reduced in abundance in some areas because of predation and/or hybridization with the white sucker (*Catostomus commersonii*).

Bluehead suckers spawn in the spring at water temperatures of approximately 10°C to 15°C during and after spring runoff. Adults congregate and broadcast and fertilize their eggs over cobble and gravel bars. The eggs incubate in 5 to 7 days, and the larvae emerge after approximately 1 week and are transported downstream into quiet nursery habitats. Juvenile and subadults use habitats of shallow to medium depth generally with rocky substrate and over large mid-channel cobble and gravel bars. Adults are frequently found in large numbers on these bars.

Flannelmouth Sucker

The flannelmouth sucker is a large sucker (Figure 2.33) native to the Colorado River system. Adults can grow to a length of 660 mm TL and a weight of approximately 4.6 kg. In 1991, the species was included as a category 2 candidate species for federal listing (56 *Federal Register* 225:58604–58836, November 21, 1991), but no action was pursued to list the species. The last time the status of the flannelmouth sucker was reviewed was in 1994, and it remains a candidate category 2 species (59 *Federal Register* 219:58982–59028, November 15, 1994). In Utah, the flannelmouth sucker is a species receiving special management under a conservation agreement in order to preclude the need for federal listing (DWR 2009).

Figure 2.33. Adult flannelmouth sucker.

Illustration © Joseph R. Tomelleri. Used with permission.

The flannelmouth sucker was historically common in most medium to large, lower elevation rivers of the upper basin (upstream of Lee's Ferry). It was found in similar habitats of the lower basin (downstream of Lee's Ferry), but in fewer numbers. Although this species is typically associated with large rivers, it also occurs in small tributaries (Bestgen et al. 2017) and occasionally in lakes and reservoirs (Bezzerides and Bestgen 2002). The flannelmouth sucker is still widely distributed in medium to large streams of the upper basin, including the mainstem Colorado River; numerous tributaries that drain a large portion of Colorado, Wyoming, and Utah; and the San Juan River drainage in New Mexico. The flannelmouth sucker is still found in most of its historical range in Colorado and Wyoming but is reduced in abundance in some areas because of hybridization with the white sucker and predation.

Flannelmouth suckers spawn in the spring at water temperatures of approximately 11°C to 17°C during the descending limb of runoff. Adults congregate and broadcast and fertilize their eggs over cobble and gravel bars. The eggs incubate in 5 to 7 days, and the larvae emerge after approximately 1 week and are transported downstream into quiet nursery habitats. Juvenile and subadults use habitats of shallow to medium depth with cover or over large mid-channel cobble and gravel bars. Adults are frequently found in large numbers on these bars or near their downstream end.

Roundtail Chub

The roundtail chub is a medium-size cyprinid (minnow) fish species (Figure 2.34) native to the Colorado River system. It is part of the "robusta complex," which includes *Gila robusta*, *G. r. grahami*, and *G. r. seminude*. Roundtail chub can reach almost 490 mm and a weight of approximately 1 kg.

Figure 2.34. Adult roundtail chub.

Illustration © Joseph R. Tomelleri. Used with permission.

In 1991, the species was included as a category 2 candidate species for federal listing (56 *Federal Register* 225:58604–58836, November 21, 1991), but no action was pursued to list the species. The last time the status of the roundtail chub was reviewed was in 1994, and it remains a candidate category 2 species (59 *Federal Register* 219:58982–59028, November 15, 1994). In Utah, the roundtail chub is a species receiving special management under a conservation agreement in order to preclude the need for federal listing (DWR 2009). In 2003, a petition was filed with the USFWS to list the roundtail chub as a distinct population segment (DPS) in the lower basin and evaluated through a stipulated settlement agreement in 2005 (70 *Federal Register* 132:39981–39986, July 12, 2005).

In 2006, the USFWS found that listing the roundtail chub as a DPS in the lower basin was unwarranted (71 *Federal Register* 85:26007–26017, May 3, 2006). That decision was challenged and following a second stipulated settlement agreement, a second 12-month finding in 2009 determined that listing the roundtail chub as a DPS in the lower basin was warranted but precluded by higher priority actions (74 *Federal Register* 128:32352–32387, July 7, 2009). In 2015, a lower basin DPS was again proposed (80 *Federal Register* 194:60754–60783, October 7, 2015), but was withdrawn from further consideration in 2017 because the species was found to be the same taxa as other species of similar appearance in the Colorado River system (82 *Federal Register* 66:16981–16988, April 7, 2017).

The roundtail chub is a spring spawner. Adults aggregate over cobble and gravel substrates and broadcast eggs that are fertilized and incubate in the interstial spaces. The larvae hatch in approximately 5 days and emerge in approximately 1 week to drift downstream to quiet productive shoreline areas. The species has a high affinity for rocky substrate, and populations are often found intermittently where the river flows through a rocky substrate or a canyon area (Francis and Bestgen 2016). Young and juveniles use shallow sheltered shoreline areas, and subadults and adults prefer large deep pools and eddies, where they can position themselves next to the eddy line and feed on debris and insects drifting in the river. The roundtail chub can be a voracious predator, consuming large amounts of fish, crayfish, frogs, and insects. Roundtail chub adults primarily consume aquatic and terrestrial insects, other fishes, and sometimes algae. Roundtail chub juveniles eat smaller insects, crustaceans, and algae.

CRITICAL HABITAT IN THE PLANNING AREA FOR LISTED FISH SPECIES

Above Westwater

This segment is included in critical habitat for the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker. It is located between the two largest populations of humpback chub in the upper basin: Black Rocks is approximately 4 miles upstream, and Westwater Canyon is immediately downstream. The abundance of humpback chub in this segment is low; however, the numbers of roundtail chub are high. This segment is dominated by a rock substrate, and there are few sand-bed nursery backwaters for newly hatched Colorado pikeminnow. There are no known spawning sites or significant nursery areas for Colorado pikeminnow, humpback chub, razorback sucker, or bonytail in this segment.

Westwater Canyon Wilderness Study Area

This segment includes Westwater Canyon, which extends for approximately 12 miles near its upper end. It is included in critical habitat for Colorado pikeminnow, humpback chub, bonytail, and razorback sucker. Westwater Canyon supports the largest self-sustained population of humpback chub in the upper basin (USFWS 2002c, 2018f). Westwater Canyon is designated as a high-use area for spawning, larvae, juveniles (ages 0–1), subadults, and adults of humpback chub. Approximately 10 miles separates Westwater Canyon from another self-sustained population of humpback chub found upstream beyond the planning area in Black Rocks, Colorado (Francis and Bestgen 2016). Critical habitat for the humpback chub extends from Black Rocks downstream through Westwater Canyon to Fish Ford (in The Moab Daily segment).

This segment of the Colorado River does not receive much use by razorback sucker. Increasing numbers have been seen in this area because of extensive stocking in and near nursery floodplains in the lower Gunnison River and in the Colorado River near Grand Junction, approximately 40 miles upstream. Small numbers of stocked bonytail are found in this segment, but there is no evidence of reproduction. Roundtail chub and flannelmouth sucker are common in Westwater Canyon, depending on river flow; low flows allow for greater numbers of these species to invade this swift-rapids reach.

The Moab Daily

The upper portion of this segment, downstream to Big Bend at RM 71, is a relatively narrow, deep reach with a predominantly rock substrate. The northern end of The Moab Daily segment from RM 107.5 to 113.0 is included in critical habitat for humpback chub and bonytail. This entire segment is included in critical habitat for Colorado pikeminnow and razorback sucker. It includes Colorado pikeminnow spawning sites downstream of

Westwater Canyon, and the lower end of this segment (downstream of Big Bend) receives high use by entrained larvae in sandy backwaters. This segment is part of one of the most important nursery areas for Colorado pikeminnow in the Colorado River. This segment also receives little, moderate, and high use by juveniles (ages 0–1), subadults, and adults, respectively. Campers and rafters frequent this area and are advised to not dispose of washwater or other materials into these backwaters to avoid contamination and stress on young Colorado pikeminnow, as well as other native fishes. In addition, this segment includes the confluence with the Dolores River, a tributary that supports populations of flannelmouth sucker, bluehead sucker, and roundtail chub, with small numbers of Colorado pikeminnow reported.

Meander Canyon

This segment is included in critical habitat for Colorado pikeminnow and razorback sucker. It is part of one of the most important nursery areas for Colorado pikeminnow in the Colorado River, where the age 0 fish become entrained in sand-bed nursery backwaters. This segment also receives little, moderate, and high use by juveniles (ages 0–1), subadults, and adults, respectively. Campers and rafters in this area are advised to not dispose of washwater or other materials into these backwaters to avoid contamination and stress on young Colorado pikeminnow, as well as other native fishes. This segment supports small numbers of flannelmouth sucker.

Glen Canyon

This segment of the Colorado River was inundated by Lake Powell from ca. 1970 to 2002. As lake elevation dropped, the upper 8 to 10 miles became riverine from 2002 to 2004, and in 2005, much of the upper segment became inundated again. Despite the lake inundation, the upper part of this segment has resembled a flowing river since ca. 2002. These changing lake elevations and the consequent dynamics of the sediment-bed river have caused large changes to the habitat of the area and to the fish community. Species of river fish, including Colorado pikeminnow, have used this upper area intermittently, depending on lake elevation.

For most of the lower two-thirds of this segment, the fish composition reflects fish species common to Lake Powell (see Table 2.8). There are few native fish species in this segment, except for small numbers of adult Colorado pikeminnow from the Colorado River and San Juan River inflows, and small numbers of adult razorback sucker also from these inflows with some individuals of this species moving across the lake and between these rivers (Durst and Francis 2016). Bonytail are rarely reported from this segment as either remnants of a pre-dam population or individuals dispersing from stocking in the upper basin. Humpback chub are not found in this segment, although a few individuals were reported in the 1970s, as Lake Powell was filling, probably survivors of a remnant population in Cataract Canyon (USFWS 2002c). Despite the small numbers of native fish in this segment, the upper 10 miles (Mille Craig Bend to North Wash) is included in critical habitat for Colorado pikeminnow and razorback sucker.

Information on critical habitat and the relative use of planning area segments by the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker is shown in Table 2.9.

Table 2.9. Location and Relative Use of Planning Area Segments of the Colorado River by Life Stages of Colorado Pikeminnow, Humpback Chub, Razorback Sucker, and Bonytail

Segment Name	Colorado Pikeminnow						Humpback Chub						Razorback Sucker						Bonytail					
	Critical Habitat	Spawn	Larvae	Juvenile (age 0–1)	Subadult	Adult	Critical Habitat	Spawn	Larvae	Juvenile (age 0–1)	Subadult	Adult	Critical Habitat	Spawn	Larvae	Juvenile (age 0–1)	Subadult	Adult	Critical Habitat	Spawn	Larvae	Juvenile (age 0–1)	Subadult	Adult
Above Westwater	All	0	1	1	1	1	All	0	1	1	1	1	All	0	0	0	0	1	All	0	0	0	0	1
Westwater Canyon Wilderness Study Area	All	0	0	1	1	1	All	3	3	3	3	3	All	0	0	0	0	1	All	0	0	0	0	1
The Moab Daily	All	0	2	1	2	3	Part	0	0	0	1	1	All	0	0	0	0	1	Part	0	0	0	0	1
Meander Canyon	All	0	3	1	2	3	None	0	0	0	0	0	All	0	0	0	0	1	None	0	0	0	0	1
Glen Canyon	Part	0	0	0	0	1	None	0	0	0	0	0	Part	0	1	1	2	3	None	0	0	0	0	1

Notes: Adopted from LaGory et al. (2003) and Valdez and Widner (2011). Use of planning area segments by life stages of fish species reflects recent conditions; these conditions could change with river flows, reservoir elevations, or other habitat dynamics.

0 = no use (blank), 1 = little use (yellow), 2 = moderate use (green), and 3 = high use (red). Critical habitat for each species is shown as gray cells, where All, Part, or None of the river segment is included in designated critical habitat.

Bird Species

The planning area provides important habitat for many bird species. The Meander Canyon segment and the northern portion of the Glen Canyon segment are located in the Canyonlands Area IBA.

Bird species data for specific locations in the planning area are available from eBird. eBird is a citizen-based global bird observation network that provides data sources for basic information on bird distribution and abundance at a variety of temporal and spatial scales. The presence or absence of species in addition to bird abundance are documented through checklist data. A birder fills out a checklist of all the birds seen or heard during a particular outing. Submissions are reviewed by automated data quality filters developed by regional birding experts before they are entered into the database, and unusual records are flagged by filters and reviewed by local experts. 2017 and 2018 eBird data from eight locations (hotspots) on the Above Westwater, Westwater Canyon Wilderness Study Area, and The Moab Daily segments and three locations on the Glen Canyon segment documented more than 130 bird species (Table 2.10). There are no species count locations for the Meander Canyon segment.

Table 2.10. Bird Species Recorded along or near the Planning Area by Segment in 2017 and 2018

Common Name	Scientific Name	Location in the Planning Area by Segment*	
		Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily†	Glen Canyon
DUCKS, GEESE, AND SWANS			
American wigeon	*Anas americana*	1, 7	–
Barrow's goldeneye	*Bucephala islandica*	–	10
Bufflehead	*Bucephala albeola*	–	10
Cackling goose	*Branta hutchinsii*	1	–
Canada goose	*Branta canadensis*	1, 2, 5, 6, 7	10
Common goldeneye	*Bucephala clangula*	1	10
Common merganser	*Mergus merganser*	1, 6, 7	10
Gadwall	*Anas strepera*	1, 7	10
Green-winged teal	*Anas crecca*	1, 7	10
Mallard	*Anas platyrhynchos*	1, 5, 6, 7	9, 10
Northern pintail	*Anas acuta*	7	–
Northern shoveler	*Anas clypeata*	–	10
Red-breasted merganser	*Mergus serrator*	–	10
Ruddy duck	*Oxyura jamaicensis*	–	10
Snow goose	*Chen caerulescens*	1	–
PHEASANTS, GROUSE, AND QUAIL			
Wild turkey	*Meleagris gallopavo*	1, 6	
LOONS AND GREBES			
Common loon	*Gavia immer*	–	10
Eared grebe	*Podiceps nigricollis*	–	11
Horned grebe	*Podiceps auritus*	–	10
Western grebe	*Aechmophorus occidentalis*	1	9, 11

Common Name	Scientific Name	Location in the Planning Area by Segment*	
		Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily†	Glen Canyon
PELICANS AND CORMORANTS			
American white pelican	*Pelecanus erythrorhynchos*	–	9
Double-crested cormorant	*Phalacrocorax auritus*	–	10, 11
EGRETS AND IBIS			
Great blue heron	*Ardea herodias*	1, 2, 4, 5, 6, 7	9, 10
Snowy egret	*Egretta thula*	1	–
White-faced ibis	*Plegadis chihi*	1, 5	9, 10, 11
VULTURES, HAWKS, AND EAGLES			
Bald eagle	*Haliaeetus leucocephalus*	1, 3, 5, 7	10
Cooper's hawk	*Accipiter cooperii*	6	–
Ferruginous hawk	*Buteo regalis*	1	–
Golden eagle	*Aquila chrysaetos*	3, 4, 6	–
Northern harrier	*Circus cyaneus*	1	–
Osprey	*Pandion haliaetus*	–	11
Red-tailed hawk	*Buteo jamaicensis*	1, 3, 4	–
Turkey vulture	*Cathartes aura*	1, 3, 6, 7	9
RAILS AND CRANES			
American coot	*Fulica americana*	–	10
Virginia rail	*Rallus limicola*	6	–

Common Name	Scientific Name	Location in the Planning Area by Segment*	
		Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily†	Glen Canyon
PLOVERS, SANDPIPERS, AND GULLS			
American avocet	*Recurvirostra americana*	–	9
Killdeer	*Charadrius vociferus*	5	–
Lesser black-backed gull	*Larus fuscus*	–	10
Ring-billed gull	*Larus delawarensis*	–	10
Spotted sandpiper	*Actitis macularius*	2, 5, 6	–
Wilson's phalarope	*Phalaropus tricolor*	–	11
PIGEONS AND DOVES			
Eurasian collared-dove	*Streptopelia decaocto*	1, 5, 6	–
Mourning dove	*Zenaida macroura*	1, 4, 6, 7, 8	–
OWLS			
Long-eared owl	*Asio otus*	1	–
Great horned owl	*Bubo virginianus*	1	–
NIGHTJARS			
Common nighthawk	*Chordeiles minor*	1	–
White-throated swift	*Aeronautes saxatalis*	1, 2, 4, 6, 7	9

Common Name	Scientific Name	Location in the Planning Area by Segment*	
		Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily†	Glen Canyon
HUMMINGBIRDS			
Black-chinned hummingbird	*Archilochus alexandri*	1, 6, 7, 8	–
Broad-tailed hummingbird	*Selasphorus platycercus*	1, 6	–
KINGFISHERS			
Belted kingfisher	*Megaceryle alcyon*	1	–
WOODPECKERS AND SAPSUCKERS			
Downy woodpecker	*Picoides pubescens*	7	–
Northern flicker	*Colaptes auratus*	1, 4, 7, 8	–
Red-naped sapsucker	*Sphyrapicus nuchalis*	1	–
FALCONS			
American kestrel	*Falco sparverius*	1, 3	–
Peregrine falcon	*Falco peregrinus*	7, 8	11
FLYCATCHERS			
Ash-throated flycatcher	*Myiarchus cinerascens*	1, 4, 6, 7	–
Black phoebe	*Sayornis nigricans*	1, 5	–
Dusky flycatcher	*Empidonax oberholseri*	3	–
Eastern kingbird	*Tyrannus tyrannus*	1	–
Olive-sided flycatcher	*Contopus cooperi*	1	–
Say's phoebe	*Sayornis saya*	1, 4, 5, 6, 7	11
Western kingbird	*Tyrannus verticalis*	1, 2, 4, 5, 6, 7	–
Western wood-pewee	*Contopus sordidulus*	1, 2	–
Willow flycatcher	*Empidonax traillii*	1, 2	–
VIREOS			
Cassin's vireo	*Vireo cassinii*	5	–
Gray vireo	*Vireo vicinior*	6	–
Plumbeous vireo	*Vireo plumbeus*	1, 8	–
Warbling vireo	*Vireo gilvus*	1, 6	–
SHRIKES			
Northern shrike	*Lanius excubitor*	1	–
JAYS AND CROWS			
American crow	*Corvus brachyrhynchos*	1, 2, 3, 4, 5, 6	–
Black-billed magpie	*Pica hudsonia*	1, 3, 5	–
Common raven	*Corvus corax*	1, 3, 4, 5, 6, 7, 8	9, 10, 11
Pinyon jay	*Gymnorhinus cyanocephalus*	4	–
Woodhouse's scrub-jay	*Aphelocoma woodhouseii*	5, 7, 8	–
LARKS			
Horned lark	*Eremophila alpestris*	1, 3	–

Common Name	Scientific Name	Location in the Planning Area by Segment*	
		Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily†	Glen Canyon
SWALLOWS			
Bank swallow	*Riparia riparia*	1, 2	–
Barn swallow	*Hirundo rustica*	1, 3, 6	–
Cliff swallow	*Petrochelidon pyrrhonota*	1, 2, 4, 5, 6	–
Northern rough-winged swallow	*Stelgidopteryx serripennis*	1, 2, 6	–
Violet-green swallow	*Tachycineta thalassina*	1, 3, 4, 5, 6, 7	–
CHICKADEES			
Black-capped chickadee	*Poecile atricapillus*	1	–
Bushtit	*Psaltriparus minimus*	6	–
Juniper titmouse	*Baeolophus ridgwayi*	4	–
Mountain chickadee	*Poecile gambeli*	4	–
NUTHATCHES AND CREEPERS			
Red-breasted nuthatch	*Sitta canadensis*	6	–
WRENS			
Bewick's wren	*Thryomanes bewickii*	3	–
Canyon wren	*Catherpes mexicanus*	1, 2, 5, 7, 8	–
House wren	*Troglodytes aedon*	4	–
Rock wren	*Salpinctes obsoletus*	1	11

Common Name	Scientific Name	Location in the Planning Area by Segment*	
		Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily†	Glen Canyon
KINGLETS AND GNATCATCHERS			
Ruby-crowned kinglet	*Regulus calendula*	6, 7	–
Blue-gray gnatcatcher	*Polioptila caerulea*	1, 3, 4, 5, 7, 8	–
THRUSHES			
American robin	*Turdus migratorius*	3, 6, 7, 8	–
Hermit thrush	*Catharus guttatus*	8	–
Mountain bluebird	*Sialia currucoides*	1, 4	–
Townsend's solitaire	*Myadestes townsendi*	1	–
Western bluebird	*Sialia mexicana*	6	–
THRASHERS			
Gray catbird	*Dumetella carolinensis*	6	–
Northern mockingbird	*Mimus polyglottos*	1, 4, 5, 6	–
STARLINGS			
European starling	*Sturnus vulgaris*	1, 6	–
PIPITS			
American pipit	*Anthus rubescens*	1	–
WAXWINGS			
Cedar waxwing	*Bombycilla cedrorum*	4, 6	–

Common Name	Scientific Name	Location in the Planning Area by Segment*	
		Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily†	Glen Canyon
WARBLERS			
Lucy's warbler	*Oreothlypis luciae*	8	–
MacGillivray's warbler	*Geothlypis tolmiei*	4	–
Orange-crowned warbler	*Oreothlypis celata*	1	–
Wilson's warbler	*Cardellina pusilla*	1, 6	–
Yellow-breasted chat	*Icteria virens*	1, 2, 4, 5, 6	–
Yellow warbler	*Setophaga petechia*	1, 2, 4, 5, 6, 7	–
Yellow-rumped warbler	*Setophaga coronata*	1, 3, 7	–
SPARROWS			
American tree sparrow	*Spizelloides arborea*	1	–
Black-throated sparrow	*Amphispiza bilineata*	1, 4	–
Brewer's sparrow	*Spizella breweri*	1	–
Chipping sparrow	Spizella passerina	1, 3, 7, 8	–
Dark-eyed junco	*Junco hyemalis*	1, 7	–
Green-tailed towhee	*Pipilo chlorurus*	7	–
Lark sparrow	*Chondestes grammacus*	1, 4, 7	–
Lincoln's sparrow	*Melospiza lincolnii*	7	–
Sagebrush sparrow	*Artemisiospiza nevadensis*	6	–
Savannah sparrow	*Passerculus sandwichensis*	2	–
Song sparrow	*Melospiza melodia*	1, 5, 6, 7, 8	–
Spotted towhee	*Pipilo maculatus*	1, 4, 6, 7, 8	–
Vesper sparrow	*Pooecetes gramineus*	1	–
White-crowned sparrow	*Zonotrichia leucophrys*	1, 2, 4, 7, 8	–
TANAGERS, GROSBEAKS, AND BUNTINGS			
Black-headed grosbeak	*Pheucticus melanocephalus*	4, 6	–
Blue grosbeak	*Guiraca caerulea*	1, 3, 4, 6	–
Indigo bunting	*Passerina cyanea*	4, 6	–
Lazuli bunting	*Passerina amoena*	1, 4, 6, 7	–
Western tanager	*Piranga ludoviciana*	4, 6	–
BLACKBIRDS AND ORIOLES			
Brewer's blackbird	*Euphagus cyanocephalus*	1	–
Brown-headed cowbird	*Molothrus ater*	6	–
Bullock's oriole	*Icterus bullockii*	1, 4, 6, 7	–
Red-winged blackbird	*Agelaius phoeniceus*	1	–
Western meadowlark	*Sturnella neglecta*	1	–
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	1	11

Common Name	Scientific Name	Location in the Planning Area by Segment*	
		Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily†	Glen Canyon
FINCHES			
American goldfinch	*Spinus tristis*	1, 4, 6, 8	–
Cassin's finch	*Haemorhous cassinii*	6	–
House finch	*Haemorhous mexicanus*	1, 3, 4, 6, 7	11
Lesser goldfinch	*Spinus psaltria*	1, 3, 6, 7, 8	–
Pine siskin	*Spinus pinus*	1	–
OLD WORLD SPARROWS			
House sparrow	*Passer domesticus*	1, 6	–

Source: eBird (2017, 2018).

Note: Public information for sensitive species in eBird is restricted because of potential harmful impact to these birds. Data for federally listed species are therefore not included in this table.

* 1 = North of Westwater Boat Launch (RM 128), 2 = Colorado River and Little Dolores River Confluence (RM 120.5), 3 = Cisco Boat Launch (RM 110.5), 4 = Hittle Bottom Camp Ground (RM 88), 5 = Colorado River Takeout Beach (RM 83.6), 6 = Colorado River – Red Cliffs Lodge (RM 78), 7 = Colorado River – Goose Island Camp Ground (RM 65.5), 8 = Colorado River – Kane Creek Blvd (RM 60), 9 = Lake Powell – Hite Overlook (RM 169), 10 = Lake Powell – Bullfrog Bay (RM N/A), 11 = Lake Powell – Last Chance Bay (RM N/A).

† eBird data for the Meander Canyon segment were not available.

Species of Management Concern

As shown in Table 2.10, the list of bird guilds and bird species (> 130) observed along four segments of the Colorado River is extensive. Using DWR's list of key habitats (Utah Wildlife Action Plan Joint Team 2015) and specifically those found in the planning area—i.e., aquatic-forested, aquatic-scrub/shrub (riparian), emergent aquatic (wetland), riverine and open water (aquatic)—FFSL recommends considering individual bird species, federally listed bird species, bird SPC, Utah Partners in Flight priority species (Parrish et al. 2002), and Utah Wildlife Action Plan SGCNs when trying to achieve habitat-related management goals, e.g., enhancement, restoration, and preservation. The following sections provide information about these habitats and key bird species that depend on them.

LOWLAND RIPARIAN AND WETLAND HABITAT

Riparian and wetland habitats, like those adjacent to the Colorado River, are generally more productive and biologically diverse than surrounding upland habitats. Bird communities in particular have greater diversity in riparian and wetland habitats than in upland habitats (Skagen et al. 2005; Woinarski et al. 2000). Roughly 50% of the bird species in the American Southwest nest exclusively in riparian and wetland habitat, and another 21% nest in higher densities in these habitats than in surrounding habitats (Johnson et al. 1985; Skagen et al. 2005). Increasing evidence also highlights the importance of riparian habitats during bird migration. Structurally complex riparian areas appear to have a higher abundance of birds and a higher diversity of bird species than do less-complex areas (Krueper et al. 2003; Scott et al. 2003).

Riparian Species

The yellow warbler (*Setophaga petechia*) is found throughout Utah (including the Colorado River) and generally nests in small riparian trees. Given the yellow warbler's relative abundance throughout the planning area, its nesting habitat parameters can be used in the development of riparian habitat restoration projects. Similarly, the western yellow-billed cuckoo (*Coccyzus americanus*) (federally listed as threatened), bald eagle (Utah SPC and SGCN), great blue heron (*Ardea herodias*), blue grosbeak (*Guiraca caerulea*), black-headed grosbeak (*Pheucticus melanocephalus*), Bullock's oriole (*Icterus bullockii*), Cooper's hawk (*Accipiter cooperii*), warbling vireo (*Vireo gilvus*), yellow-breasted chat (*Icteria virens*), and broad-tailed hummingbird (*Selasphorus platycercus*) (Utah Partners in Flight priority species) all nest in lowland riparian habitats and can be the focus of habitat restoration efforts. Lowland riparian habitats are also used by mammals such as Allen's big-eared bats (SGCN). Proposed critical habitat for western yellow-billed cuckoo intersects the Above Westwater and The Moab Daily segments, and the Meander Canyon segment is located in the Canyonlands Area IBA and in designated critical habitat for Mexican spotted owl (*Strix occidentalis lucida*). Designated critical habitat for Mexican spotted owl is also located in the Glen Canyon segment.

Wetland Species

The American avocet (*Recurvirostra americana*) (Utah Partners in Flight priority species), which is found in Utah and has been observed along the Colorado River, inhabits shallow wetlands and mudflats (often saline or alkaline) during the breeding season. The presence of this species may be used as an indication that a certain level of habitat quality or wetland restoration success has been achieved. Other important wetland species include white-faced ibis (SGCN), Wilson's phalarope (*Phalaropus tricolor*), and heron and egret species.

OPEN WATER (FLOWING AND STANDING)

Open water combines both flowing and standing aquatic habitats. It comprises approximately 2.6% of the total area of Utah (Utah Wildlife Action Plan Joint Team 2015) and includes lakes, reservoirs, streams, and rivers. Aquatic habitats on the Colorado River in many ways reflect the larger diversity of open water systems because there are areas of moderate to steep gradient (flowing water) and areas of extremely low gradient (standing water) along the five segments. Common types of birds seen in these habitats include ducks, geese, and swans. This family (Anatidae) of birds has evolved to float on the water's surface. Some species also dive for food in shallow areas. Several different species in this family can be observed on the Colorado River, including Canada goose (*Branta canadensis*), snow goose (*Chen caerulescens*), mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), northern pintail (*Anas acuta*), northern shoveler (*Anas clypeata*), green-winged teal (*Anas crecca*), American wigeon (*Anas americana*), bufflehead (*Bucephala albeola*), ruddy duck (*Oxyura jamaicensis*), common goldeneye (*Bucephala clangula*), red-breasted merganser (*Mergus serrator*), and common merganser (*Mergus merganser*).

Also represented on the Colorado River are western grebe (*Aechmophorus occidentalis*), horned grebe (*Podiceps auritus*), and eared grebe (*Podiceps nigricollis*). These species in the Podicipediformes family can be seen floating on the water but dive underwater to forage for fish. The American white pelican (*Pelecanus erythrorhynchos*) (Utah Partners in Flight priority species and Utah SPC) and osprey (*Pandion haliaetus*) also use certain open water segments of the Colorado River.

Further Reading

A Handbook of Riparian Restoration and Revegetation for the Conservation of Land Birds in Utah with Emphasis on Habitat Types in Middle and Lower Elevations (Gardner et al. 1999)

Dispersal patterns of subadult and adult Colorado squawfish in the upper Colorado River (Osmundson et al. 1998)

eBird Explore Hotspots website (eBird 2017, 2018)

Ecology and conservation of native fishes if the upper Colorado River basin (Valdez and Muth 2005)

Glen Canyon National Recreation Area Mussel Update website (National Park Service 2018)

Status and trends of the endangered Colorado squawfish in the upper Colorado River (Osmundson and Burnham 1998)

Thermal regime suitability: Assessment of upstream range restoration potential for Colorado pikeminnow, a warmwater endangered fish (Osmundson 2011)

Tributary use by imperiled flannelmouth and bluehead suckers in the upper Colorado River basin (Fraser et al. 2017)

Upper Colorado River Subbasin Floodplain Management Plan (Valdez and Nelson 2006)

Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances (Romin and Muck 2002)

Utah Partners in Flight Avian Conservation Strategy Version 2.0 (Parrish et al. 2002)

Utah Wildlife Action Plan: A Plan for Managing Native Wildlife Species and Their Habitats to Help Prevent Listing under the Endangered Species Act (Utah Wildlife Action Plan Joint Team 2015)

GIS Data Layers

eBird Locations (Hotspots), Heron Rookery, Important Bird Areas, U.S. Fish and Wildlife Critical Habitat, Utah Division of Wildlife Resources Habitat

2.3 Water Resources

Hydrology

Characterization of the Colorado River

The Colorado River is one of the iconic rivers in the United States. Famed for its natural beauty and recreation opportunities in the Rocky Mountains and Colorado Plateau, the Colorado River provides water supply for millions of people in the cities of southern California, central and southern Arizona, and southern Nevada, as well as for productive agricultural areas including the Imperial and Yuma Valleys. Above The Confluence, water from Colorado River tributaries is diverted to cities of the Colorado Front Range. Downstream of The Confluence, the river is divided administratively into the upper basin and the lower basin at Lee's Ferry, Arizona. The location of Lee's Ferry is defined in the Colorado River Compact of 1922 as a point 1 mile downstream from the confluence of the Paria River and the Colorado River. Prior to 1921, the Colorado River was referred to as the Grand River above The Confluence in present-day Canyonlands National Park. The name of the Grand River was changed to the Colorado River by an act of U.S. Congress, and today, the river upstream from the Green River is typically called the upper Colorado River. The upper Colorado River drains 26,000 square miles of the western slope of the Rocky Mountains and easternmost part of the Colorado Plateau. Hydrology is dominated by spring snowmelt, with peak annual flow occurring in May, June, and July (Fassnacht 2006; Figure 2.35).

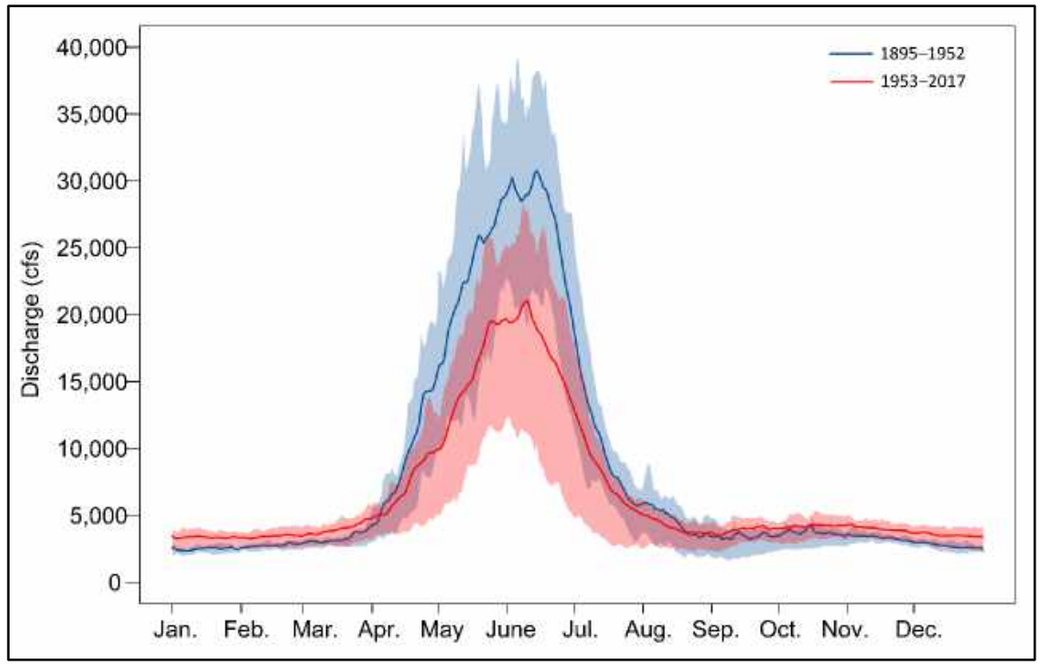


Figure 2.35. Annual hydrograph for the Colorado River near Cisco, Utah (gage 09180500) for two different peak flow regimes.[1]

The Colorado River's hydrology through the planning area includes several major tributary inflows, illustrated on Figure 2.36. Stream flow monitoring gages operated by the USGS are also shown on Figure 2.36 because they provide important information on present and long-term trends in the ebb and flow of the river.

[1] The shaded areas represent the interquartile range for daily discharge data for each day of the year during each flow period. The dominance of snowmelt flooding is apparent, as are declines in peak annual flow and increases in summer base flow during the second half of the twentieth century. Sources: Pettitt (1979); USGS (2018a).

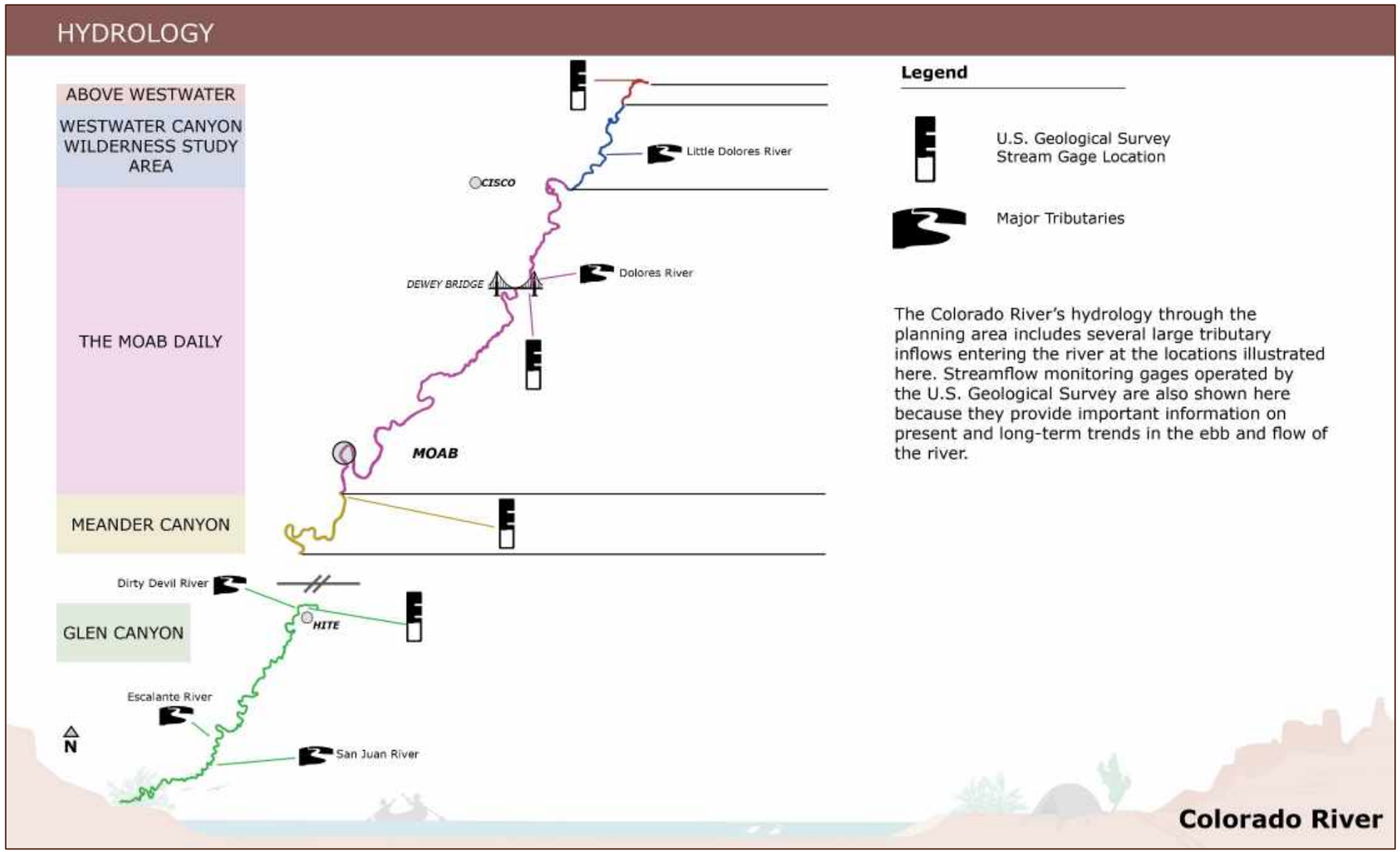


Figure 2.36. Major tributary inflows and stream flow monitoring gages in the planning area by river segment.

Scientific measurements of the upper Colorado River and its tributaries began in the early twentieth century with the establishment of gaging stations and investigations to identify possible dam sites (LaRue and Grover 1916). Reports from the middle twentieth century estimated flow and sediment flux in anticipation of construction of major dams for the Colorado River Storage Project (Iorns et al. 1965). Ongoing measurements of stream flow, sediment transport, and geomorphology support management of dams, diversions, endangered fish species, and units of the National Park System. Numerous studies of long-term data have detected changes to the hydrology and flow regime of the Colorado River in the twentieth century (see Figure 2.35) (Stockton and Jacoby 1976; Udall and Overpeck 2017; Woodhouse et al 2006; Xiao et al 2018).

The major cause of flow regime change in the Colorado River has been the diversion of significant amounts of water to the Colorado Front Range and regulation of stream flow by the Aspinall Unit on the Gunnison River and at McPhee Dam on the Dolores River. In the twentieth century, a warming climate contributed to reduced runoff in the watershed (Udall and Overpeck 2017; Xiao et al. 2018). Stream flow records reconstructed from tree rings show that years of high annual runoff in the early 1900s were some of the wettest years in the past 5 centuries (Woodhouse et al. 2006). The paleohydrologic record also has evidence of significant multi-year droughts that are only matched by the present ongoing twenty-first century sustained period of low flow (Woodhouse et al. 2010). Warming temperatures are likely to play a greater role than changing precipitation in projected declines to stream flow in the coming decades (McCabe et al. 2017; USBR 2012).

The river's channel and associated active floodplain are depicted in a cross section and in a plan view in Figures 2.37 and 2.38, respectively.

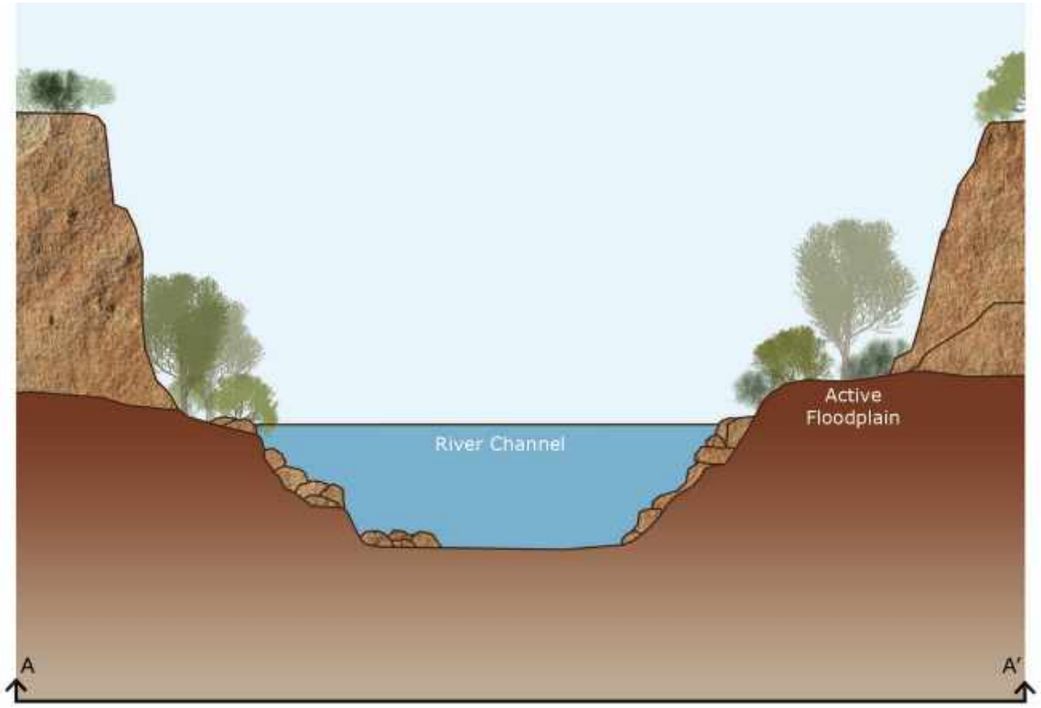


Figure 2.37. Colorado River cross section showing the active floodplain and river channel. Note: This cross section is a representation of the transect A to A' shown on the river plan view in Figure 2.38.

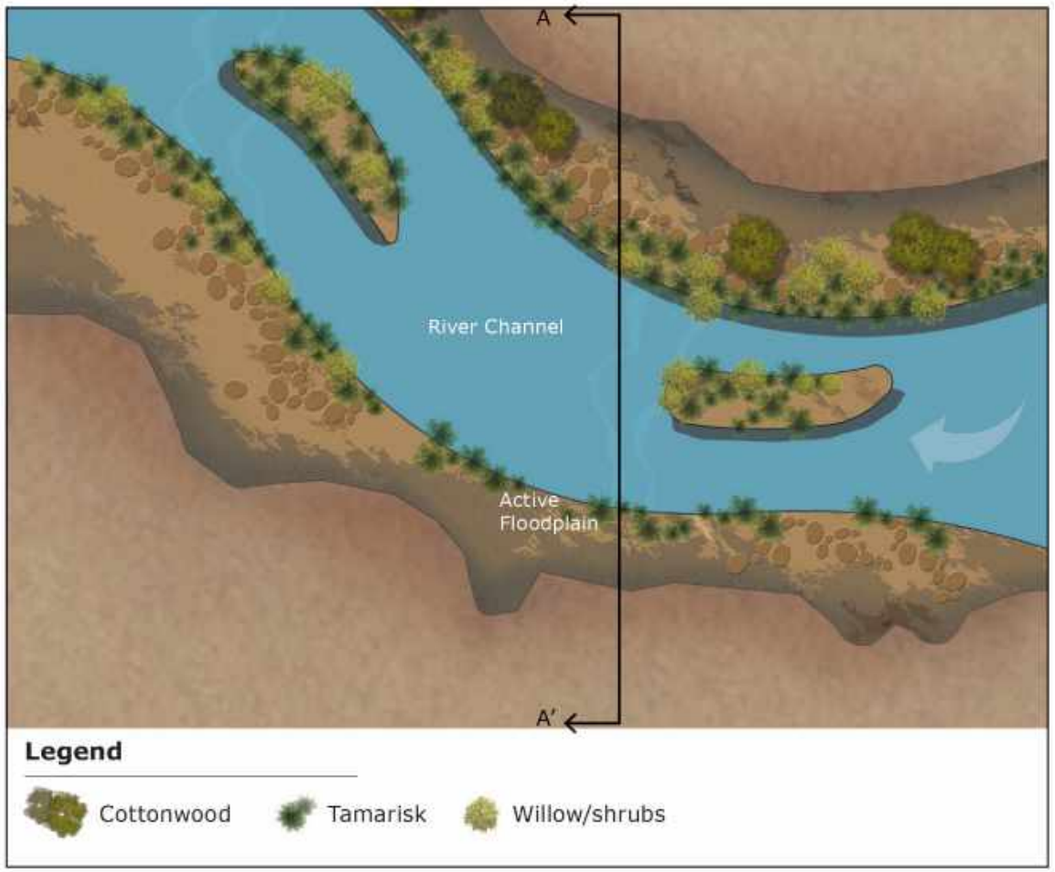


Figure 2.38. Colorado River plan view showing the active floodplain and river channel. Note: the transect A to A' shown on this figure is depicted as a cross section of the river channel in Figure 2.37.

River Segments

The four river segments upstream of Canyonlands National Park (Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily, and Meander Canyon) are free flowing, though all are influenced by upstream water development. Because the flow regime of the upper Colorado River does not significantly change downstream from the Dolores River, the hydrology of the four free-flowing reaches is discussed together.

The Glen Canyon segment is downstream of The Confluence and contains a major tributary, the San Juan River. Because this segment is currently part of Lake Powell, it is discussed separately. The modern delta of the Colorado River at the upstream end of Lake Powell is discussed because almost the entire length of the Glen Canyon segment is submerged by Lake Powell.

FREE-FLOWING SEGMENTS: ABOVE WESTWATER, WESTWATER CANYON WILDERNESS STUDY AREA, THE MOAB DAILY, AND MEANDER CANYON

Stream flow of the upper Colorado River primarily comes from the distant Rocky Mountains. Prior to major river regulation, Iorns et al. (1965) estimated that 84% of stream flow upstream from The Confluence was already in the channel by Grand Junction, Colorado, of which 37% came from the Gunnison River, a major tributary. Within The Moab Daily segment, an additional 9% was contributed by the Dolores River. The remaining amount came from small tributaries. The flow regime was dominated by annual snowmelt runoff, with flow peaking in late May and early June (see Figure 2.35). There are no major diversions in the free-flowing segments in Utah, but water is withdrawn from the Colorado River and its tributaries for municipal, industrial (non-agricultural diversions), and agricultural uses at Castle Valley, Spanish Valley, Moab, and Potash. Stream flow is primarily gaged by the long-term gage near Dewey Bridge (09180500, Colorado near Cisco, 1919–present) in The Moab Daily segment at RM 95.

Since the early twentieth century, the flow regime of the Colorado River has decreased because of climate change, water development, irrigation diversions, and water withdrawals. At Cisco, Utah, estimated annual natural flows (the estimated total runoff without any river regulation and consumptive uses or losses; USBR 2017a) declined slightly in the twentieth century (Figure 2.39, part A). During the same time period, observed total flow at Cisco, Utah, remained constant (Figure 2.39, part B); the difference between natural (unregulated) and observed annual flow can be considered the average magnitude of annual consumptive uses. In contrast to the constant total annual flow, peak annual flow declined: the 2-year flood magnitude decreased by 40% and the 5-year flood magnitude decreased by 24%. The current 5-year flood magnitude of the Colorado River is lower than the 2-year flood magnitude prior to 1950 (Figure 2.39, part C).

Since 1950, major river regulation has altered the flow regime of the upper Colorado River, decreasing peak flow magnitude and increasing base flows (VanSteeter and Pitlick 1998; Figure 2.39, parts C and D). The Colorado-Big Thompson Project began construction in 1938. Major construction for the project was completed by 1956, and today the project stores, regulates, and diverts water from the Colorado River to the eastern slope of the Rocky Mountains. In 2010, a net of 448,000 acre-feet was diverted from Colorado River headwaters, representing approximately 15% of the total runoff (Maupin et al. 2018). Peak annual flow of the Colorado declined by 29% after 1950 near Cameo, Colorado (upstream of the planning area), 30 RM above the Colorado-Gunnison confluence (VanSteeter and Pitlick 1998). In the Gunnison River, peak annual flow decreased by 38% after 1950 at Grand Junction after construction of the Aspinall Unit, a series of three dams (VanSteeter and Pitlick 1998). The upstream (and largest) dam, Blue Mesa, was completed in 1966, altering the river's flow regime. Very little water is exported from the Gunnison River basin for agricultural use. In 2010, a net of 395 acre-feet was diverted for agricultural use on the east slope of the Rocky Mountains, representing 0.03% of total runoff (Maupin et al. 2018). In the Dolores River, peak annual flow declined by 26% after the construction of the McPhee Dam in 1984. Mean annual runoff remained constant in the Colorado, Gunnison, and Dolores Rivers; the relatively stability in runoff reflects the typical pattern of reservoir operations, which store runoff in the spring and release it over the course of the year.

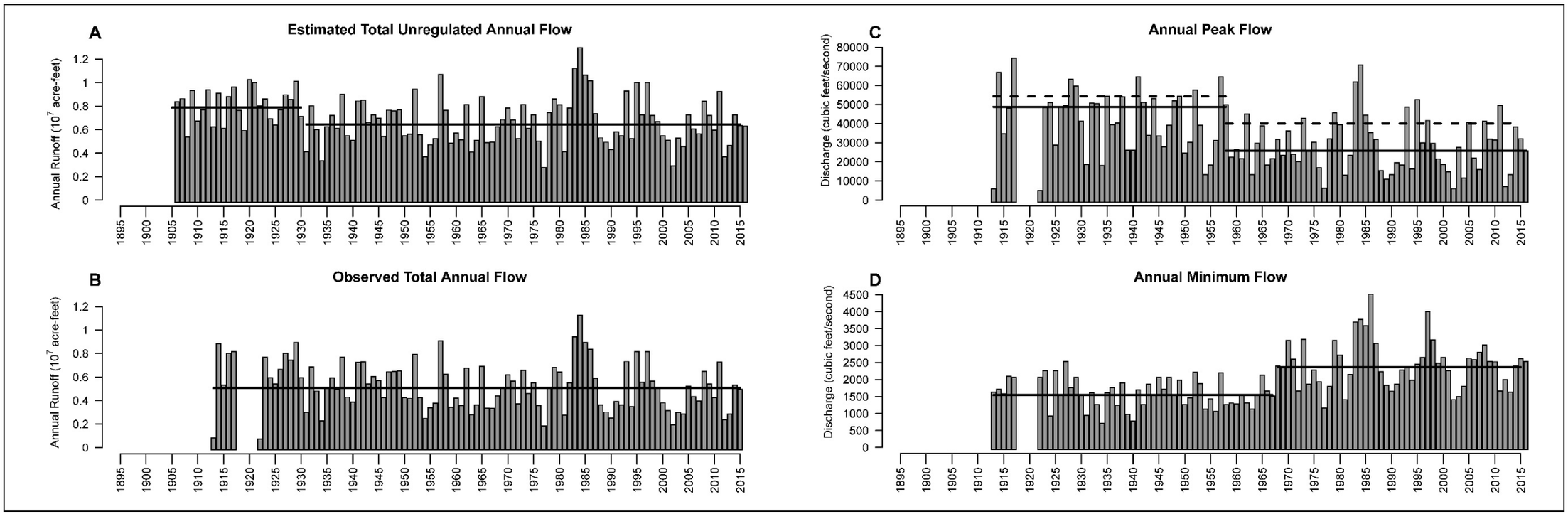


Figure 2.39. Hydrologic characteristics for the Colorado River near Cisco, Utah (gage 09180500) from 1895 to 2016.[2]

[2] A = estimated total unregulated natural flow from the USBR. B = observed total annual flow. C = time series of instantaneous annual peak flows. Solid lines in A, B, and C are the 2-year flood recurrence magnitude. Dashed lines in A, B, and C are the 5-year recurrence flood magnitude for each time period. D = The annual minimum flow. Black lines in D represent the mean for each period. Periods of flow were identified using a Pettitt test for shifts in the mean of a data set.
Sources: Pettitt (1979); USGS (2018c); USBR (2017a); Villarini et al. (2009).
Graphs modified from Allred and Schmidt (1999).

GLEN CANYON SEGMENT

This river segment is in Glen Canyon and is completely affected by the existence of Glen Canyon Dam and the operations of Lake Powell reservoir. At the upstream end of Lake Powell, the Colorado River enters the reservoir from Cataract Canyon and deposits its entire sediment load in the inundated parts of lower Cataract and Narrow Canyons. The total length of this zone of sediment deposition is approximately 40 miles, and the delta now extends downstream from the abandoned boater access point at Hite. The reservoir delta has continued to prograde (Pratson et al. 2008) but was deeply incised during the resevoir lowering in 2005 (Majeski 2009). Water supply and reservoir water storage are managed by the USBR; recreation on the reservoir and in the surrounding lands (Glen Canyon National Recreation Area) is managed by the NPS.

Three tributaries contribute stream flow directly to the reservoir: the San Juan River, the Escalante River, and the Dirty Devil River (see Figure 2.36). Iorns et al. (1965) estimated that 80% of the stream flow at Lee's Ferry, Arizona, was in the channel at Hite (RM 168). An additional 16% was contributed by the San Juan River, 0.6% by the Dirty Devil River, and 0.5% by the Escalante River. All were estimated to give proportionally a larger contribution of sediment compared to water: the San Juan, Dirty Devil, and Escalante contributed 36%, 5%, and 2%, respectively, of the total sediment load at Lee's Ferry (Iorns et al. 1965). Presently, the flow regime of the San Juan River is largely controlled by the Navajo Dam, except in summer and fall when storm-induced floods can substantially increase the discharge of the river (Propst and Gido 2004). Inflow from the Animas River, which enters the San Juan River downstream of the Navajo Dam, is unregulated. After the completion of the Navajo Dam in 1962, the magnitude of spring flood discharge declined by 28% and minimum summer flow increased by 39%. The Navajo Reservoir has been operated to simulate spring runoff since 1993, but fully restoring the pre-dam flow regime is infeasible (Propst and Gido 2004). Significant changes to the flow regime remain.

Further Reading

A watershed perspective of changes in streamflow, sediment supply, and geomorphology of the Colorado River (Schmidt 2010)

On the causes of declining Colorado River streamflows (Xiao et al. 2018)

The Colorado River (Schmidt 2007)

Updated streamflow reconstructions for the upper Colorado River basin (Woodhouse et al. 2006)

Water Resources of the Upper Colorado River Basin (Iorns et al. 1965)

GIS Data Layers

FEMA Flood Zones, Major Tributaries, National Hydrography Dataset, Stream Alteration Permits, UPDES Permits, USGS Flow Gages, Watersheds (Hydrologic Unit Code 12)

Geomorphology and Sediment Supply and Transport

Fluvial Geomorphology

Fluvial geomorphology is the study of how flowing waters create and maintain landforms, focusing on the interaction between streams and the surrounding landscape. Stream channel form and channel size result from the forces exerted by the flux of water flowing through the channel network and by the characteristics and amount of the sediment supplied to the channel and transported by flowing water. These elements act within the constraints provided by the local geology and by the riparian vegetation. These fluxes of water and sediment are evaluated using a multi-dimensional framework: longitudinal, considering a river reach from upstream to downstream; transverse, looking at the gradient of interaction in a river valley perpendicular to a channel; vertical, related to groundwater exchanges and modifications of the channel and floodplain by flows; and temporal, evaluating how fluxes of matter and energy alter the spatial dimensions over time (Corenblit et al. 2015).

The fundamental characteristics of fluvial geomorphology can change over time. Over long enough time scales, change is expected: reaches that appear stable when observed over short time scales are generally understood to still be undergoing long-term adjustments because of

changes in sediment supply, watershed runoff, and/or flow regime (Schumm and Lichty 1965). Over millennia, variation in these inputs change the sediment mass balance, altering the influx and efflux of transported sediment in a river (Lane 1955). In response, river channel form adjusts to optimize the conveyance of water and sediment so that the mass balance is achieved again. Those elements all affect attributes of stream channel and floodplain form, including bed material size and distribution, cross-section width, depth, area and shape, planform configuration, floodplain characteristics, and channel slope.

In the twentieth century, channel form and floodplain form of the Colorado River have been greatly impacted by human society. The construction of large dams, trans-basin diversions, and irrigation withdrawals have altered the flow regime, decreased annual peak flood magnitude, reduced total annual runoff, and increased base flow. Large dams also intercept sediment, and the resulting impoundment of water and sediment by dams has induced channel changes that extend hundreds of miles downstream (Borland and Miller 1960; Schmidt and Wilcock 2008; Williams and Wolman 1984). Dams further affect the thermal regime for native fishes, and hydropower operations impact the aquatic food web (Kennedy et al. 2016). Additionally, there have been widespread changes to riparian vegetation communities, the most visible being the spread of invasive, nonnative tamarisk throughout the basin (Auerbach et al. 2013; Bloodworth et al. 2016; Webb et al. 2007). Changes to riparian vegetation affect the formation and maintenance of fluvial landforms (Diehl et al. 2017), and the widespread establishment of invasive tamarisk threatens native riparian species, particularly Fremont cottonwood (*Populus fremontii*) (Scott and Miller 2017).

All of these elements lead to changes in the Colorado River, altering aspects of channel and floodplain form in response to changes in the mass balance of water and sediment. Adjustments to bed material size and distribution, cross-section width, depth, area and shape, planform configuration, and channel slope have all been observed in the planning area. New floodplains have formed as channel widths decreased, and channel planform has changed as multi-threaded channels changed to single-threaded channels with the abandonment of side channels. Both new and old floodplains now have vegetation communities dominated by nonnative vegetation (Friedman et al. 2005), potentially altering floodplain sediment deposition. Finally, changes in agricultural and municipal land use alter how floodplains interact with the river channel. The changes described above have the potential to affect the area of the channel administered by FFSL and should inform management actions.

RIVER SEGMENTS

The specific geomorphic setting of each segment upstream of Canyonlands National Park is discussed individually, followed by a combined discussion of sediment supply and transport. The Glen Canyon segment is discussed separately.

Reaches within the four free-flowing segments above The Confluence were classified by Pitlick and Cress (2003) as either "fully alluvial" or "quasi-alluvial." Fully alluvial reaches have a 0.1- to 0.6-mile-wide floodplain where the river is free to move laterally. Quasi-alluvial reaches are partially bounded by bedrock but have alluvial floodplains on one or both banks allowing for the river to adjust (Pitlick and Cress 2002). The exception is the Westwater Canyon Wilderness Study Area, where the river has a narrow bedrock gorge.

Upstream of the planning area, near Grand Junction, Colorado, the channel narrowed by 20 m from 1937 to 1993 (VanSteeter and Pitlick 1998). Upstream water development (VanSteeter and Pitlick 1998) and fine sediment deposition by the floods of 1983 and 1984 (Pitlick and Cress 2002) were identified as the causes of this channel narrowing. Notably, the very biggest floods of record in the mid-1980s did not widen the channel.

ABOVE WESTWATER

The Above Westwater segment is quasi-alluvial, flowing through the Mesozoic Glen Canyon Group, with the exception of the "Black Rocks" (RM 136), a set of named rapids that flow through 1.7-billion-year-old Proterozoic rocks. The Denver and Rio Grande Western Railroad runs along the right bank of the river throughout this entire segment.

The railroad was constructed in Ruby Canyon in the late 1800s and has an active right-of-way. Railroad grades on the floodplains of rivers act as a confining margin on a floodplain, preventing river adjustment (Blanton and Marcus 2009). Effects are diminished in narrower

reaches, and bedrock reaches, where there is limited potential for river adjustments. In the segment, the right-of-way is constructed at the edge of the active channel and blocks a small fraction of the alluvial valley from the Colorado River. In some locations, the track foundation is located at or near the water's edge, preventing channel adjustments. The effects of the railroad are relatively small, but the right-of-way has decreased transverse connectivity and acted as a control on river adjustments.

Westwater Canyon Wilderness Study Area

The Westwater Canyon Wilderness Study Area segment is a debris fan-affected canyon, with minimal to no floodplains and the steepest channel slope for the planning area segments upstream of Canyonlands National Park (Pitlick and Cress 2002). The river cuts through a complex of Proterozoic gneiss and granite, some of the oldest exposed rocks in Utah. The hardness of the crystalline bedrock acts a major control on channel width, and Westwater Canyon Wilderness Study Area is the narrowest of the planning area segments on the Colorado River. The river has a very limited ability to adjust because of the narrowness of the channel.

The Moab Daily

Parts of this segment are either alluvial or quasi-alluvial, along with a single bedrock-bounded reach centered on the Big Bend (RM 76–70). Periodic, large river bottoms are present within the alluvial reaches, especially at creek mouths where outflows of sediment occur. Channel narrowing has been observed in Professor Valley, but narrowing is discontinuous and mostly occurs on the inside of bends and at tributary mouths (Webb et al. 2004).

For much of The Moab Daily segment, the river is bordered by Utah State Route 128. The route, similar to the railroad in the Above Westwater segment, acts as a lateral control on the channel and reduces the range of adjustment for the river (Blanton and Marcus 2009). Ranching and agriculture on private land and BLM campsite development have removed riparian vegetation, decreasing bank stability and reducing sediment trapping (Allan 2004). On the right bank of the river across from Moab, the Moab UMTRA project is currently removing mill tailings and other contaminated materials from a former uranium-ore processing facility to an off-river site (DOE 2018). The process of remediation has altered the floodplain in the immediate vicinity of the old mill.

Meander Canyon

The Meander Canyon segment is alluvial, and there is minimal anthropogenic disturbance within the segment. The river is still free to fully migrate within the valley. Discontinuous channel narrowing has occurred in Meander Canyon at bends and tributary mouths. A study is in progress to quantify changes to the Colorado River in Meander Canyon; preliminary results show the channel has narrowed between the 1940s and the present, that narrowing is highly variable within Meander Canyon, and most of the narrowing has occurred in reaches where the alluvial valley is wider (Head et al. 2016).

Sediment Supply and Transport (for all four segments)

The Colorado River once delivered more fine sediment to the ocean than any other river in North America except for the Missouri-Mississippi River system (Meade et al. 1990). Current sediment delivery is a fraction of the historical average, and today, most sediment is stored in river valleys and trapped in reservoirs.

Modification of the hydrology by the Aspinall Unit, Colorado-Big Thompson Project, McPhee Dam, and other impoundments and diversions has altered the water quality in the free-flowing segments as sediment loads are impounded in reservoirs and downstream releases are largely clear water. However, the downstream effects of reservoirs depend on their size, operating schedule, and relative location with respect to flow and sediment contributing areas within the basin as demonstrated by the case studies of the impacts of Flaming Gorge Reservoir and Lake Powell (Andrews 1991). Despite significant dams and diversions in the basin, unregulated tributaries continue to deliver high sediment loads, therefore restoring turbid conditions in areas distant from the large impoundments.

Sediment supply to these segments aggregates longitudinally, increasing by 58% from the state line to Cisco (Pitlick and Cress 2002) and increasing further downstream. Iorns et al. (1965) estimated that sediment loads approximately doubled between Cisco and The Confluence. Proportionally, a greater percentage of sediment is contributed by the semiarid, lower-elevation portions of the basin compared to the downstream rate of increase in water (Andrews 1986; Iorns et al. 1965). Thompson (1985) estimated that the average annual sediment load declined after major river regulation, decreasing by 22%, from 9.7 million tons between 1946 and 1965 to 7.6 million tons between 1968 and 1982. Real-time suspended sediment data are currently collected by the USGS at Potash (gage 09185600, RM 49), 48 miles downstream from the Cisco gage. The available data show that sediment transport mostly occurs during snowmelt flooding (Figure 2.40). The annual average load from 2015 to 2017 was between 3.1 and 5.1 million tons, 33% to 60% lower than the previous pre-dam estimates. Sand transport is greatest during snowmelt floods; silt and clay transport is also high during snowmelt floods, with additional peaks in the summer and fall. Transport is also highly variable among years. Total sand loads varied up to 33% among years, and silt and clay varied up to 73%. Pitlick and Cress (2002) estimated that at least 95% of the total sediment load was transported in suspension. The magnitude of suspended sediment transport in the Colorado River is less than in the Green River; real-time suspended sediment data from 2015 to 2018 show that the mean annual sand load for the Colorado River was less than the Green River by a factor of 2.4. The average annual Colorado silt and clay load was lower by a factor of 1.2. Therefore, sediment loads are expected to increase from upstream to downstream segments, but the total sediment loads are still lower on average than the sediment loads from the Green River.

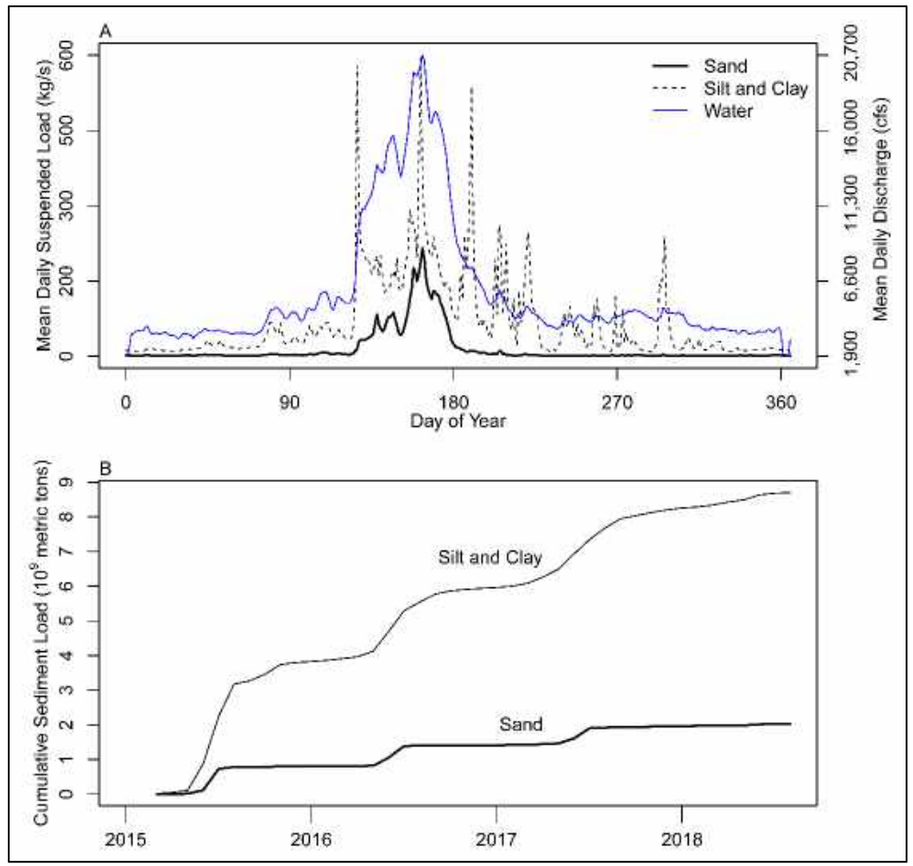


Figure 2.40. Sediment transport time series, Colorado River at Potash, Utah (gage 09185600).[3]

[3] A = time series of mean daily suspended sand load, mean daily suspended silt and clay load, and mean daily discharge. Loads are plotted on the left y-axis and discharge is plotted on the right y-axis. B = time series of cumulative sediment loads for the Colorado River at Potash, Utah, from 2015 to 2018. Cumulative loading plots show the cumulative amount of sediment transported since measurement began at Potash. For each time step, the suspended load is added to previous loading value to get the new cumulative load. Source: USGS (2018a).

Glen Canyon Segment

At the upstream end of Lake Powell, the Colorado River slows as it enters the reservoir, depositing its sediment load in the approximately 40-mile-long delta near and upstream from Hite. At the upstream end of the segment, large deltas of sediment are present; in the reservoir, banks are typically bedrock. Deltaic sediments are active and are rapidly reworked by large floods and/or changing reservoir levels (Majeski 2009).

Prior to the construction of Glen Canyon Dam, Topping et al. (2000) estimated that 60 to 66 million tons of sediment per year was transported through Glen Canyon to Lee's Ferry between 1949 and 1962. They estimated that 40% of the sediment load was sand. Sediment loads are much lower in the present day. Although precise estimates of modern sediment delivery are unavailable, the combined sediment load transported past the Potash and Mineral Bottom gages averaged 9.3 million tons per year between February 2015 and February 2018, with 26% of the load as sand (USGS 2018a); the San Juan River averaged 10.1 million tons per year from 1974 to 1980 (Thompson 1982). These estimates exclude the contributions of the Dirty Devil and Escalante Rivers but are still substantially lower than the mid-twentieth century estimates.

Today, sediment deposits are present as deltas near Hite and at the mouth of the San Juan River. The largest delta near Hite is formed by sediment from the Colorado River and Dirty Devil River and is approximately 125 miles upstream from Glen Canyon Dam. The delta of the San Juan River is approximately 60 miles upstream from the dam (Pratson et al. 2008). The Colorado River delta at Hite is deposited between 50 and 200 feet above the former river channel; the upper elevation is approximately the elevation of full pool. Majeski (2009) estimated that 0.41 million acre-feet accumulated in the delta between 1963 and 1999. During a period of reservoir drawdown between 1999 and 2005, the Colorado River eroded a new channel into the Hite delta, remobilizing approximately 85,000 acre-feet of sediment. Some of this remobilized sediment was transported away from the delta by turbidity currents, but a substantial fraction (35%) was redeposited immediately on the delta front, advancing the delta into the reservoir by approximately 40 miles (Pratson et al. 2008; Majeski 2009). Sediment transported away from the Hite delta by turbidity currents primarily accumulated behind rockfalls on the reservoir, but sediment eroded from the San Juan delta was transported by turbidity currents to the base of Glen Canyon Dam.

The inundation of Glen Canyon has dramatically altered this river segment. Large sediment deltas dominate the landscape where rivers enter the reservoir. Those deltas are eroded during periods of reservoir drawdown, remobilizing sediment and moving it farther into the reservoir. New channels are incised into the delta, and those channels do not always reoccupy the historic channel. The San Juan River now flows over a bedrock ledge, blocking upstream fish migration and downstream navigation (Schmidt et al. 2016). The same outcome would be expected at Hite when greater Lake Powell drawdowns occur in the future.

Management Implications of Current Sediment Supply and Transport

The Colorado River has changed dramatically since the early twentieth century, with decreased total stream flow, declining flood magnitude, increased base flows, and changes to land use on the banks of the river. The channel has narrowed throughout the free-flowing reaches (Pitlick and Cress 2002; VanSteeter and Pitlick 1998) coincident with declines in total annual flow and peak annual flow.

Changes to flow regime have been identified as the primary driver of channel narrowing in the Colorado River (VanSteeter and Pitlick 1998). The construction of large dams in the headwaters of the Colorado, Gunnison, and Dolores Rivers and the diversion of water for agriculture and municipal use, especially to the Front Range, have decreased flow and reduced flood magnitude, thus encouraging channel narrowing. Channel form has been further affected by changes to riparian vegetation communities and land use. The spread of tamarisk throughout riparian habitats has reduced the mobility of sediments and promoted channel narrowing (Diehl et al. 2017). Although the introduction of the tamarisk beetle has resulted in widespread tamarisk mortality (Bloodworth et al. 2016), dead trees still remain on floodplains, affecting flow and deposition. Construction of roads in the river corridor further affect the ability of the channel to adjust and currently act as a confining margin on the river (Blanton and Marcus 2009; Figure 2.41).

Figure 2.41. Matched set of photographs taken on Utah State Route 128, 6 miles upstream of Moab, view looking upstream (RM 70).[4]

Along with modification of the flow regime by dams and diversions, increasing societal demand for water has resulted in rising consumptive use in the Colorado River throughout the twentieth century. Water withdrawals to meet consumptive uses meaningfully alter the flow regime, decreasing total runoff and reducing peak annual flow magnitude and duration (Propst and Gido 2004; VanSteeter and Pitlick 1998). Demand for water is projected to increase in the coming decades (USBR 2012); a major new impoundment, the proposed Windy Gap Firming Project, will divert a new 30,000 acre-feet from the river (Northern Colorado Water Conservancy District 2018), further affecting flow regime. The river channel will continue to respond to these altered inputs, resulting in further changes to the form and function of the river.

Further Reading

A watershed perspective of changes in streamflow, sediment supply, and geomorphology of the Colorado River (Schmidt 2010)

Cataract Canyon: A Human and Environmental History of the Rivers in Canyonlands (Webb et al. 2004)

Conservation Planning for the Colorado River in Utah (Rasmussen and Shafroth 2016)

Downstream changes in the channel geometry of a large gravel bed river (Pitlick and Cress 2002)

Fill Mead First: A Technical Assessment (Schmidt et al. 2016)

Geomorphology and endangered fish habitats of the upper Colorado River: 1. Historic changes in streamflow, sediment load, and channel morphology (Van Steeter and Pitlick 1998)

Impact of humans on the flux of terrestrial sediment to the global coastal ocean (Syvitski et al. 2005)

Metrics for assessing the downstream effects of dams (Schmidt and Wilcock 2008)

Movement and storage of sediment in rivers of the United States and Canada (Meade et al. 1990)

GIS Data Layers

FEMA Flood Zones, Major Tributaries, National Hydrography Dataset, Stream Alteration Permits, UPDES Permits, USGS Flow Gages, Watersheds (Hydrologic Unit Code 12)

[4] A = photograph taken in 1933. B = matching photograph taken in 1999. The modern 1999 channel is narrower than the historic photograph, there is vegetation growth within the former active channel, and road construction has encroached into the former channel, constricting the ability of the river to adjust laterally.
Photographs from the USGS Southwest Repeat Photography Collection, Colorado River stake locations (USGS 2018d) Photograph A is courtesy of the Museum of Moab (Southeastern Utah Society of Arts and Sciences).

Water Quality

Designated Beneficial Uses and Impairments

The Clean Water Act requires every state to adopt water quality standards to protect, maintain, and improve the quality of surface waters. These water quality standards consist of three major components: beneficial uses, criteria, and the antidegradation policy. The Utah Water Quality Board is responsible for establishing water quality standards that are then administered by the DWQ. These standards are found in the Utah Administrative Code R317-2 (Standards of Quality for Waters of the State) and vary based on the beneficial use assignment of the waterbody (DWQ 2010). DWQ has developed four major beneficial use classifications to characterize the uses of surface waters within the state. Table 2.11 lists Utah's four major beneficial use classifications and sub-classifications. The beneficial use designations for the Colorado River planning area (all segments) are 1C (domestic/drinking water), 2A (frequent primary contact recreation), 3B (warm water fishery/aquatic life), and 4 (agricultural uses).

Table 2.11. Major Beneficial Use Classifications in the State of Utah

Major Beneficial Use Classification	Beneficial Use Sub-Classification
1 Domestic/Drinking Water	1C Drinking Source Water
2 Recreational Use and Aesthetics	2A Frequent Contact Recreation
	2B Infrequent Contact Recreation
3 Aquatic Wildlife	3A Cold Water Aquatic Life
	3B Warm Water Aquatic Life
	3C Nongame Aquatic Life
	3D Waterfowl/Shorebirds
4 Agricultural	4 Agriculture

Source: Utah Administrative Code R317-2-6.

DWQ assigns an impaired status to a given waterbody when the concentration of a specific pollutant is above (or in some cases below) the numeric criteria associated with the beneficial use designated for the waterbody. Beneficial use designations and water quality impairments are detailed in DWQ's integrated report and on the interactive DWQ Beneficial Uses and Water Quality Assessment Map (DWQ 2016a, 2018), and are depicted on Figure 2.42. DWQ historically monitored the water quality of the Colorado River at several monitoring sites in the four river segments upstream of Canyonlands National Park (see Water Quality layer in the GIS spatial data viewer). Most of these sites are no longer active. As of 2018, there are three active monitoring sites, all of which are in The Moab Daily segment: one at the Cisco boater access point, one downstream of the confluence with the Dolores River near Dewey Bridge, and one near Moab.

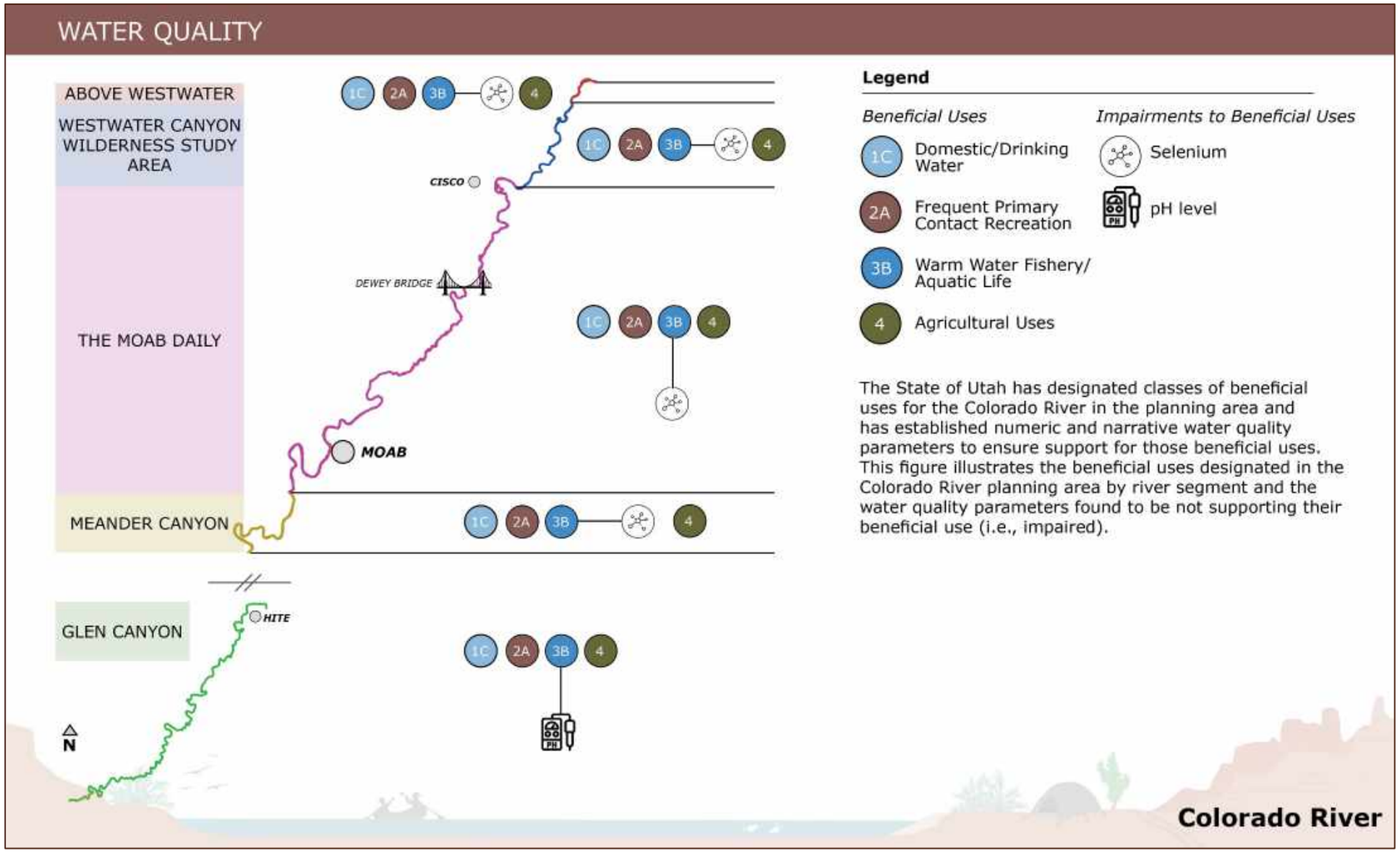


Figure 2.42. Beneficial uses and impairments in the planning area by river segment.

The Colorado River from the Utah-Colorado state line downstream to The Confluence is listed as impaired for 3B beneficial use (warm water fishery/aquatic life) because of elevated concentrations of selenium. Selenium is an essential micro-nutrient that is relatively abundant in Mancos shale–derived soils and landscapes, which occur at river level in the four free-flowing segments. In elevated concentrations, selenium can cause mortality, deformity, and reproductive failure in fish and aquatic birds (EPA 1998). Natural processes such as erosion are responsible for transporting selenium into river. Because of the elevated concentrations of selenium, the Colorado River in the free-flowing segments of the planning area is listed on the 303d list of impaired waterbodies, requiring the development of a total maximum daily load (TMDL). The TMDL for selenium in the river was approved by the EPA in June 2014 and establishes a daily average of less than 21.375 kg per day of selenium, which represented a targeted reduction in loads of 9.69 kg per day (DWQ 2014).The Glen Canyon segment of the Colorado River that is now Lake Powell is listed as impaired for its 3B beneficial use (warm water fishery/aquatic life) because of the pH of the water. This impairment status requires that a TMDL be developed to identify the magnitude of pollutant load that the water body can tolerate before pH moves out of the range of the numeric criteria (pH 6–9.5). A TMDL for the segment has not been initiated and will not likely be initiated before 2022 (DWQ 2016b).

Salinity

Almost half of the salinity in the Colorado River system is from natural sources (USBR 2017b). Other sources are agricultural irrigation return and municipal and industrial operations. Salinity loading is a water quality concern in the Colorado River basin because of the economic and environmental impacts the added salinity has downstream. Salinity of the Colorado River has increased both because of the addition of salts from the river and the depletion of water, concentrating salts already in the river. In 1974, U.S. Congress enacted the Colorado River Basin Salinity Control Act, which resulted in numerous salinity-control efforts to prevent salt from reaching the river. As of 2017, salinity-control measures have prevented nearly 1.31 million tons of salt from reaching the river per year (USBR 2017a). To meet salinity water quality standards in the lower Colorado River, it is estimated that an additional 372,000 tons of salt will need to be prevented from reaching the river by 2035 using salinity-control measures.

Salinity loading is highest in The Moab Daily segment, where tributaries overlie a collapsed salt dome, the Paradox Formation (USBR 2017b; Weir et al. 1983). The Dolores River, Onion Creek, and Pack Creek are considered impaired by the EPA because of high concentrations of dissolved solids (including salt) (Masbruch and Shope 2014). To partially address the issue of salinity from the Dolores River, saline brine is intercepted and injected underground before it can reach the Delores River (USBR 2017b). Additional salinity-control projects are in various stages of development and implementation.

Uranium

Uranium is a significant heavy metals risk in The Moab Daily segment. A large amount of uranium tailings is present on the bank of the Colorado River immediately north of Moab at the Moab UMTRA project. Elevated concentrations of uranium and ammonia are present in the groundwater near the tailings pile, negatively impacting water quality and endangered fish species. The current remediation plan minimizes the discharge of those pollutants to the Colorado River by extracting groundwater before it can enter the river (DOE 2018). The EPA does not consider the Colorado River currently impaired from uranium or ammonia, in part because of these mitigation efforts. Large floods pose a future risk, potentially inundating the tailings and mobilizing pollutants into the Colorado River system (Greenbaum et al. 2014).

Further Reading

Quality of Water Colorado River Basin, Progress Report No. 25 (USBR 2017b)

TMDL for Selenium in the Colorado River Watershed (UDEQ 2014)

Utah's Final 2016 Integrated Report (UDEQ 2016a)

GIS Data Layers

Beneficial Uses Assessment Units, Wastewater Treatment Plants, Water Quality Monitoring Sites, Water Rights Regions

2.4 Geology, Paleontology, Oil and Gas, and other Mineral Resources

Geology

The Colorado River rises in the high Rocky Mountains of west-central Colorado and flows through and drains the Colorado Plateau physiographic province in Utah. The Colorado Plateau province is a broad area of regional uplift in southeastern and south-central Utah characterized by essentially flat-lying Mesozoic and Paleozoic sedimentary rocks. In southeastern Utah, the Colorado Plateau province is distinguished by plateaus, buttes, mesas, and deeply incised canyons exposing flat-lying or gently warped strata (UGS 2018a). The Colorado Plateau province is divided into geologically distinct subdivisions. These subdivisions include the Uinta Basin and Canyonlands subdivisions. Ancient Precambrian rocks exposed in its deepest canyons make up the basement of the Colorado Plateau. Younger, more familiar layered rocks of the Colorado Plateau have been deposited on the ancient Precambrian rocks over the past 500 million years, including layers of limestone, sandstone, siltstone, and shale (USGS 2017).

Beginning ca. 70 million years ago, accelerating ca. 20 to 25 million years ago, and accelerating even more ca. 5 million years ago, both the Basin and Range and Colorado Plateau provinces were uplifted by as much as 3 km. Although the Basin and Range province was broken up into dropped-down valleys and elongated mountains, the Colorado Plateau province retained its structural integrity and remained a single tectonic block (USGS 2017). The Colorado Plateau crust rose 1 km higher than the Basin and Range, and streams cut deep stream channels, with the Colorado River being the most well-known of these streams (USGS 2017).

Ca. 5.5 million years ago, the lower Colorado River in southern Nevada and Arizona was captured (or diverted from its own bed) and joined with the upper Colorado River, which was flowing into Utah from Colorado. The headwaters of high-plateau drainages on the Kaibab Plateau were captured or linked with the lower Colorado River, which was just a few hundred meters above sea level. This threw the entire river out of equilibrium by approximately 2 to 3 km of base level change and resulted in the rapid cutting of the Grand Canyon (Darling and Whipple 2015; Young and Spamer 2000). This rapid erosion also resulted in the spectacular landforms (e.g., arches, cliffs, and pinnacles) along the Colorado Plateau and Colorado River.

The Canyonlands subdivision of the Colorado Plateau is in the southeastern quarter of Utah. The Canyonlands subdivision has been sculpted by the Colorado River and its tributaries, resulting in deep, sheer-walled canyons, plateaus, mesas, buttes, and badlands (McGinty and McGinty 2009). Much of the landscape is characterized by delicate rock forms, such as tall pinnacles, deep alcoves, natural bridges, and arches. The Canyonlands subdivision also includes isolated mountains: the Abajo, La Sal, and Henry Mountains.

Geologic units underlying the Colorado River planning area are listed in Table 2.12.

Table 2.12. Geologic Units Underlying the Colorado River Planning Area

River Segment	Geologic Units	Area (acres)
Above Westwater	Alluvium	88
	Entrada Sandstone	< 1
	Water	143
	Wingate Sandstone	1
Westwater Canyon Wilderness Study Area	Alluvium	93
	Chinle Formation	30
	Early Proterozoic Rocks	73
	Entrada Sandstone	11
	Felsic gneiss	36
	Stream alluvium	< 1
	Water	204
	Wingate Sandstone	12

River Segment	Geologic Units	Area (acres)
The Moab Daily	Brushy Basin Member of Morrison Formation	40
	Cedar Mountain Formation	19
	Chinle Formation	120
	Cutler Formation	24
	Eolian deposits	2
	Kayenta Formation	165
	Mixed eolian and alluvial deposits	5
	Moab Member of Curtis Formation	31
	Moenkopi Formation	77
	Navajo Sandstone	67
	Pediment-mantle deposits	32
	Salt Wash Member of Morrison Formation	41
	Slick Rock Member of Entrada Sandstone	1
	Slumps and slides	7
	Stream alluvium	884
	Talus and colluvium	122
	Terrace deposits	11
	Tidwell Member of Morrison Formation and Summerville Formation, undivided	6
	Water	1,614
	Wingate Sandstone	166

River Segment	Geologic Units	Area (acres)
Meander Canyon	Arkosic facies of Cutler Formation	2
	Honaker Trail Formation	79
	Lower Cutler Group (Rico, Elephant Canyon, and Halgaito Formations)	200
	Stream alluvium	202
	Terrace deposits	< 1
	Water	596
Glen Canyon	Alluvial terrace gravel deposits	39
	Alluvium	401
	Carmel Formation, Upper Members	8
	Cedar Mesa Sandstone (part of Cutler Group)	7
	Cedar Mesa, Diamond Creek, Arcturus and other Formations	206
	Colorado River channel prior to inundation by Lake Powell	1,010
	Eolian sand	< 1
	Glen Canyon Group (Navajo, Kayenta, Wingate, and Moenave Formations) and Nugget Ss	41
	Lower Cutler beds (part of Cutler Group)	4
	Mass-movement landslide and talus deposits	19
	Mass-movement slump blocks	49
	Mixed alluvial fan, colluvial, and eolian deposits	18
	Monitor Butte Member of Chinle Formation	58
	Moss Back Member of Chinle Formation	3
	Navajo Sandstone	11

River Segment	Geologic Units	Area (acres)
	Oquirrh Group, Wells, Weber, Ely, Callville and other Formations	108
	Organ Rock Shale (part of Culter Group)	38
	Owl Rock and Petrified Forest Members of Chinle Formation	< 1
	Tufa	1
	Upper member of Moenkopi Formation	121
	Water	9,052
	White Rim Sandstone (part of Cutler Group)	17

Source: UGS (2019).

Geologic Hazards

As depicted in Figure 2.43, there is a relatively low seismic hazard within the Colorado River corridor (USGS 2014). In this figure, peak ground acceleration (ground motion effect) is a measure of the maximum force experienced by a small mass located at the surface of the ground during an earthquake. The forces caused by the shaking can be measured as a percentage of gravity or %g. The %g can range from 0% to greater than 80%. The five river segments are in areas with no greater than 30%g. In comparison, Salt Lake City is in an area of 40%g to 80%g.

There are several Quaternary faults along the Colorado River. However, nearly all of these faults are Class B structures. Class B faults are structures that are likely too shallow to be a source of significant earthquakes, or the evidence for a tectonic origin is not strong enough for the structures to be classified as Class A (Crone and Wheeler 2000). Class B structures, which include faults of uncertain earthquake potential, may be related to processes such as salt deformation and dissolution, landsliding, lateral spreading, or subsidence following volcanic activity (Willis 2019). Class A structures are those for which geologic evidence indicates Quaternary deformation of tectonic origin (Crone and Wheeler 2000). Movement on Class A structures results from regional crustal stresses, and the movement is typically accompanied by earthquakes. There are very few Class A structures in the Colorado Plateau and very little is known about the few Class A structures near the Colorado River. It is likely that if more information is gathered on the Class A structures near the river they may be classified as Class B (Willis 2019).

Three of the Quaternary faults (Little Dolores River fault, Sand Flat Graben faults, Ryan Creek fault zone) are along the Colorado River approximately 5, 15, and 18 miles, respectively, southwest of the Utah-Colorado state line (along the Above Westwater, Westwater Canyon Wilderness Study Area, and The Moab Daily segments). One of the Quaternary faults (Moab fault and deformation zones) is southwest of Moab along The Moab Daily segment. Several other Quaternary faults (i.e., Needles fault zone) are along the Colorado River in the southwest portion of Canyonlands National Park and southwest of the park boundary along the Glen Canyon segment. There is a swarm of faults (Bright Angel fault system) across Lake Powell, south of Halls Crossing along the Glen Canyon segment (UGS 2018b). Figure 2.44 depicts the locations of Quaternary faults overlapping the Colorado River planning area.

Many of the geologic processes that have shaped the canyons and valleys along the Colorado River over millions of years are still active today and present geologic hazards to property and human lives. In addition to earthquakes, these geologic hazards include rock falls, landslides, flooding, debris flows, piping, slumping due to river undercutting, subsidence from salt dissolution, and collapse or settling of soils (Hylland and Mulvey 2003; Mulvey 1992).

Rock falls happen when erosion and gravity dislodge rocks from cliffs or slopes. The units most susceptible to rock falls are the Wingate Sandstone, Kayenta Formation, and Navajo Sandstone (Hylland and Mulvey 2003). Outcrops in these units are disrupted by bedding surfaces, joints, or other discontinuities that break rock into loose fragments, blocks, or slabs. Rock falls can damage structures, block roads, and threaten personal safety.

Landslides are most likely in areas with highly fractured rock, in the Paradox Formation cap rock, and in areas with clay-rich strata, such as the Chinle and Kayenta Formations where they dip toward valleys or canyons (Hylland and Mulvey 2003). However, landslides are unlikely unless water is introduced or slopes are altered. Landslides primarily present threats to structures and developments on slopes or at the base of slopes.

Flooding can occur as a result of seasonal snowmelt and during cloudburst storms, which typically occur between mid-April and September (Hylland and Mulvey 2003). When cloudburst storms drop large volumes of water in a short period of time, flooding can occur with little advance warning. Flash floods can contain debris flows that include boulders, cobbles, sand, silt, organic material, and other solid debris. Debris flows can present a threat to public safety and create property damage.

Piping is subsurface erosion caused by groundwater that moves in permeable, non-cohesive layers in unconsolidated materials and exits at a free face that intersects the layer (Hylland and Mulvey 2003). The eroded channel or "pipe" becomes enlarged as more water is intercepted until it collapses to form a gully on the surface that continues to enlarge. This process can cause damage to roads, earth-fill dams, farmland, bridges, culverts, and buildings.

Subsidence can occur when salt dissolves and overlying rock collapses. The existence of the Moab-Spanish Valley is attributed to the dissolution of salt in the salt diapir that underlies the valley by groundwater moving from the La Sal Mountains toward the Colorado River (Hylland and Mulvey 2003). Subsidence from salt dissolution can also result in the formation of sinkholes and can cause damage to structures or tilting of structures.

Collapsible soils are common in Utah, particularly in alluvial fans that have shale in their source areas (Hylland and Mulvey 2003). These soils generally consist of fine sand and silt held together by small amounts of clay. The soil collapses when it is saturated and the clay bonds dissolve. Collapsing soils can damage structures and can also contribute to debris flows during flooding events.

Radon is another geologic hazard in the planning area. Radon is an odorless, tasteless, colorless, naturally occurring radioactive gas produced from the radioactive decay of uranium. Sources of radon include granite, metamorphic rocks, black shales, volcanic rocks, uranium mines, and uranium tailings from uranium mills (Hylland and Mulvey 2003). When present near the ground surface or beneath well-drained, porous, and permeable soil, radon gas can migrate into buildings. Radon decay products are a significant cause of lung cancer when inhaled over a long period of time (Hylland and Mulvey 2003).

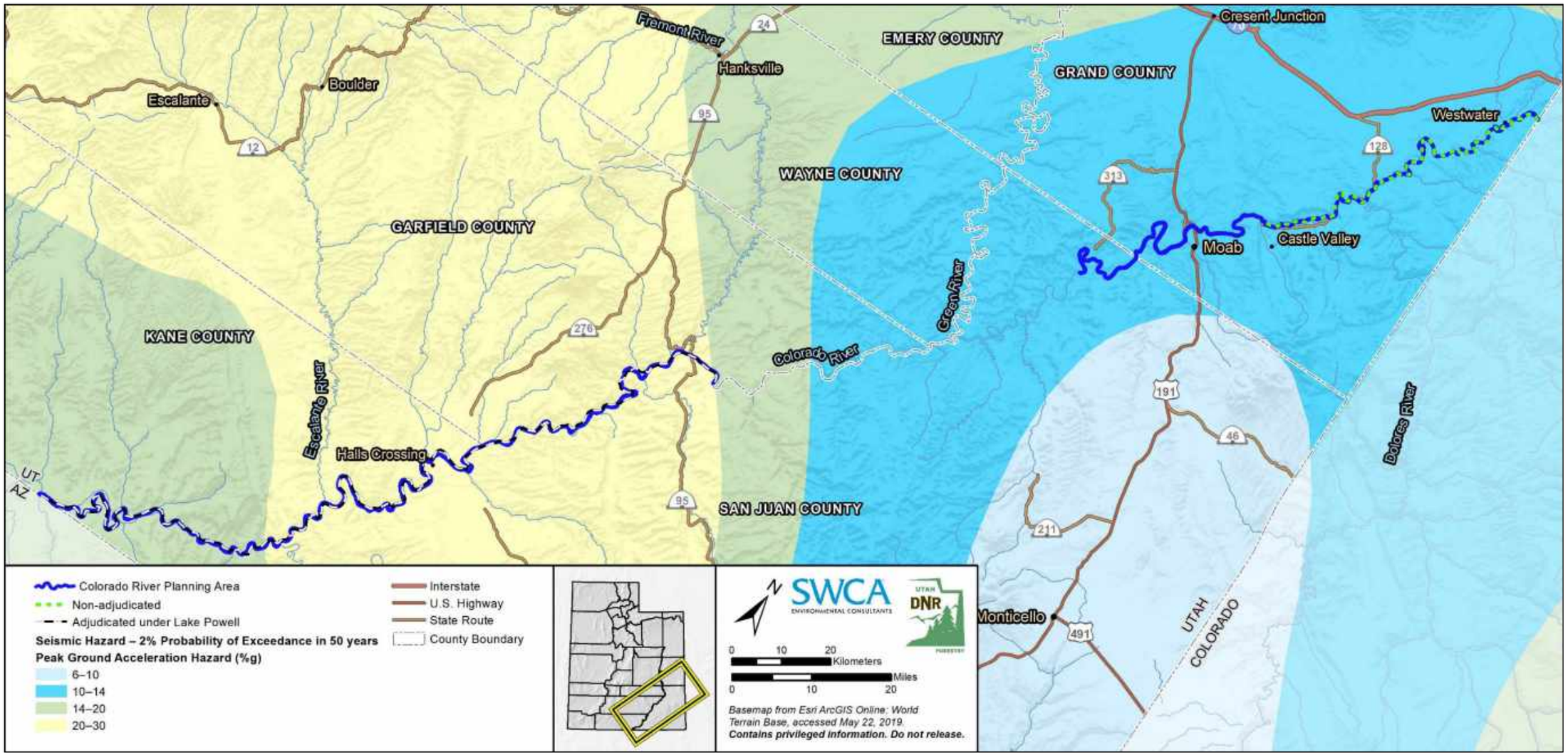


Figure 2.43. Seismic hazards along and near the Colorado River planning area.

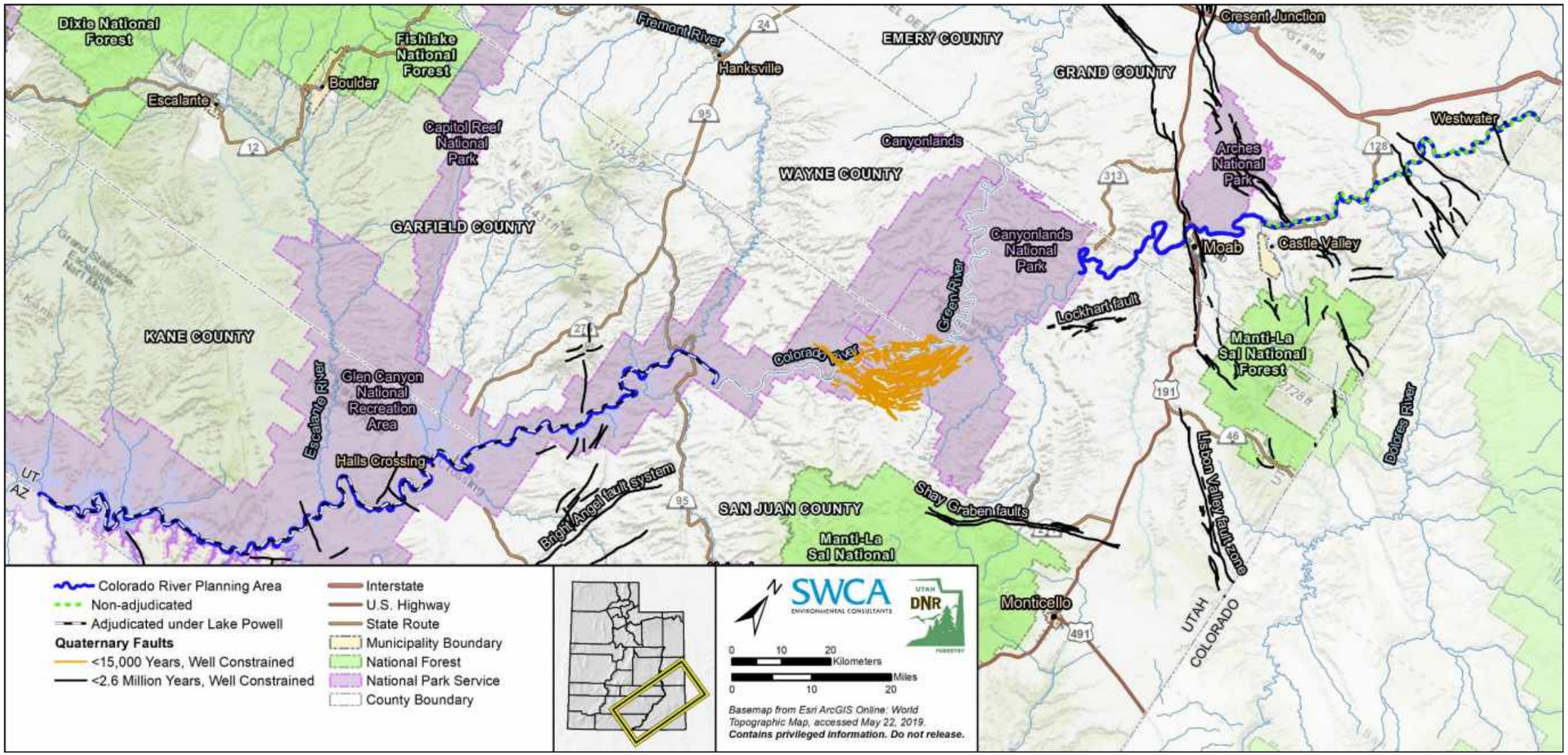


Figure 2.44. Quaternary faults overlapping the Colorado River planning area.

Paleontology

Fossil-bearing sedimentary rocks on the Colorado Plateau range in age from Pennsylvanian to Quaternary and include parts of the three great periods of earth history during the Phanerozoic eon: the Paleozoic, Mesozoic, and Cenozoic. Fossils preserved in these deposits include invertebrate, vertebrate, and plant fossils. Vertebrate fossils include the body remains of fish, amphibians, reptiles (including dinosaurs), mammals, and birds, as well as their tracks and traces. These fossils occur in rocks of Pennsylvanian, Permian, Triassic, Jurassic, Cretaceous, Tertiary, and Quaternary age and include specimens unique to this area (BLM 2008).

The BLM's Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands provides baseline guidance for predicting, assessing, and mitigating paleontological resources. The PFYC classes, as defined in the BLM Instruction Memorandum 2016-124 (BLM 2016), are described below:

Class 1 – Very Low. Geologic units that are not likely to contain recognizable fossil remains. Management concerns for paleontological resources in Class 1 units are usually negligible or not applicable.

Class 2 – Low. Geologic units that are not likely to contain paleontological resources. Except where paleontological resources are known or found to exist, management concerns for paleontological resources are generally low and further assessment is usually unnecessary except in occasional or isolated circumstances.

Class 3 – Moderate. Sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Management concerns for paleontological resources are moderate because the existence of significant paleontological resources is known to be low. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for casual collecting.

Class 4 – High. Geologic units that are known to contain a high occurrence of paleontological resources. Management concerns for paleontological resources in Class 4 are moderate to high, depending on what action is being proposed.

Class 5 – Very High. Highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources. Management concerns for paleontological resources in Class 5 areas are high to very high.

Table 2.13 lists the acres of PFYC within the Colorado River planning area.

Table 2.13. Potential Fossil Yield Classifications of the Colorado River Planning Area

River Segment	PFYC	Area (acres)
Above Westwater	2	165
	3	47
	5	6
Westwater Canyon Wilderness Study Area	1	141
	2	151
	4	119
	5	16
The Moab Daily	Data not available	529
	2	1,928
	3	165
	4	537
	5	141

River Segment	PFYC	Area (acres)
Meander Canyon	Data not available	158
	2	879
	3	9
Glen Canyon	0	10,157
	2	300
	3	460

Note: Acreage calculations account for lands between the banks of the river.
Source: UGS (2000)

Oil and Gas

Oil seeps were noted along the San Juan River in 1883 by E.L. Goodridge, and a "gusher" well was drilled by him in 1908. This was the discovery well for the Mexican Hat field, located adjacent to and within the meander area of the San Juan River (Utah Geological Association 1993). Intense prospecting for oil along the Colorado River below Moab and the San Juan River began in the 1920s (Webb 1994).

The Colorado River overlays part of the Paradox Basin, which contains areas of high occurrence potential for oil and gas. However, there are two locations with oil and gas fields (Kane Creek and Moab) that are adjacent to the Colorado River planning area (Wood and Chidsey 2015). Both areas are between Arches National Park and Canyonlands National Park (in The Moab Daily and Meander Canyon segments, respectively), and both overlap the Pennsylvanian Paradox Formation. The Moab field is not currently being developed but is actively used as a gas storage structure where gas is either injected or extracted depending on economic conditions. There are nine Kane Creek oil fields (five currently producing, one shut-in, and three abandoned) and one abandoned Leadville field within 10 miles of the river.

The Kane Creek shale consists of thinly interbedded, black, organic-rich marine shale, dolomitic siltstone, dolomite, and anhydrite; it is both the reservoir and oil source. The Leadville Limestone consists of shallow marine limestone and dolomite; the oil is sourced from organic-rich shales (e.g., Kane Creek) in the overlying Paradox Formation. Petroleum is trapped in fractured or porous reservoirs, usually on the crest of anticlinal closures (folds in the rocks). These traps are identified by a combination of geophysical seismic surveys and subsurface and surface geology.

The bed of the Colorado River between Moab and Canyonlands National Park lies in the area of the Kane Creek shale beds of the Pennsylvanian Paradox Formation and Mississippian Leadville Limestone; both have had oil plays since the 1920s based on published thickness, structural, and hydrocarbon "show" maps (Chidsey 2009, 2016; Chidsey and Edy 2017; Wood and Chidsey 2015). The Kane Creek area remains an extractive exploration target due the development of new extraction technologies. There are also several dry wells along the Colorado River southeast of Dead Horse Point State Park near the Meander Canyon segment that were plugged and abandoned in 1967 after minimal production (DOGM 2018).

Other Mineral Resources

Other mineral resources that underlay or are adjacent to the Colorado River planning area include the following:

- Uranium mining operations and occurrences between Arches National Park and Canyonlands National Park near The Moab Daily and Meander Canyon segments, as well as northeast of Lake Powell near the Glen Canyon segment (Gloyn et al. 2005; UGS 2018c)
- A large potash mining operation southwest of Moab in a known potash leasing area near the Meander Canyon segment (Bon and Wakefield 2008)
- Several small, active and inactive sand and gravel operations near The Moab Daily segment (UGS 2018c)
- Precious and base metal occurrences northeast and southwest of Moab near The Moab Daily segment, as well as occurrences under most of Lake Powell along the Glen Canyon segment that include three small, inactive placer gold operations (Doelling and Tooker 1983; UGS 2018)

In September 2004, then–Secretary of the Interior, Gale Norton, signed the Three Rivers Withdrawal, which became effective on October 6, 2004 (Wait 2004). The Three Rivers Withdrawal withdrew nearly 200 miles of river corridor along portions of the Colorado, Dolores, and Green Rivers, including the Colorado River Special Recreation Management Area, from the locating of any new hard rock mining claims. Designated wilderness and wilderness study areas along the Colorado River are also closed to mineral entry.

Leasing of Oil and Gas and Other Mineral Resources

FFSL is the executive authority for the management of sovereign lands and is required to prescribe standards and conditions for the authorization and development of surface resources on sovereign lands. Mineral leases issued by FFSL must be in compliance with state law, administrative rules, and the Public Trust Doctrine and must adhere to multiple-use, sustained-yield principles. In addition, each mineral lease must also comply with this CMP and the *Green and Colorado Rivers Mineral Leasing Plan* (SWCA 2020).

All sovereign lands on the Colorado River not closed for leasing are classified as no surface occupancy (NSO). All mineral leases issued on sovereign land will contain an NSO stipulation. NSO stipulations prohibit surface occupation for development and exploration of mineral resources but allow the subsurface resources to be legally available so that they can be accessed by means other than occupying the surface. As a result of the NSO stipulation, development of oil and gas resources can only take place if adjacent lands are leased and the resources are legally developed through directional drilling. This development is contingent on applicable land management agency decisions (e.g., DOGM, BLM, SITLA) or on the initiative of private landowners.

Further Reading

Energy Resources Map of Utah (Gurgel et al. 1983)

Large Mines in Utah 2008 (Bon and Wakefield 2008)

Oil and Gas Fields Map of Utah (Wood and Chidsey 2015)

Physiographic Provinces (UGS 2018a)

Utah Quaternary Fault and Fold Map (UGS 2018b)

GIS Data Layers

Geology, Large and Small Mines, Oil and Gas, Potential Fossil Yield Classifications, Quaternary Faults, Uranium

2.5 Community Resources

Community resources are those resources associated with the Colorado River that are valued, enjoyed, used, or needed by the general public. The general public is varied and includes stakeholder groups who participated in the planning process (see Appendix A). Community resources in the planning area are discussed in seven sections: Agriculture, Infrastructure, Cultural Resources, Recreation, Access, Public Safety, and Education.

Agriculture

Agriculture and Water Resources

The NRCS identifies important farmlands to ensure that the productive capacity of American agriculture is not impaired. The agency prepares statewide lists of soil mapping units that meet the criteria for 1) prime farmland, 2) unique farmland, 3) farmland of statewide importance, or 4) farmland of local importance (7 CFR 657). Table 2.14, as inventoried by the NRCS and using 2015 soil series data, provides the total acreage of each of these farmland types in the planning area relative to the total acreage of each county. Prime farmland has the best combination of physical and chemical characteristics for producing crops. Unique farmland is land other than prime farmland that is used for production of specific high-value crops. Farmland of state and local importance considers parameters such as location, potential for high yields of specific crops, and growing season, among others. Farmland classes are also shown in the GIS spatial data viewer.

Table 2.14. Acres of Farmland Classes within 0.5 Mile of the Planning Area in Garfield, Grand, Kane, and San Juan Counties

Farmland Classes	Garfield County (acres)	Grand County (acres)	Kane County (acres)	San Juan County (acres)
Prime farmland (percentage of county acres)	0 (0%)	38 (< 1%)	0 (0%)	0 (0%)
Prime farmland if irrigated (percentage of county acres)	0 (0%)	596 (< 1%)	0 (0%)	0 (0%)
Unique farmland (percentage of county acres)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Farmland of statewide importance (percentage of county acres)	0 (0%)	9,128 (< 1%)	0 (0%)	120 (< 1%)
Farmland of local importance (percentage of county acres)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Not mapped or not available (percentage of county acres)	0 (0%)	237 (< 1%)	0 (0%)	< 1 (< 1%)
Total county acreage	3,301,120	2,360,960	2,498,560	4,944,000

Source: NRCS (2015).

For hundreds of years, indigenous populations farmed and raised animals along Utah's waterbodies, including the Colorado River. By the mid-1800s, Utah settlers began raising livestock, growing crops, and diverting water to their lands (Envision Utah n.d. [2018]). Vast rangelands in Garfield County made cattle ranching one of the county's most important industries since pioneer times. Most of Grand County's agricultural history consists of small family farms, small family orchards, and livestock. Large sheep and cattle companies found forage for their livestock in the canyons of Grand County and in the La Sal Mountains (Utah State Historical Society 1988). In Kane County, most of the county's residents were farmers or ranchers in the nineteenth and twentieth centuries (Utah State Historical Society 1988). In San Juan County, farming was initially focused along the San Juan River bottoms, which flooded regularly or went dry too often for dependable irrigation. Early cattleman often did better than farmers in this county. Agricultural census data and irrigated land by crop for Garfield, Grand, Kane, and San Juan Counties are summarized in Tables 2.15 and 2.16, respectively.

Table 2.15. 2012 Census of Agriculture Data for Garfield, Grand, Kane, and San Juan Counties

Agricultural Parameters	Garfield County	Grand County	Kane County	San Juan County
Land in farms (acres)	91,533	W	125,441	1,608,901
Percentage of total county area	2.8%	N/A	5.0%	32.5%
Percentage use	Pastureland: 67.5% Cropland: 19.2% Woodland: 8.5% Other uses: 4.8%	W	Pastureland: 81.1% Woodland: 14.7% Other Uses: 4.3%	Pastureland: 91.1% Cropland: 7.0% Other uses: 1.9%
State rankings	**Value of sales:** Aquaculture (10) Cattle and calves (15) **Top crop items:** Nursery stock crops (2) Forage-land used for all hay and haylage, grass silage, and greenchop (16) **Top livestock inventory:** Mules, burros, and donkeys (3)	**Value of sales:** Vegetables, melons, potatoes, and sweet potatoes (8) Fruits, tree nuts, and berries (8) **Top crop items:** Vegetables harvested (9) Oats for grain (9) **Top livestock inventory:** Goats (25)	**Value of sales:** Other animals and animal products (19) Vegetables, melons, potatoes, and sweet potatoes (20) **Top crop items:** Almonds (3) Pumpkins (11) **Top livestock inventory:** Colonies of bees (11)	**Value of sales:** Grains, oilseeds, dry beans, and dry peas (8) Horses, ponies, mules, burros, and donkeys (8) **Top crop items:** Wheat for grain (2) Winter wheat for grain (2) Safflower (3) Spring wheat for grain (5) **Top livestock inventory:** Goats (1)

Sources: USDA (2012a, 2012b, 2012c, 2012d).

Notes: The numbers in parentheses reflect state rankings from 1 to 29 with 1 being the top ranking for that category.

W = Withheld in the census of agriculture to avoid disclosing data for individual farms.

N/A = not applicable.

Table 2.16. Irrigated Land by Crop in Garfield, Grand, Kane, and San Juan Counties

Irrigated Land	Garfield County (acres)	Grand County (acres)	Kane County (acres)	San Juan County (acres)
SURFACE IRRIGATED CROPS				
Orchard/fruit/nursery	53	136	0	55
Vineyards	nr	31	nr	27
Grain	174	33	18	378
Corn	0	50	0	0
Vegetables	0	3	0	10
Alfalfa	5,222	1,657	162	3,078
Grass Hay	257	43	0	454
Pasture	1,452	831	36	1,976
Fallow	182	nr	0	nr
Pasture subject to spring flooding	nr	0	nr	158
SUB-IRRIGATED CROPS				
Sub-irrigated pasture	8	0	53	9
Total Irrigated Crop Lands	**7,348**	**2,784**	**269**	**6,145**

Sources: DWRe (2000a, 2000b).

Note: nr = not reported.

In the southeast Colorado River basin, which consists of most of Grand and San Juan Counties, agriculture is the largest water user in the area. There is 8,929 acres of irrigated cropland, and the most common crops are alfalfa and pasture grass for livestock (DWRe 2000a). The average annual quantity of water diverted for cropland irrigation is 34,950 acre-feet, of which 18,430 acre-feet is depleted. A depletion is a human-caused loss of water from a surface-water system (e.g., when water is diverted for agriculture in Grand County, it reduces the amount of water available in the downstream Colorado River watershed).

During the late part of the growing season, there is a shortage of water for irrigated cropland in the southeast Colorado River basin. Because of increasing agricultural costs, it would not be feasible to develop additional agricultural water in the basin except as part of a municipal and industrial project. The best opportunity to increase water supply is to more efficiently use currently available water (DWRe 2000a).

Irrigated agriculture has primarily been established in areas of the southeast Colorado River basin with adequate water supplies and fertile soil conditions (i.e., in the Spanish Valley near Moab and in the areas around Monticello and Blanding). Entities that manage agricultural water include conservation and conservancy districts; irrigation, ditch, and canal companies; and in some cases, reservoir and pipeline companies (DWRe 2000a). Irrigation companies deliver most of the agricultural water to farmers, although there is a significant amount delivered by individuals. Individual irrigators with water rights can pump directly from the Colorado River after obtaining FFSL authorization. Agricultural water use is expected to stay about the same in this basin, although a small amount of the existing supply could be reallocated to municipal and industrial demands which are expected to increase (DWRe 2000a). Table 2.17 presents agricultural diversions and depletions for 1996 and 2020 in Grand and San Juan Counties.

Table 2.17. Agricultural Diversion and Depletions for 1996 and 2020 (acre-feet) in Southeast Colorado River Basin by County

Southeast Colorado River Basin County	1996		2020 (projected)	
	Diversions	Depletions	Diversions	Depletions
Grand County	13,800	6,910	11,890	5,950
San Juan County	21,150	11,520	21,150	11,520

Source: DWRe (2000a).

In the west Colorado River basin, which consists of most of Carbon, Emery, Wayne, Garfield, and Kane Counties (along with small portions of other counties), much of the economy centers on agriculture. The primary agricultural operation is cow/calf and beef production (DWRe 2000b). Most of the irrigated agriculture supports this production. Total diversions for agricultural irrigation in the west Colorado River basin are 295,050 acre-feet, of which 162,000 acre-feet is depleted annually. The main crops are pasture, alfalfa, small grains, grass hay, and corn silage (DWRe 2000b). This basin does not have a full water supply for all its irrigable lands. The water deficit could be diminished in many cases by reducing seepage and evaporation and improving irrigation efficiencies (DWRe 2000b).

The primary use of water, which is diverted from most rivers and streams flowing into valley areas, is crop irrigation in the west Colorado River basin (DWRe 2000b). Incorporated mutual irrigation companies serve most of the irrigated land; private irrigation systems serve approximately one-third. These companies and systems manage almost 90% of the developed water supply. Over the long term, existing irrigated acreage is projected to decline slightly because of increased population pressures while some new lands (several thousand acres) may be brought under irrigation in the Green River and western Wayne County areas (DWRe 2000b). Table 2.18 presents agricultural diversions and depletions for 1990 and 2020.

Table 2.18. Agricultural Diversions and Depletions for 1990 and 2020 (acre-feet) in West Colorado River Basin Drainages

West Colorado River Basin Drainage (related county)	1990		2020 (projected)	
	Diversions	Depletions	Diversions	Depletions
Dirty Devil River (Garfield)	83,400	43,600	80,000	42,000
Escalante River (Garfield)	23,100	12,400	22,000	12,000
Paria River (Garfield, Kane)	7,750	3,500	7,000	3,000

Note: Three additional river drainages in the west Colorado River basin are not included here because they are not in the four counties in the planning area.

Source: DWRe (2000b).

Agriculture and Water Rights

A water right is a right to the use of water based on 1) quantity, 2) source, 3) priority date, 4) nature of use, 5) point of diversion, and 6) physically putting water to beneficial use (DWRi 2011). The three basic beneficial uses of water for water rights are domestic, stock watering, and irrigation, which are allocated based on an annual requirement or "duty" as described in Table 2.19; other beneficial uses include municipal, industrial, and instream flows (Reid et al. 2008).

Table 2.19. Basic Beneficial Uses of Water and their Associated Requirements for Water Rights

Basic Beneficial Uses of Water	Requirements for Water Right (acre-feet)
Domestic: Domestic use is any use of water inside the home.	0.45
Stock watering: Stock watering is quantified based on equivalent livestock unit. An equivalent livestock unit is one horse and foal or cow and calf, or equivalent number of sheep, goats, pigs, chickens, etc. The beneficial use period for these uses is generally year-round, but can vary with specific needs.	0.028
Irrigation: Irrigation is the act of applying water to any plant to obtain optimal growth and maintenance of that plant. Although not always harvested as crops, lawns, gardens, shrubs, pastures, and nonnative trees and plants are all considered plants that require irrigation.	**Range**: 3.0 to 6.0 per irrigated acre **Average**: 4.0 per irrigated acre This "duty" is based on the highest water consuming crop, which is alfalfa, during the growing season of the region and surface irrigation practices.

Source: Reid et al. (2008),

DWRi regulates the appropriation and distribution of water in the State of Utah, pursuant to Title 73 of the Utah Code. The State Engineer, who is the director of DWRi, gives approval for the diversion and use of any water, regulates the alteration of natural streams such as the Colorado River, and has the authority to regulate dams to protect public safety. Because FFSL does not regulate water rights, the CRCMP does not outline management strategies for water rights. However, an applicant must have a valid water right before FFSL can authorize pumping equipment in the planning area.

Irrigation

IRRIGATION COMPANIES

Irrigation companies can own the right to use water from a surface and/or groundwater source, which is delivered to users by a canal, ditch, or pipeline. Individual shareholders in an irrigation company do not legally own the water right. This right is allocated based on the number of shares in an irrigation company owned by an individual shareholder. The value or quantity of water allocated to a share of water is not constant throughout the state and varies considerably from one irrigation company to another. In some canal companies, a share of water is allocated per acre, whereas in others, three or four shares may be needed to provide sufficient irrigation water for 1 acre of alfalfa (Reid et al. 2008).

IRRIGATION SYSTEMS

Small irrigators in the Colorado River watershed may obtain a permit to use irrigation pumps to withdraw water directly from the river and apply it to crops or rangeland. Methods for withdrawing water include securing hoses in the river, installing floating pumps, and constructing pumping plants. Irrigation equipment may present an impediment to navigation or degrade water quality by causing bank erosion, resulting in harm to Public Trust values. FFSL's authorization process for irrigation equipment helps protect the Public Trust on sovereign lands. Common terms for irrigation equipment are provided in Table 2.20.

Table 2.20. Common Terms for Irrigation Equipment

Irrigation Term	Definition
Pumping plant	A facility that delivers water at a designated pressure and flow rate. Includes the required pump(s), associated power unit(s), plumbing, and appurtenances, and may include on-site fuel or energy source(s) and structures.
Pump unit	Any mechanism used to withdrawal, displace, or discharge a volume of water.
Power unit	Any mechanism that supplies the necessary energy, force, or work required to operate a pump unit.
Support structure	Any building, structure, or appurtenance that supports the loads or forces placed on a streambank by a pumping plant. Support structures include flat concrete pads, scaffolding, boom arms, tracks, and struts.
Pump house	A support structure that meets the definition of confined space* and is associated with a pumping plant or activity
Sump	A configuration of pumping plant where the pump unit exists in or on the water source and where power from the power unit is delivered to the pump unit.
Discharge hose/pipe	Any hose, pipe, or plumbing used as a vessel to transport water from a pump unit.
Intake line (suction hose)	Any hose, pipe, or plumbing used as a vessel to transport water from a water source to a pump unit.
Foot valve	A mono-directional valve placed at the end of a suction hose to prevent water from draining out of the hose.
Screen	Any appurtenance of the pumping plant that removes or prevents undesirable material from entering the intake line. May be installed on the suction end of the intake line or may confine the entire pumping plant (more often associated with pump houses).

*Confined space is defined as an area large enough for employees to enter and perform work but with limited or restricted means for entry or exit and is not designed for continuous occupancy (Occupational Safety and Health Administration n.d. [2018]).

FFSL typically authorizes four common configurations of pumping plants on sovereign lands of the Colorado River: 1) intake lines that lie on sovereign lands without a support structure (with or without a foot valve or screen), 2) sumps, 3) intake lines or sumps with support structures, and 4) pump houses.

Other agricultural infrastructure built on sovereign lands includes irrigation distribution systems that can include diversions, canals, and return flow structures. When properly designed and sited, structures such as diversions and canals pose no problem to navigation, nor do they degrade bank condition. However, poorly designed and sited structures can result in increased erosion of the bed and bank. In addition, irrigation water distribution systems are efficient weed vectors, either from or to the Colorado River. FFSL recognizes the importance of weed control on and adjacent to sovereign lands.

Tile Drains (Field Drains)

Tile drains are installed to allow water in wet or saturated ground to rapidly drain away from an area, to lower the groundwater table, or to relieve hydrostatic pressure. They are typically underground linear structures oriented to land contours and are often used in agriculture because saturated soils do not provide enough aeration for crop root development. In the planning area, tile drains may conduct surplus water into the Colorado River.

FFSL recognizes that tile drains—historically buried clay pipes or tiles, but more recently plastic conduit—may have been in place for many decades. Exact locations of each tile drain are not always available or known, and it is important to note that these drains may not have been installed by the current landowner. Landowners installing new tile drain systems that extend on or over sovereign land must apply for authorization from FFSL. FFSL will work with landowners to improve bed and bank conditions if existing tile drain systems are actively causing degradation. Similar in function to tile drains but more often associated with commercial or residential development and construction are modern land drains.

Livestock Watering

Livestock watering, when linked with a water right and associated point-to-point diversion, is a recognized use of sovereign lands. However, livestock watering directly in the Colorado River can have negative impacts on bank stability and water quality. FFSL currently works with, and will continue to work with, landowners on strategies to bring water to livestock at locations away from the river. FFSL will partner with agencies such as UDAF and NRCS during this process.

FENCES

Fences are a necessary and practical component of livestock management. Fences may extend riverward only to the water's edge or reasonably beyond to restrain livestock so that navigation and recreation in the river are not compromised. All fences on sovereign lands require authorization from FFSL. Fencing in the river has been an identified problem in the past and FFSL will work with owners of existing fences to bring them into compliance.

Agricultural Management Concerns

Agricultural themes and issues raised during the public outreach process include concern about the authorization process in general; concern about authorization fees and the potential for increases; how to permit specific equipment and situations; river access for livestock; concern about trespassing, graffiti, and littering on private property by river users; fencing in or near the river; changing riverbanks; and better education for river users about river etiquette (e.g., boating regulations, private property).

Agriculture by River Segment

Agricultural activities and related infrastructure are permitted uses of sovereign lands (i.e., the bed and bank of the Colorado River). Figure 2.45 provides a river plan view of typical agricultural infrastructure seen along the Colorado River. Figure 2.46 presents agricultural data for the planning area by river segment (e.g., prime farmland).

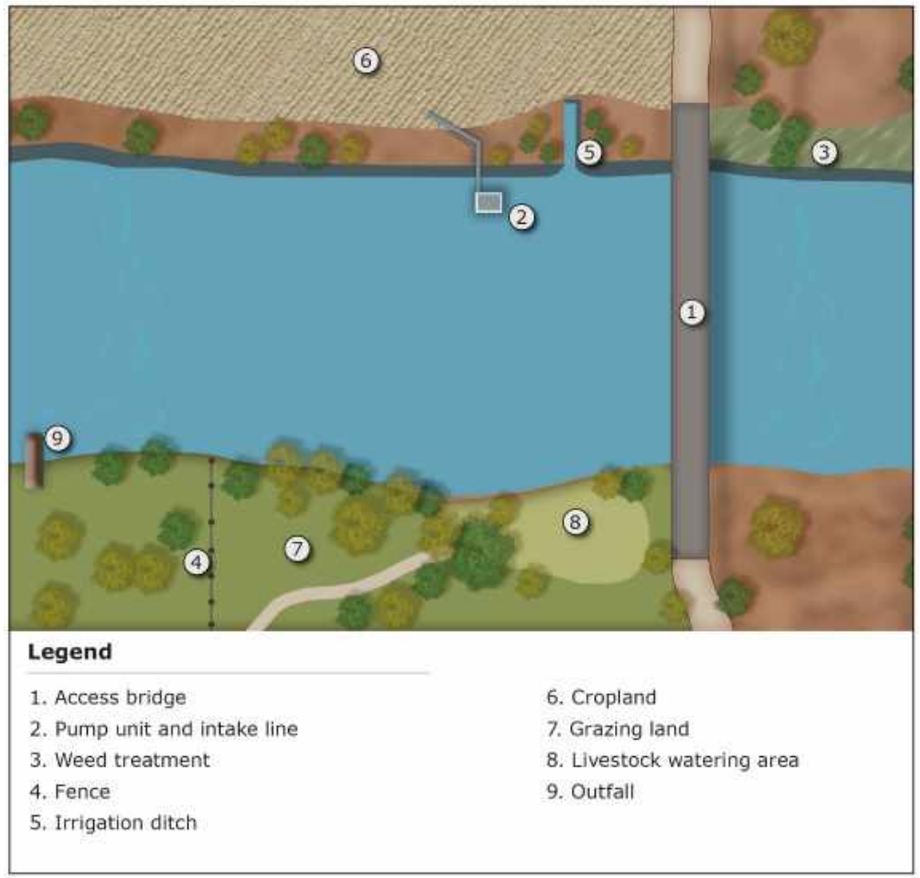


Figure 2.45. Plan view of typical agricultural infrastructure in the planning area.

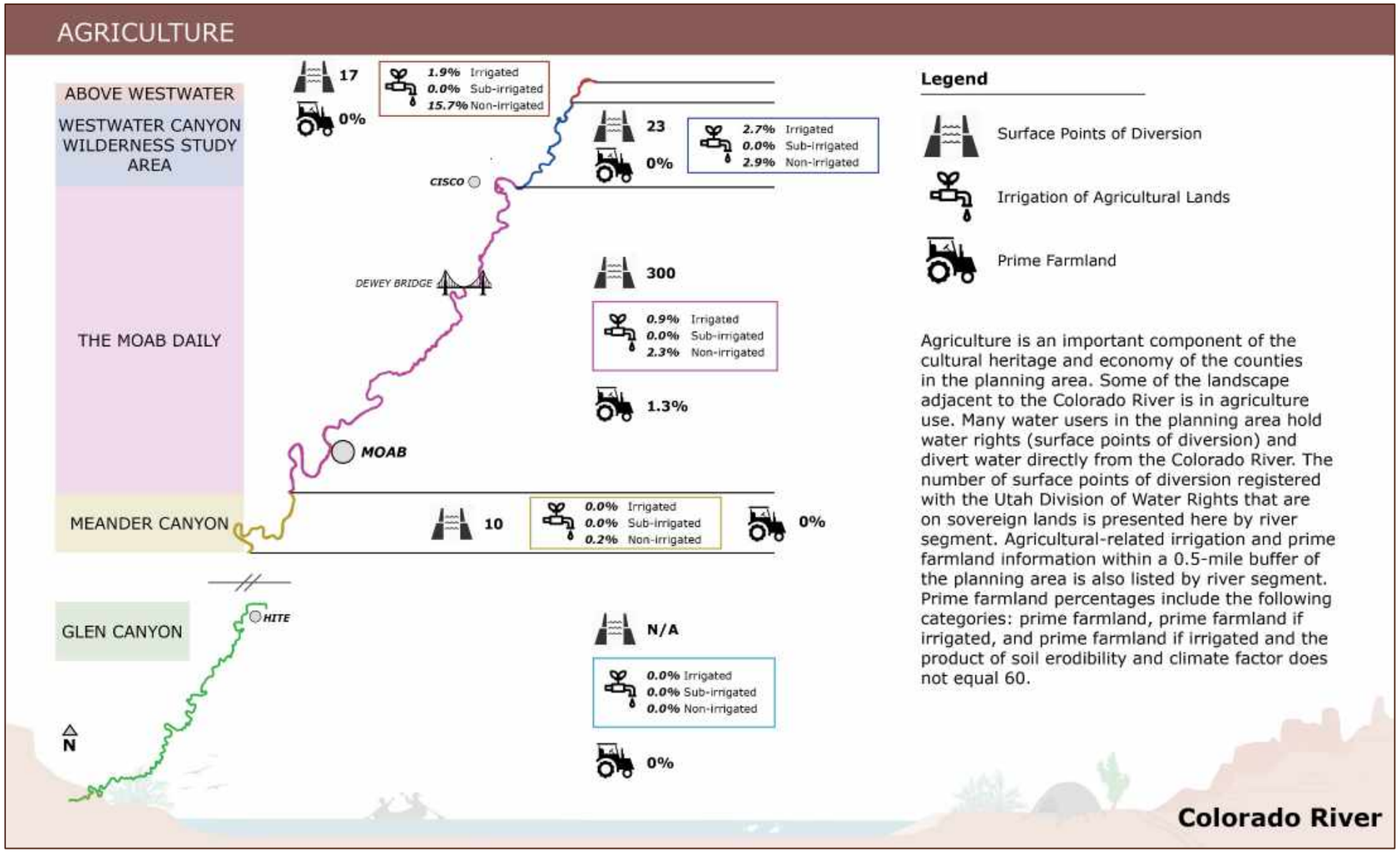


Figure 2.46. Agricultural data for the planning area by river segment.

Further Reading

Background: Agriculture in Utah (Envision Utah n.d. [2018])

Beehive History 14. Utah's Counties (Utah State Historical Society 1988)

Irrigation Pumping Plants (NRCS 2016)

Utah State Water Plan. Southeast Colorado River Basin (DWRe 2000a)

Utah State Water Plan. West Colorado River Basin (DWRe 2000b)

Water Rights in Utah (Reid et al. 2008)

GIS Data Layers

Canals, Farmland Classes, FFSL Authorizations, Grazing Allotments, Landownership, Points of Diversion, Soil Types, Water-Related and Agricultural Land Use

Infrastructure

Infrastructure in the planning area either treats the river as an obstacle to be crossed (e.g., bridges and utility crossings) or as a resource to be used (e.g., outfall structures and dams). Infrastructure in the planning area includes bridges, roads on the banks of the river, utility crossings, outfall structures, tile drains, dams, and canals and irrigation ditches. Each of these infrastructure elements is described in more detail below.

When considering infrastructure development and construction, project proponents must operate in accordance with the FFSL authorization process and other applicable federal, state, and county requirements. Some of the existing infrastructure in the planning area is sanctioned with an associated FFSL authorization; however, some infrastructure, especially older infrastructure, is not. Some bridges and other infrastructure improvements are deemed eligible for the National Register of Historic Places (NRHP) because of their age and local significance (see the Cultural Resources section of Chapter 2). Chapter 1 of the CRCMP describes the FFSL authorization process and provides information on what to do when considering construction of new infrastructure or permitting facilities that do not have current authorizations. The Infrastructure section of Chapter 3 describes design specifications for certain types of infrastructure. Infrastructure data layers are also available in the GIS spatial data viewer.

Infrastructure for recreation users in the planning area, such as boater access points, is discussed in the Recreation section of Chapter 2. Infrastructure for agricultural uses, such as irrigation pump units, is discussed in the Agriculture section of Chapter 2.

Infrastructure, if not designed and maintained appropriately, can negatively affect navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality. For example, dams can change river hydrology, present navigational and safety hazards, alter aesthetic beauty, change sediment transport below the dam, and alter fish and wildlife habitats. Proper infrastructure design and installation are important in preventing the creation of navigational and safety hazards. Careful placement of infrastructure, such as bridges along the Colorado River, is important, because poorly spaced infrastructure can damage the resource, inhibit navigation, and detract from aquatic beauty and the public recreation experience.

Bridges

Bridges serve as transportation links across the river for vehicles, trains, bicycles, and pedestrians (Figure 2.47). Bridges spanning the Colorado River are of various ages, design, and construction materials. Newer bridges generally cross the main channel without obstructions, whereas older bridges may have piers and constrict the main channel. Low clearances and bridge piers can present obstructions to navigation, can change river hydraulics, and can cause large woody debris to accumulate behind them. Bridges in the planning area are shown in the GIS spatial data viewer.

Figure 2.47. Pedestrian bridge and U.S. Route 191 bridge over the Colorado River near Moab.

Roads

In some locations in the planning area, roads have been constructed adjacent to the banks of the Colorado River because of space restrictions. For example, the Potash Road (Utah State Route 279) parallels the Colorado River south of Moab (see Figure 2.48). Roads that are placed close to or on the banks of the river may contribute to bank erosion and be at risk for flood damage. Any work to construct, improve, or repair roads below the ordinary high water mark of the Colorado River should be approved through the FFSL authorization process. Roads in the planning area are shown in the GIS spatial data viewer.

Figure 2.48. Potash Road (Utah State Route 279) adjacent to the Colorado River.

Utility Crossings

Utility crossings include water pipelines, sewer pipelines, gas pipelines, fiber optic lines, and powerlines. Crossing types are below grade and above grade. Below-grade crossings cross the river below the bed of the river and are generally not visible. Above-grade crossings either stand-alone (such as powerlines) or are attached to an existing bridge. Some older utility crossings that rest on the bed of the channel are considered above grade.

Outfall Structures

Outfall structures include storm drain outlets, irrigation return flows, and cooling water outlets.

The Clean Water Act prohibits the discharge of pollutants through point sources such as outfall structures into waters of the United States without a National Pollutant Discharge Elimination System (NPDES) permit. In Utah, the NPDES program is administered by DWQ. DWQ issues Utah Pollutant Discharge Elimination System (UPDES) permits for point source discharges. The permits define discharge limits, monitoring and reporting requirements, and other specified conditions. DWQ has issued two UPDES permits in the planning area: Moab Wastewater Treatment Facility (UT0020419) and Courthouse Wash Water LLC (Canyonlands by Night/Fairfield Inn & Suites by Marriott) (UT0025828).

Tile Drains (Field Drains)

Tile drains (field drains) are discussed in the Agriculture section of Community Resources.

Dams

No large dams span Colorado River sovereign lands. However, dams both upstream (Grand Valley Irrigation Company and Price-Stubb diversion dams in Colorado) and downstream (Glen Canyon Dam) of the planning area affect river characteristics such as flow, sediment, erosion, and water levels in the planning area. Dams on tributaries of the Colorado River can also affect the planning area.

Small irrigation dams, inactive dams, or other dams may be present near the planning area. For example, three potash pond dams are located near the Colorado River approximately 20 miles west of Moab, Utah, and a private regulating reservoir with a 16-foot structural dam height is located near the old Dewey Bridge (DWRi n.d. [2018]).

Canals and Irrigation Ditches

Canals are artificial waterways constructed for irrigation or navigation purposes. Irrigation ditches are small trenches typically constructed for irrigation or drainage. There are no known canals on the Colorado River in the planning area (DWRi n.d. [2018]). Small irrigation ditches may be present on sovereign lands in the planning area.

Flood Control

There are no known FEMA-permitted levees for flood control in the planning area. Levees are listed for the Moab area in the FEMA National Levee Database, but these levees are not FEMA-accredited and are not recognized by FEMA as providing flood protection. FEMA flood zones are available on the GIS spatial data viewer.

Pre-disaster hazard mitigation plans (HMPs) are developed by counties to reduce their susceptibility to natural hazards, including flooding. In Grand County's HMP, the risk of county flooding is identified as highly likely with a potentially severe magnitude (Grand County 2018). More than half of the city of Moab is in a floodplain. Some of the HMP objectives include mitigation to protect Moab's Water Reclamation Facility from Colorado River floodwaters, encouraging 100% participation in the National Flood Insurance Plan, and U.S. Route 191 stormwater drainage improvements. In addition, Grand County has an ordinance that specifies avoidance of development in 100-year floodplains and in natural or historic drainageways. The county also has a flood damage prevention ordinance, adopted in 2014, that applies to areas of special flood hazard.

Garfield and Kane Counties are part of the Five County Association of Governments, which has developed a *Multi-Jurisdictional Natural Hazard Mitigation Plan* (Five County Association of Governments 2017). Flooding is considered a hazard in both counties, and the Colorado River in Glen Canyon has experienced flash floods. Some of the mitigation strategies for the counties include implementing zoning to prevent development of structures near all rivers (using a 100-foot minimum setback), clearing debris and other material from all waterways, and exceeding the minimum National Flood Insurance Plan standards. Kane County has a flood-control ordinance that requires development permits in areas of special flood hazard established by FEMA.

San Juan County is currently developing an HMP. San Juan County's resource management plan outlines a policy of working with federal, state, local, and tribal agencies and property owners to ensure use of BMPs on floodplains and river terraces on public lands (San Juan County 2017). The county also has a policy of working with federal and state agencies to identify floodplains for inclusion on federal and state emergency lists.

Further Reading

Grand County Pre-Disaster Hazard Mitigation Plan 2018 (Grand County 2018)

Multi-Jurisdictional Natural Hazard Mitigation Plan (Five County Association of Governments 2017)

GIS Data Layers

Bridges, Canals, Dams, Erosion Risk, FEMA Flood Zones, Levee (Not FEMA Accredited), Points of Diversion, Stream Alteration Permits, UPDES Permits

Cultural Resources

A *cultural resource* is defined as "a building, structure, district, [archaeological] site, or object that is historically significant" (Hardesty and Little 2000:161). A cultural resource that is referred to as a *historic property*, as defined in the National Historic Preservation Act, is "any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register of Historic Places (NRHP), including artifacts, records, and material remains relating to the district, site, building, structure, or object" (54 United States Code 300308). Before a property is listed on the NRHP, a formal nomination must be written and approved by the Utah State Historic Preservation Office and the State National Register Review Board. Approved nominations are then sent to the Keeper of the NRHP for final review and listing on the NRHP. Section 9-8-404 of the Utah Code Annotated requires that state agencies (e.g., FFSL) consider the effects of their actions on historic properties.

Cultural resources in the planning area generally fall into one of three categories: prehistoric, protohistoric, or historic. Prehistoric cultural resources refer to any site, feature, structure, or artifact that predates Euro-American contact in Utah (anno Domini [A.D.] 1776). The Colorado River passes through two prehistoric culture areas: 1) the Fremont north of Canyonlands National Park and 2) the Ancestral Pueblo through Glen Canyon (Geib 1996). These two culture areas share a number of elements, including corn, beans, and squash horticulture and the creation of ceramic pottery, but they have considerable differences in art and architecture. The personal ornamentations and rock art of the Fremont culture are much more elaborate than those of the Ancestral Pueblo, whereas the opposite is true in terms of structural constructions (Simms 2008).

Based on existing inventory data, prehistoric sites along the Colorado River consist of open campsites, artifact scatters, storage and habitation structures, irrigation and farming areas, hand-and-toe holds or "Moki steps," and rock art. One example of a prehistoric cultural resource along the Colorado River in the planning area is the Fremont Stairway site (42GR0786), a prehistoric set of hand-and-toe holds that extends from the riverbank far up the adjacent rock face, forming the longest aboriginal staircase in the region. The site appears in many guidebooks and websites that guide river runners through the Above Westwater segment of the planning area.

Protohistoric cultural resources are those that date to the brief time when European-manufactured goods—such as beads, axes, knives, canned goods, horses, guns, and cookware—were traded into the area but before there were any written historic records. In Utah, this is the period between A.D. 1776 and 1850. Protohistoric or historic period Native American sites are rare and primarily include the remains of wikiups or brush structures still used by Numic-speaking peoples after Euro-American contact but before commencement of the reservation system. Although rare, examples include the Ute Panel at Cisco site (42GR0796) in the Westwater Canyon Wilderness Study Area segment, which consists of six interconnected petroglyph panels along the south-facing outcrop of a sandstone layer that depict horse-riding, bison hunting, and teepees consistent with historic Ute culture.

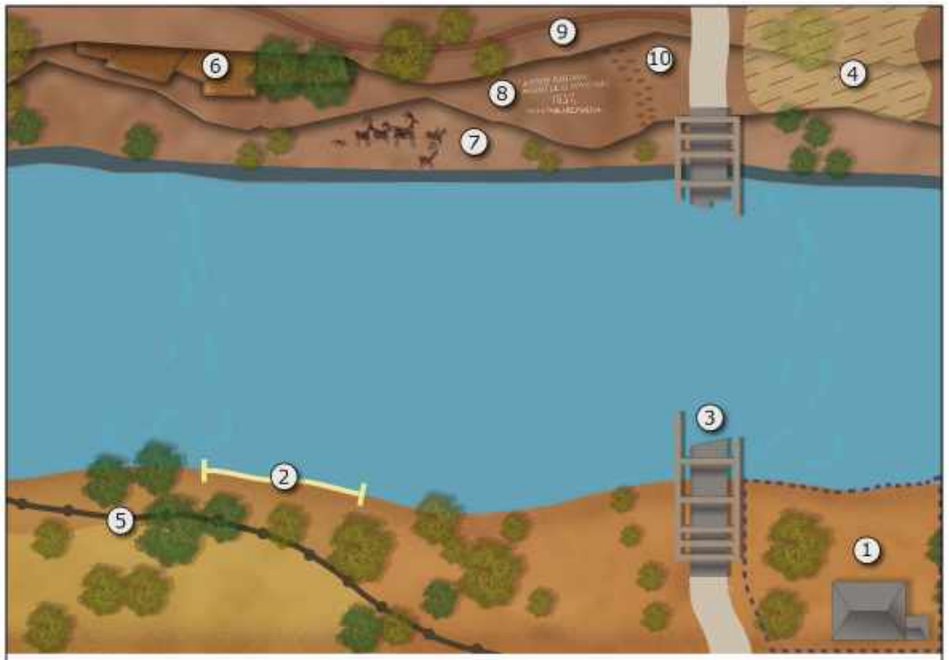
Historic cultural resources, as defined in the United States, refer to any site, feature, structure, or artifact that dates from A.D. 1500 through 50 years before present (Hardesty and Little 2000). In Utah, the Historic period dates from A.D. 1776, when Dominguez and Escalante reached Utah Lake, to 50 years before present based on Euro-American contact. Existing inventory data indicate that previously recorded historic sites on the Colorado River consist of farms and homesteads, bridges, grade-control structures, transmission lines, buildings and storage structures, railroads and associated features, historic signatures, mines, roads, and artifact scatters. A popular historic site in the Westwater Canyon Wilderness Study Area segment of the planning area is the 100-year-old historic Dewey Bridge, the longest suspension bridge in the state of Utah; the bridge burned down in 2010 after a child playing with matches accidentally set it aflame, but the metal components and associated interpretive plaque still stand.

In the 1960s, the Glen Canyon Dam Archaeological Salvage Project identified, recorded, and/or excavated thousands of historic and prehistoric sites along the Colorado River in what is now Lake Powell, ahead of its filling (in the Glen Canyon segment of the planning area) (Jennings 1966). None of the sites adjacent to the Colorado River in the Glen Canyon segment are accessible anymore, but many historic and prehistoric sites in side canyons that were recorded during the Glen Canyon Dam Archaeological Salvage Project are still accessible with a lengthy boat ride.

Generally speaking, a resource is something that is valued because it is or can be useful; it is something that "lies ready for use or can be drawn upon for aid" (King 2002:5). Therefore, the starting point for considering cultural resources from a management perspective is considering what resource values sites might have and how management can enable these values to be realized as public benefits (Lipe 2009:41). Historic and prehistoric sites along the Colorado River are often used recreationally, especially in the Glen Canyon National Recreation Area.

Cultural Resources by River Segment

All cultural resources data examined for the Colorado River planning area were obtained from the Utah Division of State History's web-based data management system (Preservation Pro), preservation files, NRHP files, and published archaeological reports. Abundant cultural resources information is available for much of the Colorado River corridor owing to development inventories like the Glen Canyon Reservoir Salvage Project, although inventory data along stretches not adjacent to NPS lands are more limited in nature. Figure 2.49 provides a river plan view of the types of cultural resources that could be encountered during development permitted with an FFSL authorization. This figure shows multiple cultural resources in one area for the purposes of illustration. In practice, cultural resources are usually not this condensed. Figure 2.50 lists some of the most culturally or historically significant cultural resources in the planning area by river segment.



Legend

1. Historic cabin with property boundary to river
2. Archaeological site eroding out of bank
3. Historic bridge remnants
4. Archaeological surface site
5. Historic fence/corral
6. Archaeological cliff structure
7. Prehistoric rock art
8. Historic inscription
9. Historic trail
10. Prehistoric hand-and-toe trail

These represent potential archaeological and architectural sites that may occur along the river and should be considered during project planning.

Archaeological sites may occur anywhere along the river: on the banks, in the channel, or adjacent to the river.

Figure 2.49. Plan view showing types of possible cultural resources in the planning area.

Further Reading

Ancient Peoples of the Great Basin and Colorado Plateau (Simms 2008)

Archaeological values and resource management (Lipe 2009)

Glen Canyon Revisited (Geib 1996)

Glen Canyon: A Summary (Jennings 1966)

Thinking about Cultural Resource Management: Essays from the Edge (King 2002)

GIS Data Layers

Archaeological Sites, National Scenic and Historic Trails

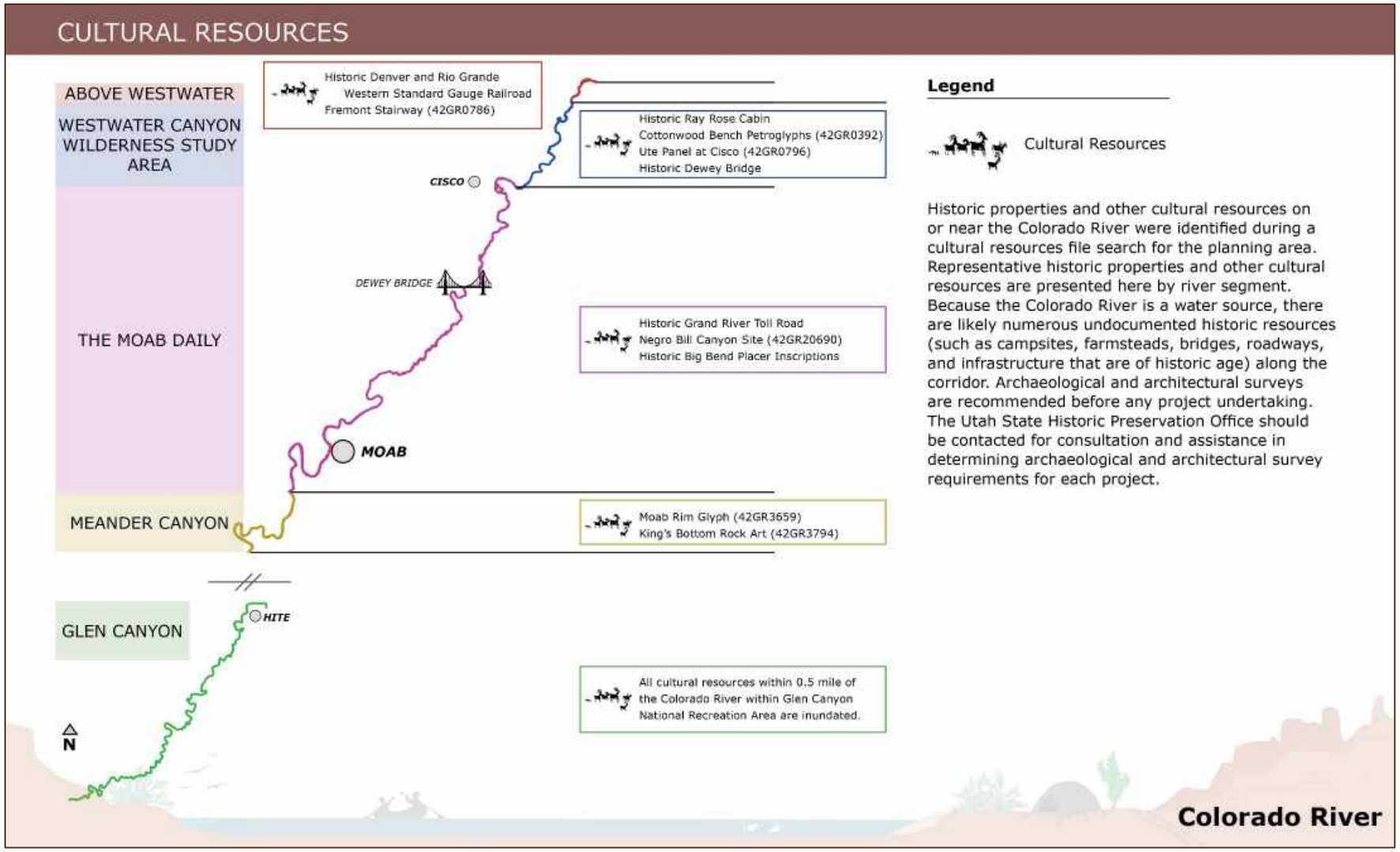


Figure 2.50. Significant cultural resources by river segment in the planning area.

Recreation

The planning area is part of a highly popular recreation destination in Utah. Recreation activities in and adjacent to the planning area consist of boating, camping, fishing, hunting, hiking, climbing, mountain and road biking, wildlife watching, interpretation of the Colorado Plateau landscape (e.g., geology, cultural resources, and paleontology), swimming, photography, and viewing the scenic beauty of the landscape, as shown in Figure 2.51. The discussion of recreation here focuses on the primary recreation activities on or adjacent to the planning area: boating and camping, hunting, fishing, and hiking and biking on trails.

The planning area is divided into five commonly used river segment names (see Table 1.2). The four northern segments are contiguous and make up approximately 100.7 RM (Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily, and Meander Canyon). The fifth segment, Glen Canyon, is separated from the four northern segments by Canyonlands National Park and a portion of Glen Canyon National Recreation Area. The Glen Canyon segment lies within the waters of Lake Powell.

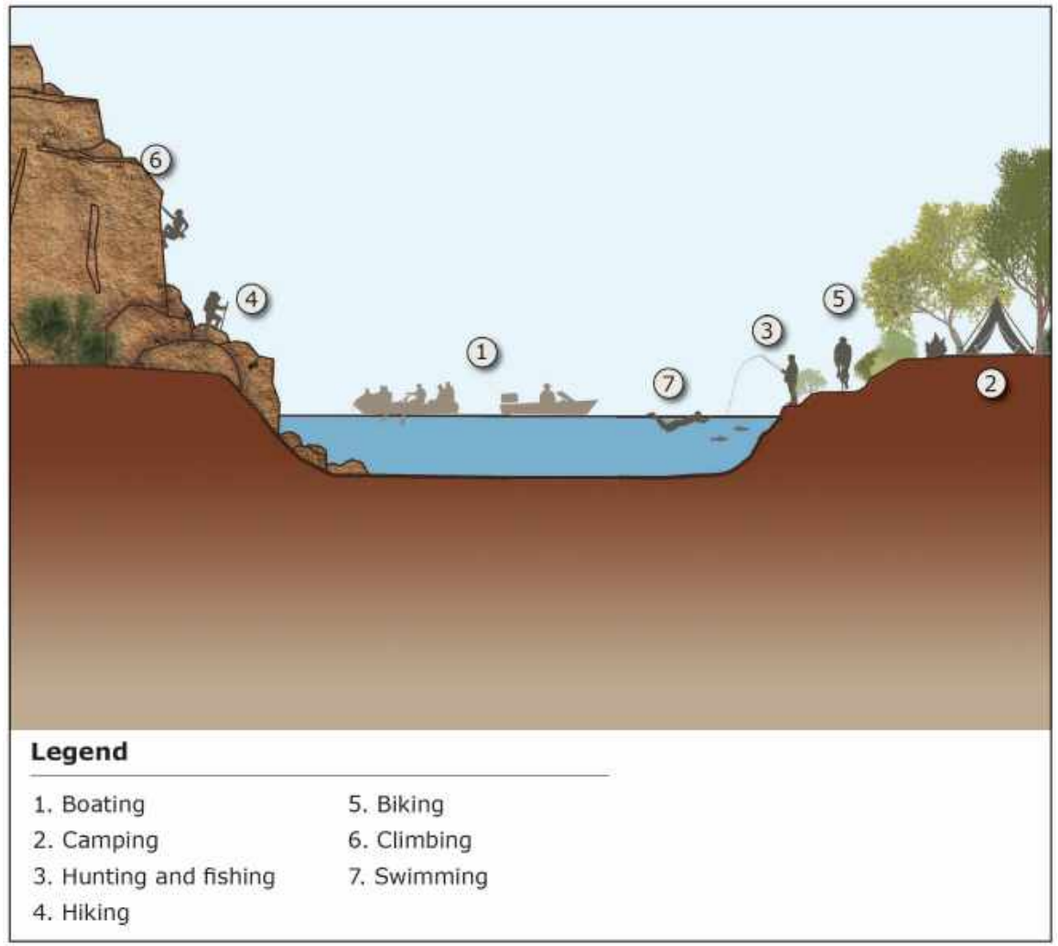


Figure 2.51. Cross section showing recreation types in the planning area.

Boating and Camping

Boating in the planning area consists of motorized watercraft such as jet boats, jet skis, shuttle boats, and sport boats and non-motorized watercraft such as stand-up paddle boards, kayaks, canoes, oar-powered rafts, and inflatables. Boaters typically require areas where they can launch and remove their craft from the river. These areas, known as put-ins, take-outs, boat ramps, and boat launches, are described as boater access points in the plan. The river distance between boater access points dictates the time spent boating for non-motorized users. Therefore, the longitudinal distribution of boater access points can be a determinant for the type of river activity and amount of non-motorized use for a given section of the river. Figure 2.52 shows a non-motorized boat on the Colorado River.

Motorized river recreation typically relies on two-way navigation, both upstream and downstream, and uses the same boater access point to start and end the trip. Boater access points for motorized river recreation need to accommodate trailered watercraft. In addition, motorized river recreation often depends on sufficient water depth to protect prop motors from damage, particularly during upstream travel when more power is required. Figure 2.53 shows a motorized boat on the Colorado River. Figure 2.54 illustrates which segments of the river are limited to non-motorized use and which segments allow non-motorized and motorized uses.

For the purposes of this CMP, a *private boater* is defined as a non-commercial (not for profit) user of the river. A *commercial outfitter* or *commercial operator* carries passengers for hire (for profit) and receives compensation for providing service, safety, and responsibility on the river.

Figure 2.52. Non-motorized boat use on the Colorado River.

Figure 2.53. Motorized boat use on the Colorado River.

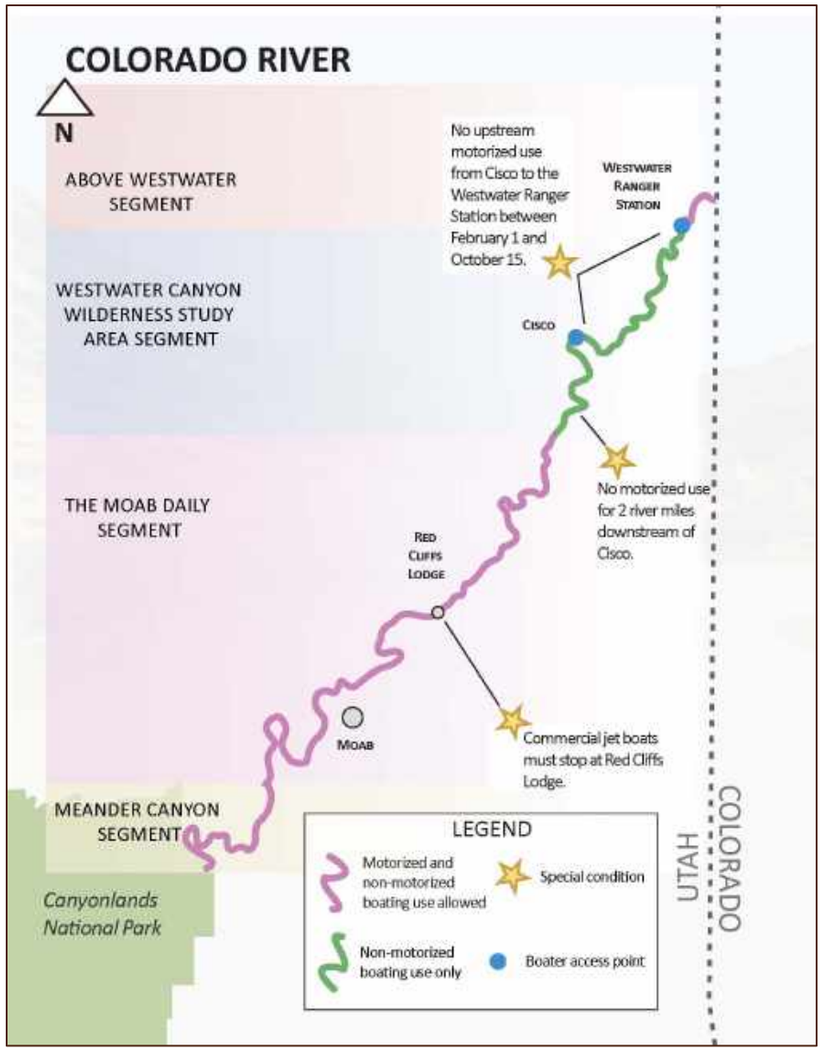


Figure 2.54. Motorized vs. non-motorized river segments on the Colorado River.

BOATING AND RECREATIONAL USE REGULATIONS

Motorized boats must be properly registered with the Utah Division of Motor Vehicles and must carry liability insurance while operating on Utah waters (motorboats with engines less than 50 horsepower are exempt from the insurance requirement). Utah's State Boating Act requires all boats to have at least one wearable, approved personal flotation device (life jacket) for each person on board (Utah Code 73-18-8). Children under 13 years of age are required to wear a life jacket. Life jackets are also required for boaters engaged in towing, people driving personal watercraft (jet skis), and people in any type of vessel on river sections that are not designated as flatwater. The boating act also requires that an extra oar or paddle be on board for those engaged in paddle sports, as well as a bailing device.

Utah's State Boating Act provides vessel navigation and steering laws for avoiding collisions, passing, overtaking another vessel, driving in narrow channels, sailboats, and persons riding on the bow of a boat. The following regulations on wakeless speed are also provided in the boating act (Utah Code 73-18-15.1):

> The operator of any vessel may not exceed a wakeless speed when within 150 feet of the following:
>
> - Another vessel
> - A person in or floating on the water
> - A water skier being towed by another boat
> - A water skier that had been towed behind the operator's vessel unless the skier is still surfing or riding in an upright stance on the wake created by the vessel
> - A water skier that had been towed behind another vessel and the skier is still surfing or riding in an upright stance on the wake created by the other vessel
> - A shore fisherman
> - A launching ramp
> - A dock
> - A designated swimming area

In addition, the operator of a motorboat is responsible for any damage or injury caused by the wake produced by the boat. Wakes from boat traffic can cause bank erosion (Bauer et al. 2002; Laderoute and Bauer 2013). Wake effects can be significant in areas of restricted depth and width, and where the distance between the vessel and bank is small (approximately a few hundred meters) (Fitzgerald et al. 2011).

The DSPR has primary responsibility for boating safety and enforcement on Utah waters under Utah's State Boating Act. However, FFSL has developed recreational use rules for its navigable rivers (Utah Administrative Code R652-70-2400). These rules are as follows:

- Overnight float trips must use a washable, reusable toilet system that allows for disposal of solid human waste through an authorized sewage system.
- Garbage, human waste, and pet waste must be carried off the river and disposed of properly.
- If toilet facilities and trash receptacles are available between Castle Creek and the Potash boater access point, they may be used in place of reusable toilets and carrying out garbage.
- The maximum group size for overnight river trips is 25 people. Two or more groups may not camp together if the group size exceeds 25 people.
- Overnight float trips must use a durable metal fire pan at least 12 inches wide, with a lip of at least 1.5 inches around its outer edge, to contain campfires.

- Only driftwood may be used as firewood. No cutting of firewood is allowed except in designated areas. Ashes and charcoal from fires must be carried out and disposed of properly.
- An ROE from FFSL and a special recreation permit from the managing federal agency are required for commercial float trips.

In areas where the BLM or NPS issue river permits, additional rules apply to river users. Particular river stretches often have their own use stipulations (e.g., Westwater Canyon). The BLM Moab Field Office has established recreational rules for river-trip camping and river use in Appendix L of its record of decision and approved resource management plan (BLM 2008). The rules apply to the Moab Field Office planning area, which includes the Above Westwater, Westwater Canyon Wilderness Study Area, and The Moab Daily segments of the Colorado River. FFSL prohibits camping on the beds of navigable rivers except in posted or designated areas (Utah Code 65A-3-1).

For recreationists, part of boating safety is anticipating the type of water conditions that will be experienced during a trip. According to the International Scale of River Difficulty, whitewater rapids are rated on a scale of I (easy) to VI (extreme and exploratory) based on their combination of difficulty and danger (American Whitewater 2005). The scale is not exact because river difficulty can change with water flow and rivers do not always fit easily into one category. Class I water is fast-moving water with riffles, small waves, and few obstructions. Class VI water exemplifies the extremes of difficulty, unpredictability, and danger, and is for experts only (Figure 2.55). The following descriptions of the five river segments include International Scale of River Difficulty classes, where applicable.

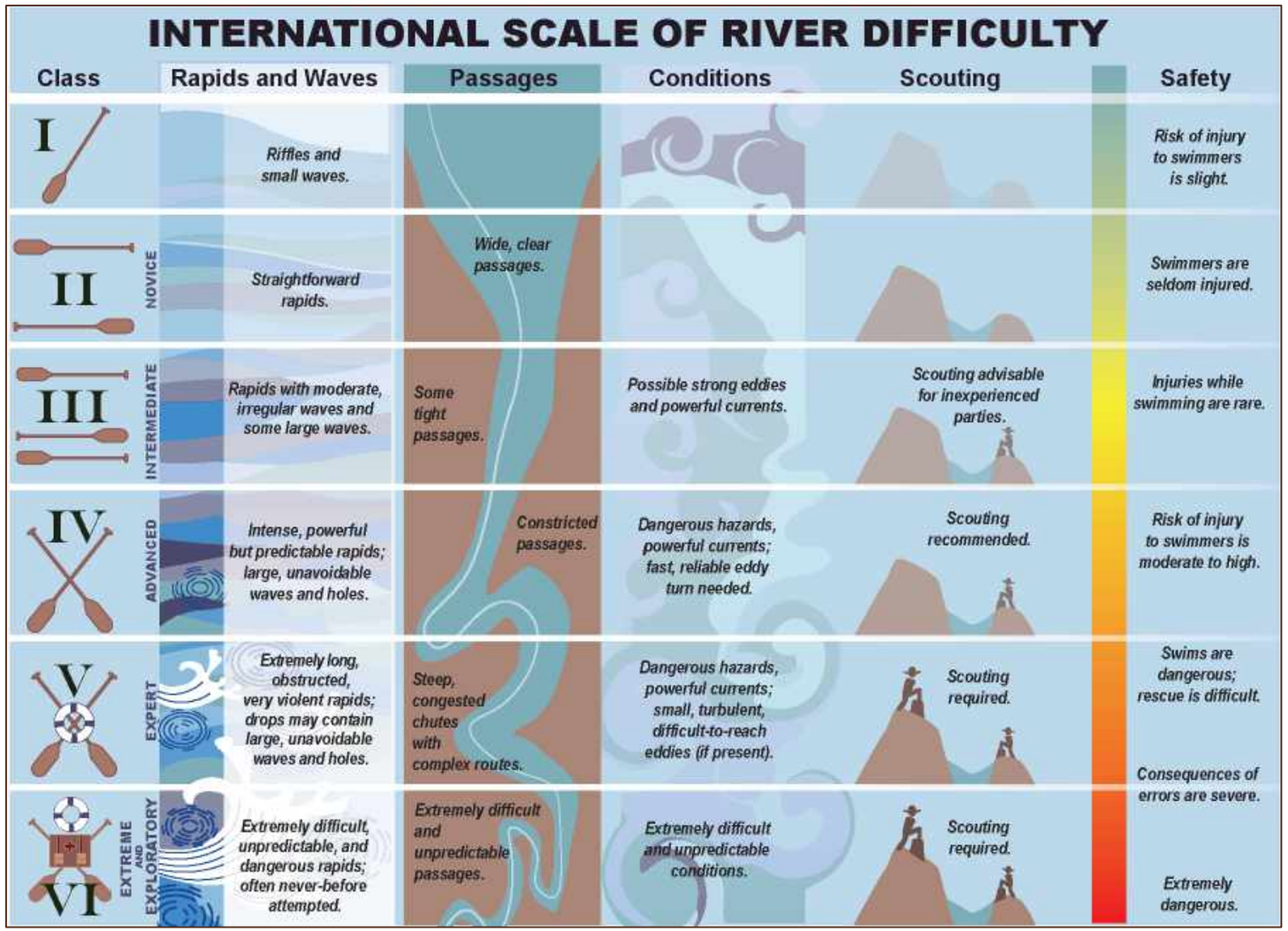


Figure 2.55. International Scale of River Difficulty.

Graphic adapted from American Whitewater (2005).

NORTHERN RIVER SEGMENTS

In the four northern river segments, multi-day non-motorized river trips are likely to travel through more than one river segment. Motorized river travel is also likely to travel through several river segments because this type of recreation typically uses two-way navigation for both upstream and downstream travel and covers long distances. In addition, in some river segments, unique geomorphic features create a distinct river recreation opportunity such as whitewater boating. In the whitewater boating example, a higher concentration of whitewater boaters would be present in that river section compared to upstream and downstream sections.

FFSL authorizes commercial recreational use on Colorado River sovereign lands. In 2018, nine commercial outfitters were permitted in the Above Westwater segment, 39 commercial outfitters were permitted in The Moab Daily segment, and 25 commercial outfitters were permitted in the Meander Canyon segment (Leech 2018). Of these FFSL-authorized outfitters, only two are motorized users (currently permitted to run from Castle Creek to the Potash boater access point). At the time this plan was published, FFSL does not issue commercial permits on the Westwater Canyon Wilderness Study Area segment (they are issued by the BLM). The BLM has a maximum allocation of 18 special recreation permits in Westwater Canyon (each of the 18 permittees also has an FFSL ROE).

The BLM Moab Field Office administers approximately 33 commercial outfitter river-based special recreation permits authorizing use on the Colorado River in the four northern river segments. The BLM estimates that commercial river outfitters provided services to approximately 60,000 visitors in 2011 (BLM 2012). Several private concessionaires operate campgrounds and boat tours along these segments of the river with private river access and associated facilities.

Two of the northern river segments (Above Westwater and Westwater Canyon Wilderness Study Area) and part of The Moab Daily segment are in the unadjudicated section of the Colorado River. During the pendency of adjudication, interim management of the riverbed will be accomplished through cooperation with BLM as discussed in Chapter 1.

As discussed in Chapter 1, the BLM has designated portions of the four northern river segments as suitable for recommendation into the National Wild and Scenic Rivers System with classifications of wild, scenic, or recreational, and has determined portions of the segments to be eligible for scenic designation.

Boating and camping activities in each river segment are discussed in more detail below.

ABOVE WESTWATER

The Above Westwater segment is part of a river stretch referred to as Ruby-Horsethief Canyon, used by both private boaters and commercial outfitters (Figure 2.56). The boater access point for this 25-mile scenic float is located near Loma, Colorado. The float is mostly flatwater with some small riffles and rapids that reach Class II whitewater at normal flows, but can increase in difficulty during periods of high flow. The BLM estimates that the Ruby-Horsethief Canyon stretch of the Colorado River received more than 23,000 visitor days in 2017 (BLM 2017). Motorized use is allowed in Ruby Canyon (Horsethief Canyon is located only in the State of Colorado).

There are 34 designated campsites in the Ruby-Horsethief Canyon stretch, all of which are located in Colorado and managed by the BLM in Colorado. Overnight camping permits are required year-round. Currently there are no designated campsites along the Utah portion of the Ruby-Horsethief Canyon stretch. A permit is not required for day use in Ruby-Horsethief Canyon.

Figure 2.56. Above Westwater segment.

Westwater Canyon Wilderness Study Area

Westwater Canyon is the first whitewater stretch on the Colorado River after it enters Utah (Figure 2.57). The canyon portion of the Westwater Canyon Wilderness Study Area segment is 17 miles long and includes Class IV rapids. The boater access point for this float is located at the Westwater Ranger Station. BLM river rangers conduct permit and equipment checks, provide information, and patrol the canyon in this area. There are 11 individual campsites and one reservable group campsite for public use at the ranger station. In 2011, the BLM reported 15,000 visitors to the Westwater Ranger Station, divided evenly between commercial river trips and private use on Westwater Canyon (BLM 2012). Permits are required year-round for commercial and private use on Westwater Canyon. The BLM permits 18 commercial outfitters in the canyon. To protect wildlife values, upstream motorized boat travel from the Cisco boater access point and from the Westwater Ranger Station is not allowed between February 1 and October 15. In addition, upstream motorized use is never allowed above Cottonwood Wash (RM 112.5) in this segment. Exceptions can be made with prior approval for emergency situations or administrative uses. In other words, seasonal (October 16–January 31) upstream motorized travel is allowed above the Cisco boater access point, but only to Cottonwood Wash (a distance of approximately 2 river miles).

The daily number of visitors in this segment is limited to 150 people (split equally between private and commercial use) because of heavy recreational demand and to protect the canyon's primitive nature. Group sizes are limited to 25 or fewer people. Between April 1 and September 30, private use is limited to five permits or 75 people (whichever occurs first) per day and commercial use is limited to 75 passengers per day. From October 1 to March 31, use is limited to seven permits or 150 people per day. Permits are required for day use and overnight camping (boaters are allowed only one night of camping in the canyon).

Figure 2.57. Westwater Canyon Wilderness Study Area segment.

The Moab Daily

This 65-mile segment of the Colorado River features multiple boater access points, developed campgrounds, outstanding scenery, and Class I through III whitewater (Figure 2.58). The ease of access from Moab and Utah State Route 128 (which parallels much of this segment) makes this one of the more popular river sections in Utah. The changes in river gradient and channel structure over this river segment result in different river recreation opportunities, users, and watercraft in different areas.

Motorized and non-motorized watercraft are used on this segment. Non-motorized watercraft include canoes, kayaks, rafts, stand-up paddle boards, inner tubes, and other inflatables. Motorized watercraft include jet boats with an in-board propulsion system (used for jet boat tours north and south of Moab and shuttle services south of Moab), sport boats with outboard propulsion systems, and sometimes rafts with small transom-mounted outboards for flatwater sections. Propellers on outboard motors are easily damaged from shallow and turbid water. *Draft* is the minimum depth of water a boat can safely navigate. Jet boats are draft restricted in certain conditions; a jet boat may be unable to slow to required wakeless speeds in low flows or shallow channels. Jet boats used for shuttle services are also draft restricted and may cease operations in low water.

The BLM administers 22 special recreation permits for commercial outfitters offering motorized and non-motorized river trips in this segment. Commercial outfitters offered 51,355 non-motorized river trips to visitors on The Moab Daily segment in 2011. The BLM estimates daily private use on this section is 50% of the commercial use numbers, which would be 25,677 private non-motorized boaters in 2011 (BLM 2012). The 22 BLM commercial special recreation permits had 56,804 users in 2017 and 56,123 users in 2018. Private boaters do not require a permit for day use on The Moab Daily segment at this time.

The initial 25 miles of The Moab Daily segment from Bald Eagle Campsite to Hittle Bottom Campground offers scenic flatwater boating, with multiple boater access points and developed campgrounds that allow for various trip lengths. The highest upstream boater access point in this segment is Cisco, which is typically used as a take-out for boaters floating down from Westwater Canyon. Boaters floating past or launching from the Cisco boater access point may not travel under motorized power for 2 river miles below Cisco.

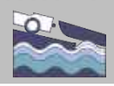
The 13-mile river section from Hittle Bottom Campground to the Takeout Beach boater access point contains several Class III rapids attracting novice to intermediate whitewater boaters. Commercial whitewater rafting trips are popular on this section as well. Numerous BLM-managed campgrounds and boater access points are present in this section. Downstream of the Takeout Beach boater access point, the river difficulty decreases to Class I. Utah State Route 128 is visible from much of this section of the river, and a paved bike path is located between the river and the highway.

The 17-mile section of the Colorado River from the U.S. Route 191 bridge to the Potash boater access point contains slow-moving Class I water meandering between spectacular sandstone cliffs. This entire section parallels Utah State Route 279 on river right. Kane Creek Boulevard parallels the river on the left for approximately 3 miles. Developed campgrounds are present along this section of the river as well as several established boater access points, along with numerous informal access points. This section is a launching point for individuals embarking on a non-motorized multi-day float trip to The Confluence. Non-motorized watercraft for these multi-day trips includes canoes, kayaks, and rafts. Several outfitters rent canoes for this purpose and include upstream jet boat shuttle packages. The Confluence area is not accessible by road and non-motorized boaters not continuing downstream into Cataract Canyon typically shuttle back upstream on a commercial jet boat. This 17-mile section is also popular for motorized watercraft.

Because of the shallow riffle sections and turbid water, motorized watercraft in The Moab Daily segment consist primarily of jet boats. Commercial jet boat roundtrip tours operate in The Moab Daily segment. Daily scenic tours travel upstream under the U.S. Route 191 bridge to the private boater access point at Red Cliffs Lodge. This upstream turn-around point for jet boats is dependent on sufficient water levels for navigation; the turn-around point may occur earlier than the Red Cliffs Lodge boater access point by necessity at locations such as Takeout Beach, Salt Wash Rapid, and Big Bend campground. Commercial jet boat tours also travel downstream as far as The Confluence (this part of the river includes the Meander Canyon segment). These jet boats travel on a river corridor with blind corners and limited area to maneuver. Depending on river flows and the specific area, jet boats are forced to violate speed and proximity boating regulations. Sections of the river require that jet boats stay on plane to keep from running aground or becoming stuck. The BLM permits one upstream commercial motorized operator.

The BLM manages numerous developed campgrounds, boater access points, and trailheads on lands adjacent to the Colorado River (above the OHWM) in The Moab Daily section (Table 2.21). Camping is allowed in developed campgrounds only on the south side of the river and designated sites only on the north side of the river.

Table 2.21. Public Recreation Amenities in The Moab Daily River Segment

Recreation Amenity (approximate river mile)	Boater Access Point 	Trailhead 	Campground 	Restrooms 
Cisco (110.5)	X			X
Fish Ford (105.5)	X			X
Dewey Bridge (94.5)	X		X	X
Amphitheater Loop (88.5)		X		
Hittle Bottom (88)	X		X	X
Lower Onion Creek (85.5)	X		X	X
Rocky Rapid (80.5)	X			X
Sandy Beach (76)	X			X
Takeout Beach (74)	X			X
Upper Big Bend (72)			X	X
Big Bend (71.5)	X		X	X
Oak Grove (71)			X	X
Hal Canyon (71)			X	X
Six Mile Beach (70.5)	X			
Drinks Canyon (70.5)			X	X
Grandstaff (67.5)		X	X	X
Goose Island (65.5)			X	X

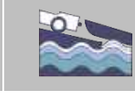
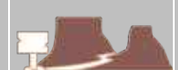
Recreation Amenity (approximate river mile)	Boater Access Point 	Trailhead 	Campground 	Restrooms 
Moab Town (64.5)	X			
Lions Park Transit Hub (64)				X
Jaycee Park Campground (60)		X	X	X
Kings Bottom Campground (60)			X	X
Moonflower Canyon (60)		X	X	X
Poison Spider Trailhead (60)		X		X
Williams Bottom Campground (58.5)			X	X
Kane Springs Campground (59) (privately owned)			X	X
Corona Arch Trailhead (54)		X		X
Gold Bar Campground (54)	X		X	X
Potash (47.5) (privately owned)	X		X	X

Figure 2.58. The Moab Daily segment.

Meander Canyon

This 17-mile segment of the Colorado River contains slow-moving water (Class I) bound by spectacular sandstone cliffs and is a popular multi-day float trip to The Confluence of the Green and Colorado Rivers in Canyonlands National Park. Non-motorized boaters typically take 3 to 6 days to float the 47 miles from the Potash boater access point to The Confluence. This section is also a popular commercial jet boat tour from Moab to The Confluence. The roundtrip jet boat tour is approximately 3 hours from Moab.

The Potash boater access point is managed by Canyonlands National Park but is located on private land owned by the adjacent potash company. It is a major launch point for private and commercial river trips traveling downstream into Canyonlands National Park. In 2010, Canyonlands National Park completed an environmental analysis of proposed upgrades to the Potash boater access point, designed to improve visitor experience and reduce resource impacts (Canyonlands National Park 2010). The preferred alternative included installing informational signs, constructing three shade structures, constructing a changing room, establishing designated areas for overnight parking, developing campsites, and developing a loop road to the boat launch and a trail from the parking area to the launch. Some of these upgrades have occurred.

A river permit is required for overnight camping in Canyonlands National Park. Visitor use estimates for the Colorado River in Canyonlands National Park are shown in Table 2.22. These numbers provide an estimate for boaters on the Meander Canyon segment.

Table 2.22. 2017 Visitor Use Estimates for the Colorado River in Canyonlands National Park

Colorado River Destination	Commercial Visitors	Non-commercial Visitors	Total Visitors
Spanish Bottom	N/A*	455	455
Cataract Canyon	3,252	934	4,186
Total	**3,252**	**1,389**	**4,641**

Source: Young (2018).

N/A = not available.

* Two jet boat companies operate in Canyonlands National Park. NPS estimates these commercial operators shuttle 90% of non-motorized users back upstream on the Colorado River from Spanish Bottom.

SOUTHERN RIVER SEGMENT

Glen Canyon

This segment of the Colorado River is inundated by Lake Powell, and sovereign lands are not accessible at the surface of the lake. Lake Powell has a complex shoreline nearly 2,000 miles in length encompassing 96 major canyons. Most of the shoreline is accessible by boat only, offering visitors an opportunity to explore canyons or venture ashore to hike or camp. Lake

Powell is a premier destination for motorized boats and associated activities such as water skiing and wakeboarding. Lake Powell also attracts non-motorized boaters using a range of watercraft such as stand-up paddle boards, kayaks, and inflatables. Non-motorized watercraft are often carried on board motorized watercraft for optional water recreation or to access shore from anchor.

The USBR manages pool elevations on Lake Powell. Full pool is 3,700 feet elevation above mean sea level. At the end of water year 2018, pool elevations were approximately 105 feet below full pool on Lake Powell. Lower pool elevations restrict access to marinas, side canyons, hikes, geologic features, and dispersed camping, and result in increased navigation hazards. Lower pool elevations may expose sovereign lands at the north end of the lake.

Motorized and non-motorized boats are available for rent at Lake Powell, but many individuals bring their own boats. Houseboats are popular for multiday trips. Commercial boat tours to area attractions such as Rainbow Bridge are also available. Lake Powell currently has five marinas offering a variety of services and facilities: Wahweap, Antelope, Dangling Rope, Halls Crossing, and Bullfrog. Additional marinas are present but not accessible because of the current lower pool elevations. Motorized boats must be inspected for quagga and zebra mussels before launching on Lake Powell and are required to complete decontamination procedures before leaving boater access points.

Whitewater boaters on the Colorado River enter Lake Powell from Cataract Canyon upstream. A small motor is often used by these boaters to travel the approximately 30 miles of the lake to a boater access point, which is typically at the confluence with the Dirty Devil River or at Hite Marina (which is no longer operating as a marina). Lower pool elevations at Lake Powell make accessing Hite Marina difficult below 3,650 feet mean sea level. Whitewater boaters must obtain a permit from Canyonlands National Park to float through Cataract Canyon. There is no restriction on the number of private permits issued.

Developed campgrounds are available at Wahweap, Bullfrog, and Halls Crossing marinas. Five primitive camping areas are available at Lone Rock Beach, Stanton Creek, Hite, Dirty Devil, and Farley. The large number of canyons inundated by Lake Powell offers unlimited opportunities for dispersed camping on the water and on the shore; camping is allowed anywhere on the shorelines except in developed marinas. Dispersed shoreline campsites are primarily located on sandbars and slickrock. Houseboats are equipped for camping at anchor. Some boaters use a combination of shore and vessel-based camping. All campers are required to have a portable toilet for human waste unless toilets are available on a vessel. Fires are allowed below the lake's high-water mark.

Hunting and Fishing

Hunting and fishing on the Colorado River are regulated by the DWR. Hunting opportunities along the five river segments include big game species (e.g., mule deer [*Odocoileus hemionus*], desert bighorn sheep [*Ovis canadensis nelsoni*], and pronghorn [*Antilocapra americana*]), upland game bird species (e.g., wild turkey [*Meleagris gallopavo*]), and waterfowl species (e.g., multiples species of ducks and geese). At a minimum, all hunters must obtain a basic hunting license to hunt game animals on private or public lands in Utah. Waterfowl hunters over the age of 16 must also possess a federal migratory bird hunting and conservation stamp. Some Utah game species require special licenses in addition to the basic license. Hunters are advised to consult the DWR's website to determine special license requirements or closures for respective game species for areas adjacent to the Colorado River sovereign lands.

Anyone 12 years old or older must have a license to fish in Utah. Utah will accept a valid Arizona Lake Powell fishing license for those fishing in the lake. The Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily, and Meander Canyon river segments offer opportunities to catch channel catfish (*Ictalurus punctatus*), common carp (*Cyprinus carpio*), walleye (*Sander vitreus*), and largemouth bass (*Micropterus salmoides*). Lake Powell, which contains the Glen Canyon river segment, is a popular fishing destination for smallmouth bass (*Micropterus dolomieu*), largemouth bass, striped bass (*Morone saxatilis*), walleye, channel catfish, black crappie (*Pomoxis nigromaculatus*), and bluegill (*Lepomis*

macrochirus). Fishing guide services and fishing information are available at locations such as Bullfrog Marina. The DWR has established specific fishing regulations for the Colorado River from the Utah-Colorado state line downriver to the Hite bridge on Utah State Route 95 and for Lake Powell (DWR 2018b).

The DWR also manages a limited number of hunting and fishing access areas in Utah. Two types of access areas are managed by the agency:

- Walk-in-access (WIA) areas are tracts of private land on which the agency has leased hunting, trapping, or fishing privileges for public recreation. Landowners enrolled in the WIA program receive monetary compensation and may also qualify for habitat restoration projects. In most cases, access to WIA properties is limited to foot traffic only.
- Wildlife management areas (WMAs) are single tracts of land owned by the DWR, or two or more tracts of land owned by the DWR, that are close to each other and managed as a single unit. WMAs are often managed to protect wildlife habitat and public access.

One WMA is located along Colorado River sovereign lands: the Scott M. Matheson Wetland Preserve (Preserve) (Figure 2.59). This WMA is jointly owned by DWR and The Nature Conservancy and is located adjacent to the Colorado River and the city of Moab. The Preserve provides wetland ecosystem and wildlife habitat preservation, as well as low-impact recreation. More than 200 species of birds, amphibians, and mammals have been identified at the Preserve. Hunting for mule deer, wild turkey, and waterfowl is allowed in the northern portion, and bird watching and hiking are common activities in the southern portion. Other recreation at the Preserve includes ice skating and canoeing. The Colorado River typically floods the Preserve every year in late May or early June.

Figure 2.59. Scott M. Matheson Wetland Preserve along the Colorado River.

Trails

Portions of multiple hiking and biking trails are present along or close to the Above Westwater, Westwater Canyon Wilderness Study Area, The Moab Daily, and Meander Canyon river segments (though generally not on sovereign lands). These trails are designated for bicycles and hiking (unless noted) and include Agate Wash, Bull Pasture, Anderson Ferry, Cisco Landing, Kokopelli, Owl Draw Upland, Top of the World, Ron Johnsons, Lower Onion Creek, Porcupine Rim, Grandstaff Trail (hike only), Poison Spider/The Portal, Jackson (Hole), Corona Arch (hike only), Day Canyon, Long Canyon, and Potash Road. In addition, numerous hiking and biking trails are present above the canyon rims along the river segments. Hiking and biking trails can be viewed on the GIS spatial data viewer.

Recreation Management Concerns

Management concerns for recreation arise predominantly on the four northern river segments. Recreation issues and themes identified by individuals and organizations during the CRCMP public outreach process include the following:

- Conflicts between motorized and non-motorized use, primarily on The Moab Daily segment.
- Improvement of boater access points and facilities (e.g., ramps, restrooms, trash receptacles). Boater access points specifically mentioned by the public for improvement include Fish Ford, Dewey Bridge, Hittle Bottom, Takeout Beach, Moab Town, and Potash.
- Creation of new boater access points. Potential new boater access points requested by the public include Mineral Bottom, a small ramp upstream of Sandy Beach, a ramp near Lions Park Transit Hub for small craft like paddle boards (or downstream of Grandstaff), Bill's site near the Moab Town ramp, and the opposite bank of Hite Marina.
- Increased overall recreation use and crowding of the river.
- Bank erosion, primarily from motorized wakes.
- Congestion at heavily used boater access points, such as Moab Town ramp.
- Protection of the Colorado River canyons and viewsheds for the recreation experience.

Conflicts between motorized and non-motorized users were the most often stated public concern. Commenters who dislike motorized use (e.g., jet boats and jet skis) stated that this type of use is noisy, disrupts peace and solitude, presents safety issues, causes bank erosion, contributes to pollution, disrupts camping, and overall diminishes the non-motorized experience. They indicated that motorized boat use has increased in recent years and boats are now larger and faster. Commenters suggested prohibiting motorized use in certain areas (e.g., below Big Bend) or limiting motorized use in some way (e.g., number of boats allowed, boat speed, operating hours or days). Commenters also supported multiple use (motorized and non-motorized use) and indicated that motorized boats provide a recreation opportunity for people with different interests. In addition, they stated that motorized boats provide options for the handicapped and elderly to experience the river. Commenters also indicated that motorized users were respectful and considerate. Several commenters stated that with some additional management and education, motorized and non-motorized users could co-exist together in positive ways.

The northern part of the planning area is a popular recreation destination within a 1-day drive of large metropolitan populations along the Wasatch Front and the Colorado Front Range. Managing agencies have established river permit systems for the more remote canyons of these segments. The permit systems are designed, in part, to minimize user impacts on the resource, particularly for overnight camping. The BLM permit system in the Above Westwater segment and the Canyonlands National Park river permit for the Meander Canyon segment do not appear to limit the number of users per day. Crowding may be an issue on these two river segments under the current river permit system. Westwater Canyon Wilderness Study Area is the only river permit system on these segments that limits the number of river users per day regardless of overnight camping use.

The Moab Daily segment is easily accessible from Utah State Routes 128 and 279 and U.S. Route 191. In recent years, the BLM has established developed campgrounds, parking areas, and boater access points to concentrate increasing visitor use to hardened surfaces and reduce dispersed use and its associated resource impacts. The developed site improvements can, in turn, increase visitor use simply because of the presence of additional amenities and ease of access to the river.

FFSL requires commercial outfitters, but not private users, to obtain authorizations to float The Moab Daily segment. Authorized commercial motorized use, consisting of two jet boat companies, is currently limited from the confluence of Castle Creek with the Colorado River (the Red Cliffs Lodge boater access point) to the Potash boater access point. The BLM does not require permits for private river users on The Moab Daily segment. This stretch of river is crowded at times and most users are non-motorized, traveling downstream. Many of the non-motorized users are in low-capacity vessels that sit close to the water or are river users floating in the river in life jackets near their vessel. Motorized users do not always slow down to appropriate speeds near non-motorized users and may not give non-motorized users or swimmers enough space. Sometimes, non-motorized users paddle into the path of approaching motorized watercraft. Crowding on The Moab Daily segment may be exacerbating safety issues. FFSL's ability to address this issue is limited because this activity occurs on the water and not on the bed or banks of the Colorado River; however, FFSL intends to develop a recreation resource management plan in the near future to provide specific solutions and management actions for recreation conflicts, crowding, and public safety issues (see Chapter 3 goals and objectives for recreation). Until the recreation resource management plan is complete, no authorizations will be issued for new commercial jet boat or other commercial motorized operations, and no expansion of existing commercial jet boat or commercial motorized operations will be permitted. FFSL will also consider the motorized/non-motorized conflicts when issuing authorizations for commercial non-motorized river trips on The Moab Daily segment. FFSL will work with those agencies and entities having jurisdiction over this matter to ensure public safety.

An additional management concern on rivers is the mitigation of navigational hazards. Data and public input indicate the there are few human-made navigation obstacles in the planning area. Natural navigational hazards typical of most rivers are present, including rocky spots, shallow areas, overhanging tree branches, deadfall, and debris from flash flooding. Whether such hazards affect navigation usually depends on the water level. The lack of human-made navigational obstacles in the planning area minimizes the need for portages. Portages are areas where boaters must carry their watercraft around an obstacle in the river, such as a dam. A portage consists of two boater access points: an exit point to leave the river and an entry point to return to the river. There are no known portages in the planning area.

Recreation Areas by River Segment

Figure 2.60 illustrates boater access points, campgrounds, and WMAs along the river segments. The percentage of each river segment that is designated as suitable for recommendation into the National Wild and Scenic Rivers System or determined to be eligible for designation into the system is also shown.

Further Reading

BLM Moab Daily River website (BLM n.d. [2018b])

BLM Westwater Canyon website (BLM n.d. [2018a])

Business Plan for Westwater Canyon of the Colorado River (BLM 2012)

Colorado River Ruby-Horsethief Recreation Area Draft Business Plan Update (BLM 2017)

DSPR Boating webpage (DSPR 2018)

Glen Canyon Dam Long-Term Experimental and Management Plan Environmental Impact Statement (USBR and NPS 2016)

Integrating Recreational Boating Considerations Into Stream Channel Modification & Design Projects (Colburn 2012)

International Scale of River Difficulty (American Whitewater 2005)

National Wild and Scenic Rivers System (2018)

Ruby-Horsethief Canyon (Recreation.gov 2018)

"Interior Secretary Norton in Moab to sign river mining withdrawal; groups on hand to protest policies" (Wait 2004)

Utah Fishing Guidebook (DWR 2018b)

Utah hunting: Information on hunting in Utah (DWR 2018c)

GIS Data Layers

Boating Access, Campgrounds, DWR-Managed Access, Education Facilities, National Landscape Conservation System (Wilderness Areas, Wilderness Study Areas, Wild and Scenic Rivers), National Scenic and Historic Trails, Navigational Hazards, Recreation Facilities, Trailheads, Trails, Utah Scenic Byways

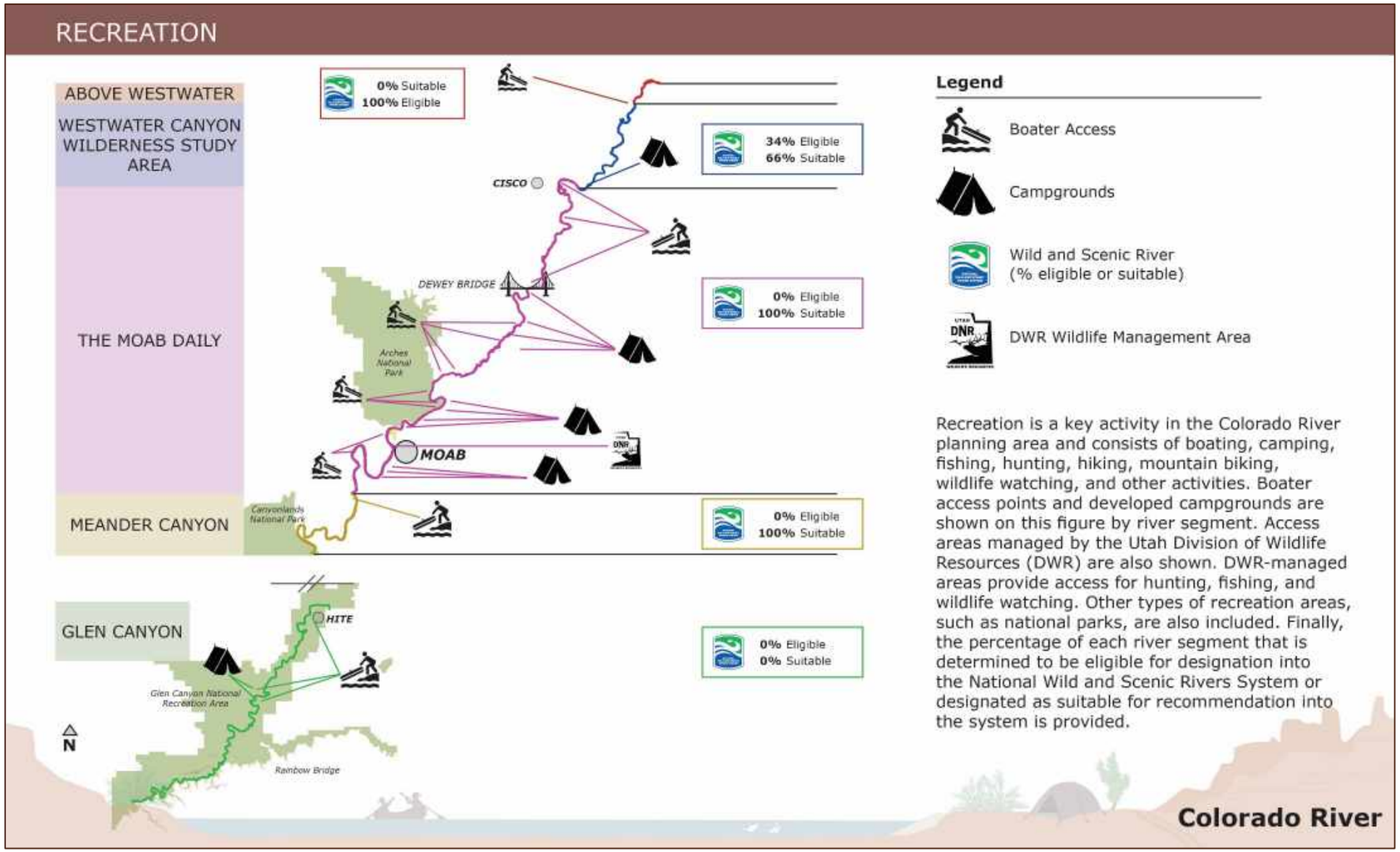


Figure 2.60. Boater access points, campgrounds, and wildlife management areas along the Colorado River.

Access

Access is the ability to approach and use the Colorado River for recreation, development, education, research, or other purposes such as flood control. Because the State of Utah–owned bed and banks of the Colorado River are considered sovereign land and therefore public land, the public can generally access the Colorado River, riverbed, and banks as long as they do not trespass across private land.

Access to the planning area for the development of infrastructure or other projects requires an authorization such as an easement, general permit, or ROE from FFSL (see Section 1.7 in Chapter 1). Access to infrastructure such as utilities and outfall structures must be protected so that maintenance and repairs can be conducted. Access to infrastructure for recreation users in the planning area must also be protected so that activities such as boating, fishing, and hunting can occur. Boater access points for recreationists are shown on the GIS spatial data viewer. Infrastructure should be designed to be safe for the public, protect natural resources, consider river fluctuations, and be Americans with Disabilities Act–accessible as required by law.

Good public access fosters stewardship and support for the protection and enhancement of the river corridor. Access should take into account and tie into regional transportation networks (i.e., other trails and public transit) where possible. By doing so, it can provide an alternative transportation network for the region. Access must be balanced to protect the river. Too many access points can damage the river and associated infrastructure; too few access points can limit opportunities to experience the river, create crowding at access areas, and reduce the public support for and use of the river. For these reasons, spacing of access points is important. Careful planning helps to preserve opportunities for access that have not yet been developed. Although there are no recommended distances between access points, FFSL will take into account safety, the number and type of existing access points, the presence of private land, roads, river use class, and other factors when deciding how close access points should be placed along the river.

In 2011 and 2012, the BLM partnered with the Utah Guides and Outfitters Association, DSPR, and FFSL to implement a pilot program to increase recreational boating opportunities along the Colorado River. The program was opened to adaptive sports organizations and educational institutions. The pilot program was a success, and it was adopted and expanded as a permanent access program in 2013 (Moab Daily Access Program) (Jones 2014).

Public Safety

Public safety refers to the welfare and protection of the general public. Public safety in the planning area primarily applies to recreational use of the Colorado River by watercraft and the associated boater access points, as well as by hunters and fishermen. Public safety could also apply to other recreation uses (e.g., wildlife watching, hiking, biking) on the banks of the river or on bridges in the planning area. Natural hazards, such as wildfire and floods, are also public safety issues.

Public use of facilities such as parking lots and restrooms is outside of FFSL jurisdiction because these structures are not located directly on sovereign lands, and safety at these locations is the responsibility of other entities. The safety of workers during the construction, operation, and maintenance of utility lines, bridges, roads, and other facilities in the planning area is protected through regulations administrated by the federal Occupational Safety and Health Administration.

Water quality is considered a public safety issue because the beneficial uses for the five segments of the Colorado River include domestic/drinking water and frequent primary contact recreation (such as swimming). The planning area is not impaired for domestic/drinking water and frequent primary contact recreation (see the Water Quality section of Chapter 2).

Conflicts between motorized and non-motorized users are present in the planning area, primarily in The Moab Daily segment, and may present safety issues (see Recreation Management Concerns section). FFSL will work with those agencies and entities having jurisdiction over this matter to ensure public safety.

FFSL, the BLM, DWR, and DSPR all have responsibility for law enforcement on the Colorado River. Potential public safety hazards in the planning area are present in Figure 2.61.

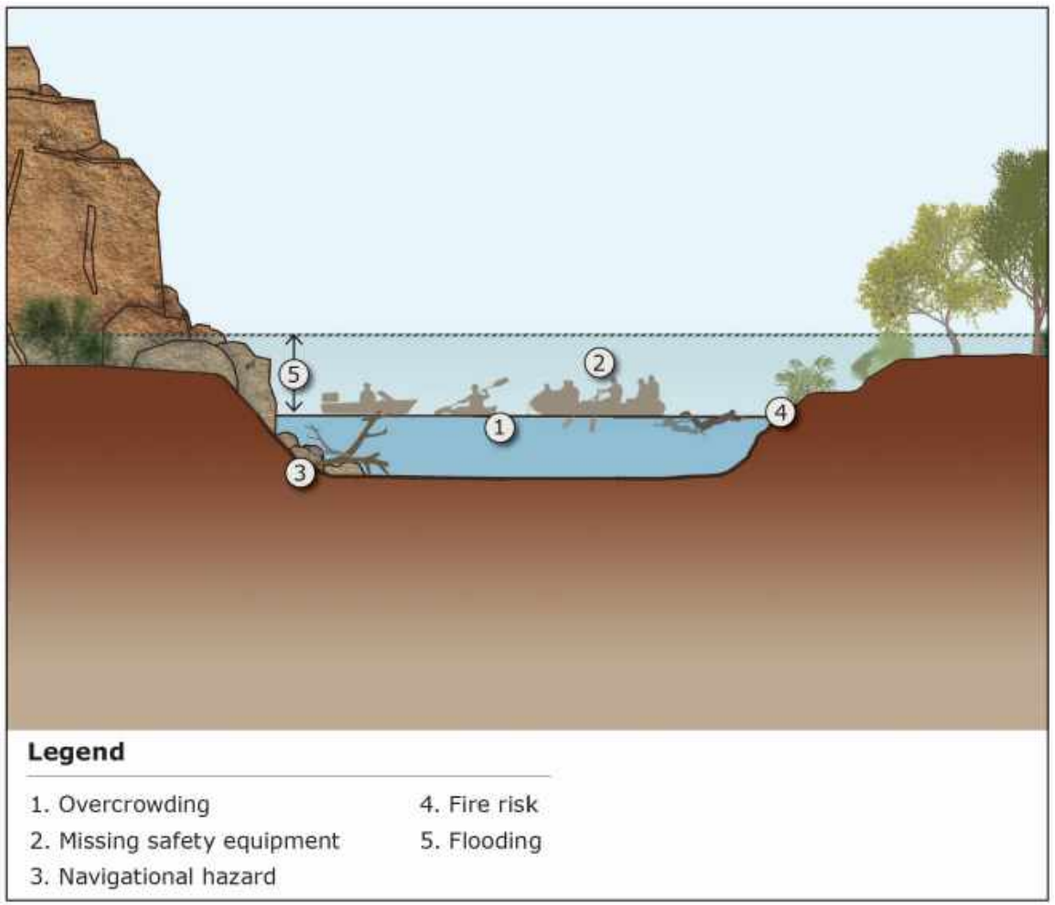


Figure 2.61. Cross section showing potential public safety hazards in the planning area.

In addition to flooding and fire, drought, severe weather, earthquakes, landslides, and rockfall are some of the other natural hazards that could occur in Garfield, Grand, Kane, and San Juan Counties. A risk assessment in Grand County's HMP ranks severe weather, flooding, wildfire, and drought as the top four natural hazards (Grand County 2018). The HMP developed for the Five County Association of Governments lists problem soils, landslides, wildfire, flood, and earthquakes as the primary natural hazards for Garfield and Kane Counties (Five County Association of Governments 2017).

The EPA has developed a draft sub-area contingency plan for the Colorado River that provides response planning to guide initial actions to major oil discharges that threaten waters of the United States (EPA 2017). The EPA's general approach to a spill is to control the source of the spill as quickly as possible and then limit downstream impacts. The contingency plan discusses sensitive areas, specific hazards, worst-case discharges and projections, cultural resources, threatened and endangered species, response operations and roles, and coordination with other agencies and levels of government.

Education

Education is an important component of successfully managing the planning area because it provides direction to user groups for the appropriate use of the Colorado River, clarifies FFSL's jurisdiction and management authority on Colorado River sovereign lands, and fosters public appreciation of the river and understanding of its value and the need to protect it. In addition, educating Colorado River planners and managers through the dissemination of research data and analysis can improve their understanding of the ecosystem and enhance the management and stewardship of the resource.

User groups that benefit from educational efforts about the Colorado River are listed in Figure 2.62.

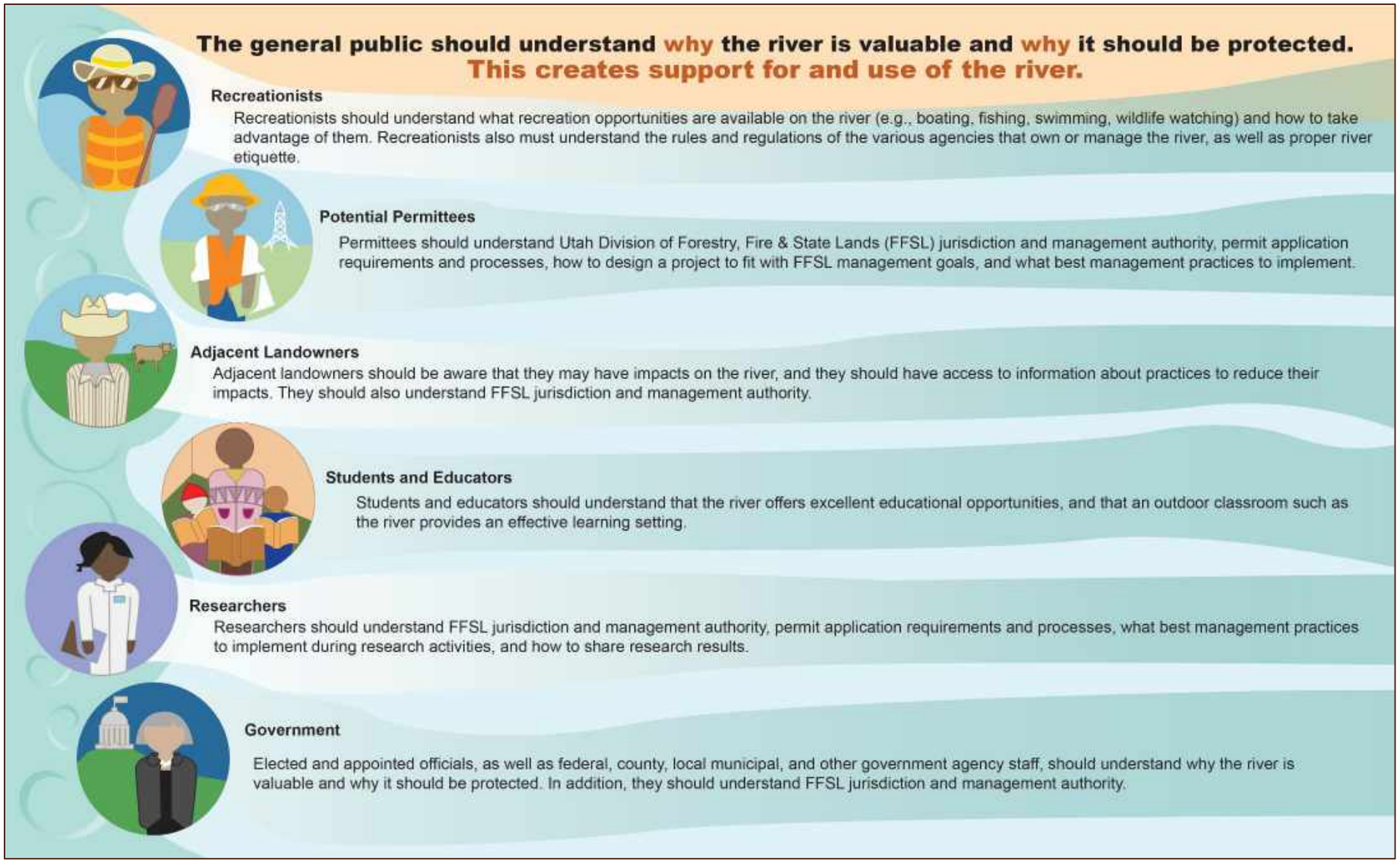


Figure 2.62. User groups in the planning area.

Educational Materials

Several entities provide educational materials about the Colorado River in or near the planning area. These include Arches National Park, Canyonlands National Park, the BLM's Moab and Monticello Field Offices, the Moab Information Center, the Scott M. Matheson Wetlands Preserve, and Dead Horse Point State Park.

Comments from the public outreach process indicated a need to better educate recreationists using the river. Education is needed about respecting private property rights, handling trash, preventing graffiti, river manners, and other topics. Education could occur through new signage at popular boater access points, by working with commercial outfitters and non-profit groups like American Whitewater, and through the FFSL and BLM permitting processes. Figure 3.18 in Section 3.4 contains FFSL's suggestions for stewardship and river etiquette.

The Colorado River in the planning area does not currently have a coordinated signage system. Interpretive and informational signing could help increase public awareness about the river, river etiquette, access, safety, and recreational opportunities. For these reasons, FFSL would support the implementation of a coordinated signage system on the four northern river segments in the planning area. Such a system would be especially useful to boaters and fishermen.

In general, signs should be easy to spot, easy to maintain, and consistent. Interpretive signs could be distributed at key locations (such as boater access points) to provide educational information about river etiquette, the history of the Colorado River, wildlife and habitat restoration and protection efforts, unique ecological features, and local culture. All signs should fulfill a need, command attention, convey a clear and simple meaning, and command respect from river users. However, signs should be carefully placed and should not detract from the natural environment, viewsheds, or aesthetic beauty.

Research

Research on the Colorado River is often conducted in the planning area and may require FFSL authorization for access and equipment installation. Researchers may be associated with universities, other educational facilities, private or public entities, non-profit organizations, or government agencies. FFSL encourages research on the Colorado River and would support partnerships with organizations doing research, such as the Recovery Program, Colorado River Research Group, and Utah State University's Center for Colorado River Studies.

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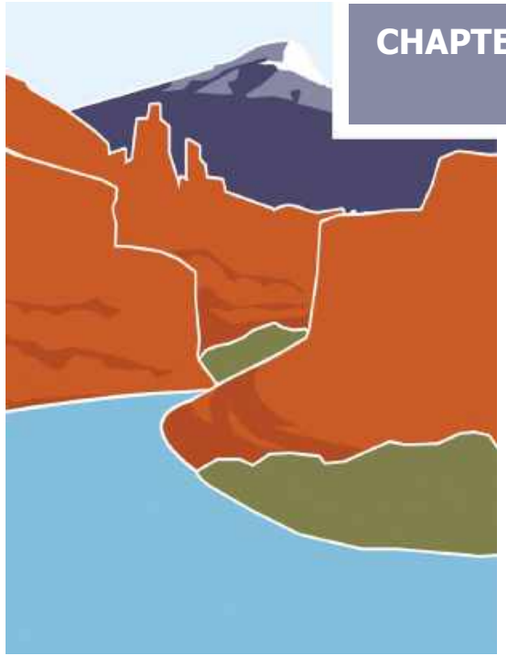

CHAPTER 3 – MANAGEMENT FRAMEWORK

3.1 Introduction

This chapter focuses on strategies that FFSL will implement to manage the Colorado River resources described in Chapter 2. Management strategies are organized by resource and consist of goals and objectives focusing on actions and decisions within FFSL's jurisdiction. Identified goals and objectives allow multiple opportunities for coordination with other Colorado River management entities. Collectively, strategies discussed in this chapter are designed to facilitate FFSL's management of Colorado River sovereign lands and resources in accordance with the Public Trust Doctrine and under multiple-use, sustained-yield principles, as stated in Utah Administrative Code R652-2-200 and Utah Code 65A-2-1. In cases where FFSL does not have direct management authority over a particular element of the river, FFSL will coordinate with the agencies and other partners that do have such authority. The term *partners* as used in this chapter is defined as landowners, 501(c) and nonprofit organizations, special interest groups, and other Colorado River stakeholder groups.

Managing for the Public Trust

As described in Chapter 1, in managing for the Public Trust, FFSL "recognizes and declares that the beds of navigable waters within the state are owned by the state and are among the basic resources of the state, and that there exists, and has existed since statehood, a public trust over and upon the beds of these waters. It is also recognized that the public health, interest, safety, and welfare require that all uses on, beneath or above the beds of navigable lakes and streams of the state be regulated, so that the protection of navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality will be given due consideration and balanced against the navigational or economic necessity or justification for, or benefit to be derived from, any proposed use" (Utah Administrative Code R652-2-200). The following management strategies reflect FFSL's commitment to the Public Trust on sovereign lands when considering specific projects, decisions, and applications for authorizations or permits:

- Navigation: FFSL will strive to maintain or improve navigation on the Colorado River. Decisions concerning river management will consider mitigation and removal of existing navigational hazards as well as parameters for new projects to facilitate navigation.
- Fish and wildlife habitat: FFSL will strive to maintain, enhance, or restore aquatic, wetland, riparian, and terrestrial fish and wildlife habitat under its jurisdiction.
- Aquatic beauty: FFSL will strive to maintain or improve aesthetic conditions in and along the Colorado River, recognizing that aquatic beauty increases the value of the Colorado River as a community resource.
- Public recreation: FFSL will consider and support diverse recreation activities and facilities at sustainable levels.
- Water quality: FFSL will support the State of Utah's antidegradation policy and Colorado River salinity standards for water quality.

When implementing management strategies, FFSL is obligated to follow applicable laws, including statutes, regulations, and legal doctrines.

Desired Future Condition

A *desired future condition* is a benchmark for what a resource should look like with the implementation of a management plan and associated goals and objectives. The CRCMP identifies desired future conditions for ecosystem resources; water resources; geology, paleontology, oil and gas, and other mineral resources; and community resources. The subsequent management goals and objectives provide a means to work toward the desired future conditions. Although the use of desired future conditions has limitations (as does any planning construct), these conditions allow for multiple-use management, can be modified

over time based on new data, and avoid the pitfalls of setting a "restored" ecological condition as a management target. For example, in managed systems like the Colorado River, setting restoration goals must account for normal conditions—e.g., invasive species and hydrologic modifications—that make restoration to some earlier condition unrealistic or in some cases unattainable.

River Use Classes

As described in Chapter 1, Utah Administrative Code R652-70-200 indicates that sovereign lands should be classified based on their current and planned uses and provides definitions for six classes. FFSL uses the classes to guide management and use of Colorado River sovereign lands with diverse current and desired future conditions. Table 3.1 lists and describes the river use classes.

Table 3.1. Classification of Sovereign Lands

River Use Class	Description
Class 1	Manage to protect existing resource development uses
Class 2	Manage to protect potential resource development options
Class 3	Manage as open for consideration of any use
Class 4	Manage for resource inventory and analysis
Class 5	Manage to protect potential resource preservation options
Class 6	Manage to protect existing resource preservation uses

Source: Utah Administrative Code R652-70-200

Note: Class 4 is not applied to the CRCMP planning area because adequate information about Colorado River sovereign lands exists to develop this planning document.

A map book of how these use classes are applied to Colorado River sovereign lands is found in Chapter 1, Figure 1.8. From a management perspective, FFSL recognizes that different activities have different impacts on sovereign lands. Table 3.2 lists common activities (proposed actions) requiring FFSL authorization and guidance for applicants seeking an easement, general permit, ROE, or other authorization. Proposed actions not listed in Table 3.2 will be reviewed on a case-by-case basis by FFSL to arrive at an appropriate use determination.

Use determinations for proposed actions consist of allowable (A), potentially allowable (P), and not allowable (N). An "A" use determination will likely require no site-specific analysis of resources within a project area, but the project will still be reviewed for adherence to BMPs. For "P" use determinations, a site-specific analysis may be completed to determine project feasibility and mitigation opportunities or requirements. The site-specific analysis will consider potential impacts (beneficial and adverse) of the proposed project to Colorado River resources. Certain BMPs must be incorporated into project design, as well as long-term maintenance to minimize adverse impacts to sovereign lands. For "N" use determinations, the proposed use will not be permitted unless the CRCMP is amended. The suitability of proposed easements, general permits, ROEs, and other authorizations will also be considered in the context of existing authorizations to avoid potential conflicts, e.g., boater access points and utilities in the same location. Finally, under certain jurisdictions such as Clean Water Act (CWA) permit conditions, FERC Management Areas, or FEMA-accredited levee operation and maintenance, some proposed actions may not be authorized regardless of FFSL river use class or use determination.

Table 3.2. Use Determinations for Proposed Actions by River Use Class

Proposed Action*	Class 1	Class 2	Class 3	Class 5	Class 6
Bed, Bank, and Vegetation Management					
Bank stabilization (bioengineering)	A	A	A	A	A
Bank stabilization (hardened)	A	A	P	P	P
Dredging†	P	P	P	P	P
Fire prevention treatments	A	A	A	P	P
Grade controls	P	P	P	P	P
Herbicide treatment (authorization required)	A	A	A	A	A

Proposed Action*	Class 1	Class 2	Class 3	Class 5	Class 6
Vegetation planting and propagule harvesting (e.g., willow whips)	A	A	A	A	A
Vegetation removal	A	A	A	P	P
Education and Research					
Education and interpretation	A	A	A	A	A
Scientific research instruments	A	A	A	A	A
Survey and monitoring activities	A	A	A	A	A
Habitat Management					
Aquatic habitat structures	A	A	A	A	A
Wildlife habitat (e.g., nesting structures)	A	A	A	A	A
Fisheries Management					
Fisheries management actions	A	A	A	A	A
Infrastructure					
Above-ground water, oil and gas, sewer, and communication lines§	P	P	N	N	N
Below-ground or buried utilities†	A	A	A	A	P
Bridges (pedestrian)†	A	A	A	P	P
Bridges (vehicle)†	A	A	A	P	N
Dams	P	P	P	N	N
Intake canals	P	P	P	P	P
Irrigation pumps	A	A	A	A	A
Fences (to the water's edge only)	A	A	A	P	P
Outfall structures	A	A	A	P	P
Overhead power lines‡	P	P	P	P	P
Regulatory markers (e.g., buoys, signage)	A	A	A	A	P
Trash booms	A	A	A	P	P
Recreation					
Boat docks (permanent)†	N	N	N	N	N
Boat docks (seasonal/temporary)†	A	A	A	P	P
Boat ramps†	P	P	P	P	P
Navigational hazard removal	A	A	A	A	A
Other recreation structures (permanent)†	P	P	P	P	P
Other recreation structures (temporary/seasonal)†	A	A	A	P	P
Emergency Actions					
Emergency response and cleanup	A	A	A	A	A
Emergency response training	A	A	A	A	P
Oil and Gas¶					
Mineral Resources¶					

Notes: A = allowable; P = potentially allowable with certain conditions; N = not allowable.

* Actions generally pertain to public and commercial activities, but some carry over to private landowners (e.g., bank stabilization, emergency cleanup, fire prevention, herbicide treatment, vegetation planting, vegetation removal, and habitat or nesting structures).

† In the interest of supporting the Public Trust, utilities, bridges, boat docks, boat ramps, dredging, and other similar actions proposed by private landowners will generally not be permitted. Irrigation pumps and electrical utilities servicing pumps installed and maintained by private landowners are exempt from this condition. Above-ground utilities that cross the river require authorization because sovereign lands include the air space over the river.

‡ Height to be determined during site-specific planning and based on National Electrical Code power line clearance guidelines (National Electrical Code 2017).

§ Potentially allowable if attached to existing permitted structures.

¶ Refer to the *Green and Colorado Rivers Mineral Leasing Plan* (SWCA 2020) for specific guidance for oil, gas, and mineral leasing on sovereign lands.

Class 4 is not applied to the CRCMP planning area because adequate information about Colorado River sovereign lands exists to develop this planning document.

Resource Management Issues

The management strategies in this chapter are organized by resource and follow the same order as in Chapter 2 (Current Conditions). Each resource section includes a list of desired future conditions for that resource as well as a management strategy table with goals; subsequent objectives; and applicable management, permitting, and intersecting agencies. BMPs for the resources are also included.

Management issues for Colorado River resources have been identified by FFSL, the planning team, and through the public involvement process (i.e., at public open houses, stakeholder meetings, county commissioner meetings, during the public comment period, and on FFSL's project website). Where resource (or sub-resource) management issues overlap, management goals are included in the resource section most pertinent to the objectives for achieving the goal.

Management Goals and Objectives

The goals and objectives reflect the intention of FFSL to protect and sustain the Pubic Trust resources while providing for their use. Each goal is supported by objectives that can be used to achieve the goal. Goals and objectives equate to specific management prescriptions to be implemented by FFSL where it has jurisdiction (e.g., inventory and map noxious weed occurrences in and along the banks of Colorado River). Where FFSL does not have jurisdiction or has concurrent jurisdiction, objectives consist of coordination (e.g., coordinate with cities, counties, agencies, and partners to improve existing recreation infrastructure and to add recreation infrastructure where needed), cooperation, and general support (e.g., support state and local law enforcement efforts to minimize boater speeding and enforce wake rules). FFSL will work proactively and cooperatively with management agencies, permitting agencies, intersecting agencies, and interested partners to implement applicable management goals and objectives.

Interagency Coordination

Effective coordination and communication with government agencies regarding Colorado River resources are vital to ensuring the health and long-term stability of the ecosystem. Coordination and communication between FFSL and other agencies will vary in timing and intensity based on the resource issue. For the purposes of developing the CRCMP management strategies, the government agencies involved fall into one or more of the following three categories depending on their participation in each unique resource issue:

1. Management agency: A management agency is directly responsible for the management of a particular resource. As mandated through Utah Code, administrative rule, or agency objectives, a management agency is responsible for on-the-ground management and/or monitoring.
2. Permitting agency: A permitting agency is responsible for authorizing Colorado River resource-related permits. For example, FFSL, DWQ, and DWRi can each issue permits for projects in or adjacent to the Colorado River. Each permitting agency has the potential to impact the resource through permit authorizations, including mitigation. A permitting agency is responsible for monitoring permit compliance.
3. Intersecting agency: An intersecting agency is an agency that does not have direct responsibility for managing a particular resource or permitting activities on the Colorado River but is tangentially related. The decisions of an intersecting agency may directly or indirectly impact a particular resource. In addition to federal and state agencies, an intersecting agency can include a tribal government, county government, municipal government, and a regional planning organization. FFSL management decisions impact resources that may be managed, influenced, and/or researched by intersecting agencies. These agencies often have tools, data, and information that could be used by FFSL to make well-informed management decisions. Intersecting agencies may be responsible for research and/or monitoring at a broad scale.

Although adjacent private landowners, businesses, special interest groups, land managers, local universities, and other stakeholders may not be listed as responsible parties in each goals and objectives table, FFSL is interested and available to discuss resource-specific matters with any concerned entity.

Best Management Practices

Implementation of BMPs for resources helps avoid or minimize impacts to Colorado River sovereign lands. BMPs may range from using approved plant lists and seed mixes for revegetation to design specifications for buried utility lines. Many BMPs pertain specifically to the bed and bank of the Colorado River. For BMPs relevant to land uses extending from the river and beyond, readers can review supplemental literature, e.g., *Riparian Buffer Design Guidelines for Water Quality and Wildlife Habitat Functions on Agricultural Landscapes in the Intermountain West* (Johnson and Buffler 2008) or consult other sources of technical information such as the local offices of the NRCS. Users of the CRCMP should review BMPs during their project planning process and demonstrate in the application documents which BMPs are incorporated, how they will be implemented, and/or why they are not practicable. BMPs are aspirational in nature and may change over time based on available information or technology. FFSL may deviate from BMPs as written in this CMP on a case-by-case basis.

3.2 Ecosystem Resources

Desired future conditions for ecosystem resources are as follows:

- A sustainable river system supporting human uses, diverse populations of native plant and animal species, and desirable introduced and native fish with limited constraints from invasive and nonnative species.
- A healthy river corridor preserving wildlife migration routes through contiguous habitats and between fragmented habitats.
- Recognition that natural disturbance can be beneficial, but that anthropogenic disturbance such as development and pollution should be avoided to the extent practicable.
- Preservation of areas providing ecosystem services (e.g., flood attenuation and wildlife habitat) and restoration of degraded ecosystems to enhance overall ecological condition.

As discussed in Chapter 1, Section 1.11, river use classes are applied to specific locations on Colorado River sovereign lands based on a variety of parameters. Table 3.3 describes what the river use classes mean for ecosystem management.

Table 3.3. River Use Classes and Ecosystem Management

River Use Class	What the Use Class Means for Ecosystem Management
Class 1	Higher potential for actual loss or degradation of wildlife habitat due to authorizations and uses. High potential for restoring wildlife habitat and improving vegetation communities because more bed, bank, and vegetation management is allowed.
Class 2	Potential future loss or degradation of wildlife habitat due to possible authorizations and uses. High potential for restoring wildlife habitat and improving vegetation communities because more bed, bank, and vegetation management is allowed.
Class 3	Moderate potential for actual loss or degradation of wildlife habitat due to authorizations and uses; more emphasis on mitigation than in Classes 1 or 2. Moderate potential for restoring wildlife habitat and improving vegetation communities because more bed, bank, and vegetation management is allowed than in Classes 5 and 6 (e.g., vegetation removal).
Class 5	Potential for future ecosystem services and wildlife habitat protection and conservation. Adjacent lands may resemble those eligible for conservation easement status. Likely no current regulatory restrictions on adjacent land use. Emphasis on streambank and instream wildlife habitat restoration, though not all bed, bank, and vegetation management activities may be allowed.
Class 6	Emphasis on protection and conservation of ecosystem services and wildlife habitat. Ongoing opportunities for adaptive management and habitat improvement projects. Current regulatory protection of adjacent land use. Emphasis on streambank and instream wildlife habitat restoration, though not all bed, bank, and vegetation management activities may be allowed.

Wildlife Habitat

Fish and wildlife habitat is one of the components of the Public Trust FFSL is mandated to protect. The management goals and objectives for wildlife habitat generally seek to protect, enhance, and restore healthy native wildlife habitats. Table 3.4 presents management goals and objectives common to all classes for wildlife habitat. Figure 3.1 provides a list of BMPs for wildlife habitat in the planning area.

Table 3.4. Wildlife Habitat Goals and Objectives Common to All Classes

Wildlife Habitat Goal 1: Protect and sustain healthy native habitats in and along the banks of the Colorado River.
Objective: Cooperate with agencies and partners to identify and maintain areas with high wildlife habitat value, including wetlands and IBAs.
Objective: As part of the authorization application process, consider the cumulative impacts of past, present, and future projects on instream and adjacent wildlife habitat through consultation with the management, permitting, and intersecting agencies listed below.
Objective: Minimize habitat fragmentation from authorizations and uses, especially in areas with high wildlife habitat value; cluster authorizations with habitat impacts whenever possible.
Objective: Focus habitat protection efforts on areas with healthy native plant communities.
Objective: Identify and protect areas providing healthy habitat for special-status plant species (i.e., the threatened Navajo sedge).
Management Agencies: FFSL, DWQ, DWR, BLM, and USFWS
Permitting Agencies: FFSL, DWRi, DWQ, BLM, USACE, and USFWS
Intersecting Agencies: County, municipal, and tribal governments; FERC; and USBR
Wildlife Habitat Goal 2: Restore and enhance native habitats in and along the banks of the Colorado River.
Objective: Support restoration of the riparian zone, emphasizing connectivity along the river corridor.
Objective: Coordinate with agencies and partners to re-establish floodplains and other geomorphic features where appropriate (e.g., point bars, bank woody debris, side channels and secondary channels, and low emergent benches).
Objective: Support removal of structures degrading native habitats.
Objective: Work with agencies and partners to identify problem areas of bank erosion, determine the causes of the erosion, and encourage solutions to limit or prevent future bank erosion.
Management Agencies: FFSL, DWQ, DWR, BLM, and USFWS
Permitting Agencies: FFSL, DWRi, DWQ, BLM, USACE, and USFWS
Intersecting Agencies: County, municipal, and tribal governments; FERC; and USBR
Wildlife Habitat Goal 3: Support habitat restoration or enhancement on lands adjacent to the Colorado River.
Objective: Coordinate with agencies and partners on projects that are adjacent to and benefit habitat on sovereign lands.
Objective: Cooperate with agencies and partners to inventory adjacent lands where restoration or enhancement would benefit navigation, water quality, fish and wildlife habitat, recreation, or aquatic beauty.
Management Agencies: FFSL, DWR, BLM, NPS, and USFWS
Permitting Agencies: FFSL, BLM, USACE, and USFWS
Intersecting Agencies: County, municipal, and tribal governments
Wildlife Habitat Goal 4: Manage invasive and noxious weed species in and along the banks of the Colorado River.
Objective: Inventory and map noxious weed occurrences in and along the banks of the Colorado River.
Objective: Identify concentrations and dispersal vectors for noxious weeds within the river corridor.
Objective: Target and treat invasive weed species (especially tamarisk, Russian olive, Russian knapweed, and purple loosestrife), and treat colonizing invasive species in the planning area.
Objective: Coordinate with adjacent landowners who are interested in treating invasive and noxious weed infestations on their property.
Management Agencies: FFSL, UDAF, BLM
Permitting Agencies: FFSL, BLM
Intersecting Agencies: County, municipal, and tribal governments; NRCS; and NPS

Best Management Practices

Use native or desirable species from approved plant lists and seed mixes when revegetating disturbed areas or conducting restoration or enhancement activities (see Table 2.4 in Chapter 2).

Implement measures to reduce the introduction and spread of invasive and noxious weed species during project construction and maintenance, such as equipment washing and inspection.

For invasive and noxious weed species management, refer to guidance on the Southeastern Utah Riparian Partnership's website, including the *Field Guide for Managing Salt Cedar in the Southwest* (USFS 2014b) and *Tamarisk Best Management Practices in Colorado Watersheds* (Nissen et al. 2010).

Enhance the river vegetative buffer to minimize noise and light pollution. During project design and construction, use equipment with low levels of lighting and noise.

Tamarisk removal project along the Colorado River.

Protect undisturbed areas, maximize open space, and minimize surface disturbance in project designs.

Limit negative impacts to streambanks. Project designs should protect bank stability.

Implement erosion-control measures (e.g., silt fencing and straw wattles) during project construction to protect aquatic habitat.

Figure 3.1. Best management practices for wildlife habitat in the planning area.

Wildlife Species

The management goals and objectives for wildlife species seek to support healthy populations of native fishes, migratory birds, and terrestrial wildlife. Table 3.5 presents management goals and objectives for wildlife species that are common to all classes. Figure 3.2 provides a list of BMPs for wildlife species in the planning area.

Table 3.5. Wildlife Species Goals and Objectives Common to All Classes

Wildlife Species Goal 1: Recognize the importance and support the sustainability of viable populations of native and desirable nonnative fishes, along with migratory bird species and their habitats.
Objective: Coordinate with agencies and partners to encourage the creation, restoration, enhancement, and maintenance of a diversity of habitats and adequate cover, reproductive sites, and food supply for fish and migratory birds.
Objective: Support inventory, monitoring, and research of fisheries and migrating bird populations with agencies and partners, including non-governmental organizations and citizen science groups.
Objective: Support DWQ aquatic wildlife–related beneficial uses and help ensure compliance with numeric criteria for pollutants.
Objective: Emphasize the protection of sovereign land areas providing habitat for the special-status fish and migratory bird species in Table 2.7.
Objective: Coordinate with USFWS on new authorizations proposed in areas of designated critical habitat on sovereign lands (see Table 2.7).
Objective: Manage for consistency with current USFWS plans for threatened, endangered, and candidate species, and with any management plans for other special-status species (e.g., the range-wide conservation agreement and strategy for the roundtail chub, bluehead sucker, and flannelmouth sucker [DWR 2006]).
Objective: Consider individual bird species, federally listed bird species, Utah bird SPC, Utah Partners in Flight priority species, and *Utah Wildlife Action Plan* SGCN when trying to achieve habitat-related management goals (e.g., enhancement, restoration, preservation).
Objective: Support flows and releases that benefit special-status fishes and amphibians on sovereign lands (see Table 2.7).
Objective: Manage to preserve and protect critical habitats for spawning and rearing for listed and sensitive native fish species.
Management Agencies: FFSL, DWR, BLM, and USFWS
Permitting Agencies: FFSL, DWRi, DWQ, BLM, USACE, and USFWS
Intersecting Agencies: County, municipal, and tribal governments and Upper Colorado River Endangered Fish Recovery Program

Wildlife Species Goal 2: Recognize the importance of and support the sustainability of viable populations of native terrestrial wildlife species on lands adjacent to the Colorado River.

Objective: Coordinate with agencies and partners to encourage projects that are adjacent to sovereign lands and benefit terrestrial wildlife species.

Objective: Promote the creation, restoration, enhancement, and maintenance of a diversity of habitats and adequate cover, reproductive sites, and food supply for terrestrial wildlife on adjacent lands.

Objective: Support inventory, monitoring, and research of terrestrial wildlife populations on adjacent lands with agencies and partners, including non-governmental organizations and citizen science groups.

Objective: Emphasize the protection of sovereign land areas connected to special-status terrestrial wildlife habitat species (see Table 2.7) on adjacent lands.

Management Agencies: FFSL, DWR, BLM, USFWS, and NPS

Permitting Agencies: FFSL, BLM, USACE, and USFWS

Intersecting Agencies: County, municipal, and tribal governments

Wildlife Species Goal 3: Support the control or eradication of existing aquatic invasive species and terrestrial nonnative, invasive species; discourage the spread of existing aquatic invasive species and terrestrial, nonnative species; and discourage the introduction of new aquatic invasive species and terrestrial, nonnative species to the Colorado River.

Objective: Support control and eradication of aquatic and terrestrial nonnative, invasive pests presently in the river system through coordination with DWR and other agencies.

Objective: Coordinate with DWR on public awareness programs and other strategies for keeping nonnative, invasive pest species out of the Colorado River.

Management Agencies: FFSL, UDAF, and BLM

Permitting Agencies: FFSL, BLM

Intersecting Agencies: County, municipal, and tribal governments; NRCS

Best Management Practices

Adhere to all federal regulations for wildlife species (e.g., Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act).

Apply seasonal bird nesting guidelines described in *Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances* (Romin and Muck 2002) during project implementation.

Refer to DWR key habitats and priority species when planning restoration projects in and along the river (Utah Wildlife Action Plan Joint Team 2015).

Refer to *Utah Partners in Flight Avian Conservation Strategy Version 2.0* (Parrish et al. 2002) for priority bird species and conservation actions.

Heron rookery along the Colorado River.

Consider federally listed bird species, bird SPC, Utah Partners in Flight priority species, and SGCNs when working to achieve habitat-related goals such as enhancement or restoration.

Follow herbicide and pesticide application protocol carefully, especially near aquatic resources, as follows:

- Applicators should be certified, licensed, or properly trained to work with pesticides and herbicides.
- Follow the manufacturer's label instructions.
- Follow all applicable federal, state, and local laws and regulations.
- Select compounds that are effective but are not likely to drift, do not leach into groundwater or wash into streams, are not toxic to people or other organisms, are easy to apply, and are not persistent in the environment.
- Use the minimum amount of compound needed to be effective.
- Select an appropriate application method for the local conditions.
- Ensure that no banned or unregistered pesticide or herbicide is applied.
- Do not apply herbicides or pesticides during storm events or windy weather.
- Do not apply herbicides or pesticides when water is running on or off-site or if the ground is saturated.
- During application, note and protect irrigation canals, open trenches, surface waters, wetlands, designated 303(d) waters, and groundwater sources.
- Understand appropriate safety procedures and emergency spill actions.
- Follow applicable invasive species laws and regulations.

Refer to the *Utah Aquatic Invasive Species Management Plan* (DWR and Utah Invasive Species Task Force 2009) for aquatic invasive species management.

Figure 3.2. Best management practices for wildlife species in the planning area.

3.3 Water Resources

Desired future conditions for water resources are as follows:

- A sustainable river system with improvements, where possible, to naturalized flow, and floodplain connectivity.
- Maintenance of seasonal variation in discharge and instream flows that support sediment transport and enhance riparian plant communities where possible.
- A reduction in channel narrowing through a healthier flow regime where possible.
- Continued invasive species reduction to help improve sediment mobility and reduce channel narrowing.
- Improvements in water quality, especially reductions in selenium and salinity.
- Recognition that a warming climate is reducing runoff in the Colorado River watershed.
- Recognition of the importance of reducing consumptive use.

As discussed in Chapter 1, Section 1.11, river use classes are applied to specific locations on Colorado River sovereign lands based on a variety of parameters. Table 3.6 describes what the river use classes mean for water resources management.

Table 3.6. River Use Classes and Water Resources Management

River Use Class	What the Use Class Means for Water Resources Management
Class 1	Higher potential for monitoring, modifying, and replacing existing instream structures negatively affecting water resources. Higher potential for the installation of new instream structures or other authorizations and uses that could have a negative effect on water resources. Most uses are allowed in this class.
Class 2	Potential for installation of new instream structures or other authorizations or uses that could have a negative effect on water resources. Most uses are allowed in this class.
Class 3	Combination of existing authorizations and uses and protection of water resources; more emphasis on mitigation than in Classes 1 or 2. More authorizations and uses are allowed than in Classes 5 and 6 (e.g., bridges, vegetation removal). Potential degradation of local water resources is possible without successful implementation of BMPs and mitigation measures.
Class 5	Potential for future protection of water resources. Emphasis is on preserving existing healthy water resources and maintaining the opportunity to protect water resources. Certain authorizations and uses require more review than in Classes 1–3 (e.g., vehicle bridges, outfall structures).
Class 6	Protection of water resources. Current regulatory protection of adjacent land use lessens the likelihood of impacts to water resources. Fewer authorizations and uses are allowed, and some require more review than in Classes 1–5 (e.g., below-ground or buried utilities).

Hydrology

The hydrology goals and objectives seek to reduce negative impacts on hydrologic conditions in the Colorado River, while improving hydrologic conditions where possible. Table 3.7 presents management goals and objectives for hydrology that are common to all classes. Figure 3.3 provides a list of BMPs for hydrology management in the planning area.

Table 3.7. Hydrology Goals and Objectives Common to All Classes

Hydrology Goal 1: Support studies and research regarding instream structures and, where appropriate, support modification or removal.
Objective: Support comprehensive mapping and inventory of instream structures.
Objective: Assess condition of instream structures to determine impact on hydrology.
Objective: Consider removal or repair of those instream structures degrading hydrologic conditions.
Objective: Ensure that placement and design of new instream infrastructure will not degrade hydrology during the authorization application process (see BMPs following this table).
Management Agencies: FFSL
Permitting Agencies: FFSL, DWRi, DWQ, and USACE
Intersecting Agencies: FERC and USBR
Hydrology Goal 2: Support restoration efforts that integrate river processes.
Objective: Consider geomorphologic characteristics when managing river restoration efforts. For example, in river segments where the slope is steep, consider the likelihood of scour versus segments where slope is gentle. Also consider the likelihood of deposition.
Objective: Consider the needs of the larger river system when designing specific restoration efforts.
Management Agencies: FFSL, DWRi, and BLM

Permitting Agencies: FFSL, DWRi, BLM, and USACE
Intersecting Agencies: FERC and USBR
Hydrology Goal 3: Recognize that increasing demand for consumptive use of Colorado River water may alter the flow regime, decreasing total runoff and reducing peak annual flow magnitude and duration.
Objective: Encourage and support water conservation when opportunities arise.
Objective: Support agencies and partners using creative solutions to reduce water consumption.
Management Agencies: DWRi, DWRe, and BLM
Permitting Agencies: FFSL, DWRi, BLM, and USACE
Intersecting Agencies: FERC, USBR, and FEMA
Hydrology Goal 4: Recognize the importance of flows supporting healthy instream processes, as well as aquatic habitat and adjacent habitat.
Objective: Support research of flows and releases that would benefit the riverine ecosystem and fluvial processes.
Objective: Coordinate with agencies and partners to develop management strategies for projected declines to stream flows caused by warming temperatures.
Objective: Coordinate with DWR and other management agencies to study instream flows that support fisheries and associated aquatic and wildlife habitat.
Objective: Collaborate with and encourage management agencies and partners to promote healthy flow regimes, especially those supporting the life history requirements of native species.
Management Agencies: DWR, DWRe, and BLM
Permitting Agencies: FFSL, DWRi, BLM, and USACE
Intersecting Agencies: FERC, USBR, and FEMA
Hydrology Goal 5: Recognize the importance of flows supporting a variety of recreation uses.
Objective: Support research of preferential flows for all recreation types.
Objective: Coordinate with agencies and partners to discern how projected declines to stream flows might affect river recreation.
Objective: Collaborate with and encourage management agencies and partners to promote healthy flow regimes, including those beneficial to river recreation.
Management Agencies: DWRi, DWRe, and BLM
Permitting Agencies: FFSL, DWRi, BLM, and USACE
Intersecting Agencies: FERC, USBR, and FEMA

Best Management Practices

Use bioengineering techniques when possible.

Through engineering analyses, demonstrate no adverse impact on hydraulic, hydrologic, and scour/erosion conditions for new projects.

Replace and/or enhance bank vegetation disturbed by construction.

Ensure that steep channel bank slopes are 2.5:1.0 or flatter to support vegetative growth.

Ensure that structure measures are adequately toed down below the design scour depth or provide grade control to limit long-term scour.

Bank stabilization along the Colorado River.

Use *Integrating Recreational Boating Considerations Into Stream Channel Modification & Design Projects* (Colburn 2012) as an information source for integrating recreational needs into stream channel project design and implementation.

Figure 3.3. Best management practices for hydrology in the planning area.

Geomorphology and Sediment Supply and Transport

Table 3.8 presents management goals and objectives for geomorphology and sediment supply and transport that are common to all classes. Figure 3.4 provides a list of BMPs for geomorphology and sediment supply and transport in the planning area.

Table 3.8. Geomorphology and Sediment Supply and Transport Goals and Objectives Common to All Classes

Geomorphology and Sediment Supply and Transport Goal 1: Recognize the role of tamarisk in the reduction of sediment mobility and the promotion of channel narrowing.
Objective: Identify, target, and treat tamarisk in the planning area.
Management Agencies: FFSL and UDAF
Permitting Agencies: FFSL
Intersecting Agencies: DWR and NRCS

Geomorphology and Sediment Supply and Transport Goal 2: Improve connectivity between the river channel and floodplains where possible.
Objective: Work with agencies and partners to reduce nonnative vegetation on floodplains that may be altering floodplain sediment deposition.
Management Agencies: DWRe and DWRi
Permitting Agencies: FFSL, DWRi, and USACE
Intersecting Agencies: FERC, USBR, and FEMA
Geomorphology and Sediment Supply and Transport Goal 3: Work toward a healthier stream flow regime, improved sediment supply and transport, and reduced channel narrowing where possible.
Objective: Support and promote research identifying ways to improve the health of the Colorado River and resulting in more sustainable management.
Objective: Work with agencies and partners to better manage dams, diversions, and irrigation withdrawals with adverse effects on flow regime, sediment supply and transport, and geomorphology in the Colorado River (e.g., Aspinall Unit on the Gunnison River, McPhee Dam on the Dolores River).
Management Agencies: DWR and DWRe
Permitting Agencies: FFSL, DWRi, and USACE
Intersecting Agencies: FERC, USBR, and FEMA

Best Management Practices
Discourage activities in and adjacent to the channel that cause significant impact to sediment transport and the sediment balance in the river.
Through engineering analyses of projects, seek to minimize adverse impact on geomorphic processes such as scour, erosion, aggregation, or degradation of sediment features.
Discourage the diversion of flow or other reduction of flow during spring runoff when most sediment transport occurs.

Figure 3.4. Best management practices for geomorphology and sediment supply and transport in the planning area.

Water Quality

Water quality is one of the components of the Public Trust FFSL is mandated to protect. FFSL relies on DWQ's designated beneficial uses for water quality (not the river use class system). Table 3.9 presents management goals and objectives for water quality. Figure 3.5 provides a list of BMPs for water quality in the planning area.

Table 3.9. Water Quality Goals and Objectives Common to All Classes

Water Quality Goal 1: Promote the policy of antidegradation of Colorado River water quality.
Objective: Coordinate with DWQ to ensure compliance with Utah Water Quality Act regulations (Utah Administrative Code R317).
Objective: Require water quality certifications and provisions per Utah Administrative Code R317-15 and R652-20-3000. The purpose of certification is to ensure that the federally permitted or licensed activities will be conducted in a manner complying with applicable discharge and water quality requirements to maintain the chemical, physical, and biological integrity of waters of the U.S. within the state.
Objective: Promote maintenance and improvement of existing water quality to protect the beneficial uses designated for the Colorado River.
Objective: Consider water quality during the authorization application process.
Objective: Manage sovereign lands in a manner consistent with the Colorado River Salinity Control Program and implement BMPs and restoration projects to reduce salinity contributions to the Colorado River system.
Objective: Support the timely completion of the Moab UMTRA project to limit the impacts of tailings pile pollutants on the Colorado River.
Objective: Work with agencies and other stakeholders to educate adjacent agricultural landowners on the use of BMPs to protect water quality.
Management Agencies: FFSL and DWQ
Permitting Agencies: DWQ
Intersecting Agencies: County, municipal, and tribal governments; DWRe; NRCS; and Colorado River Basin Salinity Control Forum and Council

Water Quality Goal 2: Recognize the importance of minimizing pollutant loads to the river, specifically those identified in the TMDL (e.g., selenium, pH).
Objective: Coordinate with DWQ to ensure compliance with the numeric criteria for parameters of concern (e.g., selenium, pH).
Objective: Follow TMDL recommendations in all 303(d) listed reaches.
Objective: Coordinate with municipal stormwater management entities and other entities that discharge to reduce pollutant loads to the river.
Objective: Communicate new project proposals to DWQ to help ensure impacts do not affect compliance with existing water quality standards.
Objective: Support maintenance of existing and/or restore degraded wetland, riparian, and vegetated infiltration buffers adjacent to sovereign lands.
Management Agencies: FFSL, DWQ, and BLM
Permitting Agencies: DWRi, DWQ, BLM, and USACE
Intersecting Agencies: County, municipal, and tribal governments; UDAF; and NRCS

Best Management Practices

Implement sediment- and erosion-control measures (e.g., silt fencing and straw wattles) during project construction to protect water quality.

Where appropriate, use bioengineering practices for bank stabilization.

Encourage treatment of stormwater with constructed wetlands, bio-swales, and other features.

Revegetate the riparian corridor to provide filtration and thermal protection.

Rehabilitate riparian zones by establishing riparian buffers.

Stabilize streambanks through revegetation, snag removal and clearing, flow regulation structures, revetments, or deflectors.

Ensure areas designated as critical point sources meet UPDES requirements.

Address high selenium concentrations by implementing the following standard as defined in the *TMDL for Selenium in the Colorado River Watershed* (DWQ 2014):

- Total maximum load as a daily average of less than 21.375 kilograms/day
- Load reduction of 9.69 kilograms/day

Implement water use efficiencies as common practice.

Minimize surface runoff whenever possible.

Figure 3.5. Best management practices for water quality in the planning area.

3.4 Geology, Paleontology, Oil and Gas, and other Mineral Resources

Desired future conditions for geology, paleontology, oil and gas, and other mineral resources are as follows:

- Improved awareness and understanding of geologic hazards and sensitive geological resources/formations in the planning area.
- Recognition of the value of paleontological resources in the planning area and protection of known paleontological resources.
- Effective management of oil and gas and other mineral resources in the planning area.

Mineral substances are classified in Utah Administrative Code R652-20-200 and include metalliferous minerals (e.g., copper, tin); coal; oil, gas, and hydrocarbon; oil shale; potash; gilsonite; building stone and limestone; phosphate; and gemstone and fossils (e.g., agate). In this section, oil and gas resources are discussed separately from the remaining mineral resources.

FFSL will use the *Green and Colorado Rivers Mineral Leasing Plan* (SWCA 2020) to determine where oil and gas and mineral leasing is allowed and to identify the required constraints, mitigations, and BMPs. The river use class system does not designate where oil and gas or mineral leasing is allowed and does not apply to surface occupancy or any geological, paleontological, oil and gas, or mineral resource extraction. Table 3.10 describes what the river use classes mean for geology, paleontology, oil and gas, and other mineral resources.

Table 3.10. River Use Classes and Geology, Paleontology, Oil and Gas, and other Mineral Resources

River Use Class	What the Use Class Means for Geology, Paleontology, Oil and Gas, and other Mineral Resources
Class 1	Higher potential for damage to infrastructure from geologic hazards because infrastructure is often clustered in Class 1 areas. Paleontological resources may have been disturbed or damaged by existing infrastructure. More appropriate class for authorizing the leasing of oil and gas and other mineral resources.
Class 2	Higher potential for disturbance or damage to paleontological resources from new authorizations and uses. More appropriate class for authorizing the leasing of oil and gas and other mineral resources.
Class 3	Moderate potential for disturbance and damage to paleontological resources from new authorizations and uses. Appropriate class for authorizing the leasing of oil and gas and other mineral resources, with more emphasis on mitigation than in Classes 1 and 2.
Class 5	Lower potential for damage to infrastructure from geologic hazards because there is less infrastructure in Class 5 areas. Lower potential for disturbance or damage to paleontological resources from new authorizations and uses. Less appropriate class for authorizing the leasing of oil and gas and other mineral resources; mitigation is heavily emphasized.
Class 6	Lower potential for damage to infrastructure from geologic hazards because fewer authorizations and uses are allowed. Lower potential for disturbance or damage to paleontological resources from new authorizations and uses. Least appropriate class for authorizing the leasing of oil and gas and other mineral resources; stringent mitigation would be required.

Geology

Table 3.11 presents management goals and objectives for geology that are common to all classes. Figure 3.6 provides a list of BMPs for geology management in the planning area.

Table 3.11. Geology Goals and Objectives Common to All Classes

Geology Goal 1: Improve awareness and understanding of geologic hazards in the planning area.
Objective: Identify and consider geologic hazards during the authorization application process.
Management Agencies: UGS
Permitting Agencies: FFSL, DWRi, DWQ, FERC, and USBR
Intersecting Agencies: County, municipal, and tribal governments; FEMA; and DOE
Geology Goal 2: Protect and preserve sensitive geological resources/formations in the planning area.
Objective: Identify and consider sensitive geological resources/formations during the authorization application process.
Management Agencies: FFSL and UGS
Permitting Agencies: FFSL, DWRi, DWQ, FERC, and USBR
Intersecting Agencies: County, municipal, and tribal governments; FEMA; DOE

Best Management Practices

Coordinate with UGS to incorporate BMPs in new authorizations on a case-by-case basis (where there are geologic hazards or sensitive geological resources/formations).

Locate new infrastructure, development, and other uses in areas that minimize potential impacts to sensitive geological resources/formations.

Locate new infrastructure, development, and other uses in areas that minimize potential impacts from geologic hazards.

Figure 3.6. Best management practices for geology in the planning area.

Paleontology

Table 3.12 presents management goals and objectives for paleontology that are common to all classes. Figure 3.7 provides a list of BMPs for paleontology management in the planning area.

Table 3.12. Paleontology Goals and Objectives Common to All Classes

Paleontology Goal 1: Consider paleontological resources during the authorization application process.
Objective: Coordinate with management agencies such as UGS to determine whether paleontological resource record searches, pre-disturbance surveys, monitoring, mitigation, or avoidance is needed in areas with moderate to high potential to contain paleontological resources.
Management Agencies: FFSL and UGS
Permitting Agencies: FFSL and UGS
Intersecting Agencies: BLM
Paleontology Goal 2: Protect and preserve paleontological resources found on sovereign lands.
Objective: Coordinate with management agencies such as UGS to protect and preserve paleontological resources currently existing or newly discovered on sovereign lands.
Objective: Consider developing strategies to make individual paleontological resource sites available for public education and recreation purposes.
Objective: Develop and implement strategies to educate users about appropriate behaviors while observing and appreciating paleontological resources.
Management Agencies: FFSL and UGS
Permitting Agencies: FFSL and UGS
Intersecting Agencies: County, municipal, and tribal governments; NPS; and BLM

Best Management Practices

In the event of an unanticipated discovery of a paleontological resource during construction of an authorized project on sovereign lands, work should be immediately halted and FFSL should be notified of the discovery. FFSL will consult with the appropriate managing agency before work resumes.

Locate new infrastructure, development, and other uses in areas that minimize potential impacts to paleontological resources.

Figure 3.7. Best management practices for paleontology in the planning area.

Oil and Gas Resources

Table 3.13 presents management goals and objectives for oil and gas resources that are common to all classes. Figure 3.8 provides a list of BMPs for oil and gas resources in the planning area.

Table 3.13. Oil and Gas Resources Goals and Objectives Common to All Classes

Oil and Gas Resources Goal 1: Balance oil and gas resource development on sovereign lands while minimizing negative impacts, protecting Public Trust resources, and protecting the natural environment.
Objective: Foster coordination and cooperation in the management of all resources on the Colorado River with oil and gas applicants, and with local, state, federal, and tribal agencies with management authority adjacent to or on the Colorado River.
Objective: Enforce all applicable regulations, mitigation, and BMPs during oil and gas operations and appropriate reclamation after developments cease.
Objective: Coordinate closely with DOGM for leases adjacent to Class 6 areas.
Management Agencies: FFSL, DOGM, BLM, and tribal governments
Permitting Agencies: FFSL, DOGM, BLM, and tribal governments
Intersecting Agencies: County, municipal, and tribal governments, and UGS

Best Management Practices

Coordinate with DOGM and the BLM to incorporate BMPs in new leases in the planning area on a case-by-case basis.

Follow all applicable rules, regulations, and guidance, e.g., DOGM's *Onsite Pit Guidance Document* (Doebele 2017); DOGM's *Incident Reporting Guidance Document* (Cordova 2018), *The Practical Guide to Reclamation in Utah* (DOGM 2000), Utah Administrative Code Title R647, and *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* (The Gold Book) (BLM 2007).

Prior to leasing, applicant must demonstrate that there will be compensation for any extraction of Public Trust resources on sovereign lands, and that there will be no negative impact on the surface of sovereign lands from drilling into underlying formations.

Consider mitigating or screening structures and operations in upland areas from view if visible from the river to minimize disruptions, sound, exhaust, fugitive dust, and visual impacts to aquatic beauty and recreation.

Figure 3.8. Best management practices for oil and gas resources in the planning area.

Mineral Resources

Table 3.14 presents management goals and objectives for mineral resources that are common to all classes. Figure 3.9 provides a list of BMPs for mineral resources in the planning area.

Table 3.14. Mineral Resources Goals and Objectives Common to All Classes

Mineral Resources Goal 1: Balance mineral resource development on sovereign lands while minimizing negative impacts, protecting Public Trust resources, and protecting the natural environment.
Objective: Foster coordination and cooperation in the management of all resources on the Colorado River with mineral applicants, and with local, state, federal, and tribal agencies with management authority adjacent to or on the Colorado River.
Objective: Enforce all applicable regulations, mitigation, and BMPs during mineral resource development and extraction operations and appropriate reclamation after projects cease.
Objective: Coordinate closely with permitting agencies for leases adjacent to Class 6 areas.
Management Agencies: FFSL, DOGM, BLM, and tribal governments
Permitting Agencies: FFSL, DOGM, BLM, and tribal governments
Intersecting Agencies: County, municipal, and tribal governments, and UGS

Best Management Practices

Coordinate with other management and permitting agencies to incorporate BMPs in new leases in the planning area on a case-by-case basis.

Follow all applicable rules, regulations, and guidance for the particular mineral resource being extracted.

Prior to leasing, applicant must demonstrate that there will be compensation for any extraction of Public Trust resources on sovereign lands, and that there will be no negative impact on the surface of sovereign lands from drilling into underlying formations.

Consider mitigating or screening structures and operations from view if visible from the river to minimize disruptions, sound, exhaust, fugitive dust, and visual impacts to aquatic beauty and recreation.

Figure 3.9. Best management practices for mineral resources in the planning area.

3.5 Community Resources

Desired future conditions for community resources are as follows:

- A sustainable river system supporting multiple uses (e.g., recreation, irrigation) and providing navigability and safe access for diverse stakeholders.
- Preservation and enhancement of the aquatic beauty of the river ecosystem without impairment of multiple uses.
- Preservation of existing agricultural landscapes bordering sovereign lands.
- Preservation of cultural resources and recognition of prehistoric and historic landscapes.
- Improved education of river users to promote stewardship of the resource, reduce conflicts, and enhance public safety.
- A reduction in user conflicts and improved recreation coordination between management agencies.
- Protection of the recreation experience and the Public Trust values by creatively managing growing recreational use.

As discussed in Chapter 1, Section 1.11, river use classes are applied to specific locations along on Colorado River sovereign lands based on a variety of parameters. Table 3.15 describes what the river use classes mean for community resource management.

Table 3.15. River Use Classes and Community Resources

River Use Class	What the Use Class Means for Community Resources
Class 1	Clustering of community resources such as infrastructure and recreation facilities may exist or occur in this class with concern for safety, practicality, conflicting uses, and resource degradation. Cultural resources may have been disturbed or damaged by existing infrastructure. More infrastructure and recreation structures are allowed than in Classes 5 and 6.
Class 2	Clustering of community resources such as infrastructure and recreation facilities may occur in this class with concern for safety, practicality, conflicting uses, and resource degradation. Higher potential for disturbance or damage to cultural resources from new authorizations and uses. More infrastructure and recreation structures are allowed than in Classes 5 and 6.
Class 3	Appropriate class for clustering of community resources such as infrastructure and recreation facilities but with an emphasis on mitigation to avoid impacts to ecosystem, water, and cultural resources. Moderate potential for disturbance or damage to cultural resources from new authorizations and uses.
Class 5	Preference for authorizations and uses maintaining current agricultural activities and the potential for future resource preservation and restoration; mitigation is heavily emphasized. Lower potential for disturbance or damage to cultural resources from new authorizations and uses. Certain authorizations and uses require more review than in Classes 1–3 (e.g., pedestrian bridges, boat docks).
Class 6	Preference for authorizations and uses consistent with existing resource protections. Fewer infrastructure and recreation structure options than in other classes; some authorizations and uses require more review. Lower potential for disturbance or damage to cultural resources from new authorizations and uses. New authorizations and uses may have to adhere to mitigation standards and regulations associated with conditions of conservation easements, deed restrictions, and other state or federal laws.

Agriculture

Management goals and objectives generally seek to support the viability of agriculture as a desirable land use along the river, the use of sustainable agricultural practices, the enhancement of wildlife habitat on agricultural lands, and the mitigation or reduction of environmental impacts to water quality and other important environmental attributes of the river corridor. Table 3.16 presents management goals and objectives for agriculture that are common to all classes. Figure 3.10 provides a list of BMPs for agriculture in the planning area, including some from Utah State University (USU) Water Quality Extension (USU 2018). FFSL is willing to discuss the permitting of specific agricultural equipment or unique agricultural situations as questions arise.

Table 3.16. Agriculture Goals and Objectives Common to All Classes

Agriculture Goal 1: Support programs to preserve agricultural lands along the river through agricultural conservation easements or other tools that help ensure the long-term viability of agriculture and recognize its importance as a vital open space and cultural resource in the region.
Objective: Support other management agencies and partners to identify opportunities for the preservation of agricultural lands along the river.
Management Agencies: FFSL, UDAF, and NRCS
Permitting Agencies: None
Intersecting Agencies: County, municipal, and tribal governments
Agriculture Goal 2: Discourage the establishment and transport of noxious and invasive weed species threatening both adjacent agricultural lands and the riparian ecosystem.
Objective: Provide outreach and education targeted to adjacent agricultural landowners regarding noxious and invasive weed species threatening riparian ecosystems and spreading to and from agricultural lands through canal systems and other irrigation infrastructure.
Objective: Work with adjacent landowners and other management agencies and partners to identify, map, and treat infestations of noxious weeds along the river, within adjacent riparian areas, and along canals and ditches.
Management Agencies: FFSL, BLM, NPS, and UDAF
Permitting Agencies: FFSL
Intersecting Agencies: County, municipal, and tribal governments and NRCS
Agriculture Goal 3: Support instream irrigation infrastructure that enhances or does not substantially impair the Public Trust.
Objective: Provide outreach and educational materials describing BMPs for pumps, fences, and other instream structures.
Objective: Work with adjacent landowners and other partners to identify and upgrade instream structures or agricultural infrastructure currently impacting navigation, recreation, water quality, fisheries and wildlife habitat, or aquatic beauty.
Objective: Work with adjacent landowners and other partners to identify and upgrade instream structures or agricultural infrastructure that are not water efficient.
Objective: Require the use of water-efficient agricultural infrastructure in new authorizations.
Management Agencies: FFSL, UDAF, NRCS, and conservation districts
Permitting Agencies: FFSL and DWRi
Intersecting Agencies: County, municipal, and tribal governments; DWR; and DWQ
Agriculture Goal 4: Support projects on adjacent agricultural lands that apply BMPs and conservation practices to reduce streambank erosion, improve water quality, and preserve or enhance wildlife habitat.
Objective: Work with private landowners and other management agencies to maintain, improve, or establish vegetated buffers, including riparian vegetative corridors, vegetated swales, or constructed wetlands to trap sediment, filter nutrients, and provide wildlife habitat.
Objective: Encourage the construction of off-stream watering systems that reduce streambank erosion, nutrient loading, and bacterial contamination while also reducing herd injuries and livestock health risks such as foot disease and injury.
Objective: Support targeted grazing practices to improve plant species composition of riparian areas.
Objective: Support responsible grazing techniques (e.g., provision of shade or supplemental feed in areas away from the river) to disperse livestock and reduce concentrations of livestock on the streambank.
Objective: Work with private landowners to remove any fencing currently impacting navigation, recreation, water quality, fisheries and wildlife habitat, or aquatic beauty.
Management Agencies: FFSL, DWQ, UDAF, and NRCS
Permitting Agencies: FFSL and DWRi
Intersecting Agencies: DWR

Best Management Practices

Use vegetation strips as barriers to prevent potential pollutants from running off into surface waters (conservation buffers).

Manage irrigation to increase efficiency and reduce non-point source pollution to surface waters.

Employ practices to conserve and reduce the amount of sediment reaching surface waters (e.g., planting vegetation strips, crop rotation, applied tillage practices, mulching).

Use various integrated weed management methods (e.g., physical control, chemical control, biological control) to treat weeds while protecting soil, water, and air quality. See Figure 3.2 (BMPs for Wildlife Species) for herbicide and pesticide BMPs.

Manage grazing to lessen the water quality impacts from livestock (e.g., off-channel watering systems).

Fences may extend riverward only to the water's edge or reasonably beyond to restrain livestock so as not to create a navigational hazard.

Agriculture infrastructure such as pump units and intake lines should have fish screens.

Figure 3.10. Best management practices for agriculture in the planning area.

Source: USU (2017).

Infrastructure

Infrastructure management goals and objectives generally seek to 1) minimize the impacts of new and existing infrastructure and 2) protect elements of the river system such as the river channel and its banks. Without proper design, installation, and maintenance, infrastructure can have negative effects on the Public Trust resources. The appropriate placement of infrastructure, proper infrastructure design and installation, and ongoing maintenance are a priority for FFSL to protect bank stability, fish and wildlife habitat, geomorphic processes, cultural resources, and adjacent land uses. Table 3.17 presents management goals and objectives for infrastructure that are common to all classes.

Table 3.17. Infrastructure Goals and Objectives Common to All Classes

Infrastructure Goal 1: Minimize the impact of new infrastructure.
Objective: Avoid creating new navigational hazards or negatively impacting other Public Trust resources with infrastructure development.
Objective: Promote the restoration of instream and adjacent habitat impacted during construction of new infrastructure.
Objective: Coordinate with DWQ to ensure compliance with Utah Water Quality Act regulations (Utah Administrative Code R317) and numeric criteria for pollutants of concern to protect beneficial uses.
Management Agencies: FFSL, BLM
Permitting Agencies: FFSL, DWRi, DWQ, BLM, and USACE
Intersecting Agencies: County, municipal, and tribal governments and DWR
Infrastructure Goal 2: Support efforts to minimize the impact of infrastructure removal.
Objective: Avoid impacts to adjacent habitats during infrastructure removal.
Objective: Restore habitat impacted during infrastructure removal, as per a revegetation or restoration plan.
Objective: Coordinate with DWQ to ensure compliance with Utah Water Quality Act regulations (Utah Administrative Code R317) and numeric criteria for pollutants of concern to protect beneficial uses.
Management Agencies: FFSL, DWQ, and BLM
Permitting Agencies: FFSL, DWRi, and BLM
Intersecting Agencies: County, municipal, and tribal governments
Infrastructure Goal 3: Support projects that apply bioengineering methods to address bank and channel stability as appropriate.
Objective: Replace impermeable and hardened surfaces where possible.
Objective: Use densely rooted, native plant material to protect banks and decrease excessive erosion or scour and incorporate appropriately placed and sized rocks to anchor bioengineering as needed.
Management Agencies: FFSL, BLM
Permitting Agencies: FFSL, DWRi, BLM, and USACE
Intersecting Agencies: NRCS

Infrastructure Goal 4: Support flood-control measures minimizing impacts to the bed and bank of the Colorado River and maintaining or enhancing floodplain connectivity.
Objective: Coordinate as necessary with local government and other management agencies during emergency or high flow events that require flood control.
Objective: Support restoration of habitat damaged during flood events with an emphasis on bank stabilization and re-vegetation with appropriate species.
Management Agencies: DSPR, DWRe, USACE, and FEMA
Permitting Agencies: FFSL, DWRi, USACE, and FEMA
Intersecting Agencies: County, municipal, and tribal governments and DWRe

Figure 3.11 illustrates the correct placement of infrastructure in and along the Colorado River.

Figure 3.12 provides a list of BMPs for the permitting, construction, and removal of infrastructure in the planning area.

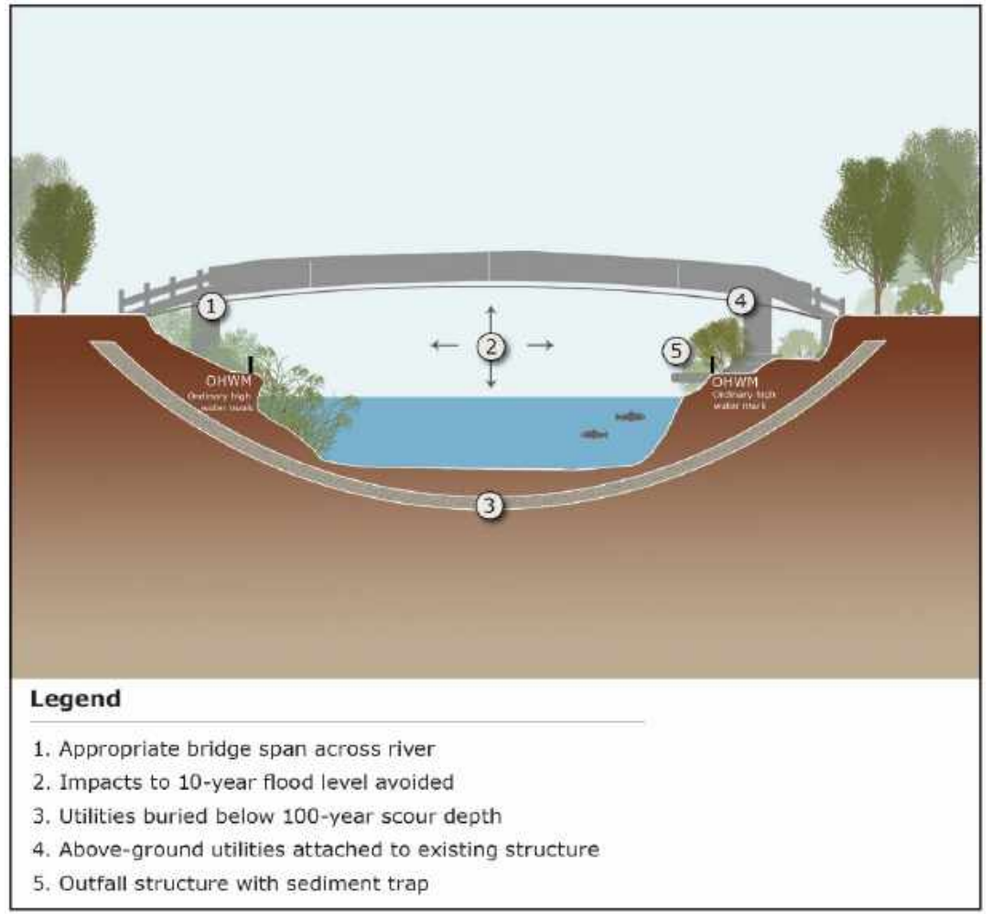

Figure 3.11. Correct placement of infrastructure in and along the Colorado River.

Best Management Practices

General

When removing existing bridges, above-grade utility crossings, outfall structures, and diversion dams, adhere to applicable CWA, stream alteration, and flood-control permits. These permits will require removal of the infrastructure without significantly or adversely affecting water quality and bank stability. Below-grade utility crossings should generally be abandoned in place after ensuring that pipes are plugged.

Habitat impacted during infrastructure removal should be restored during the same growing season as project implementation and seasonal conditions allow.

As unpermitted infrastructure is discovered on FFSL sovereign lands in the Colorado River corridor, owners should come into compliance through the permitting process or remove the infrastructure.

Bridges over the Colorado River.

Although no minimum spacing of infrastructure is stipulated, the proximity of one facility to another should be considered as part of the permitting process. In general, pedestrian bridges should not be authorized within 500 feet of one another unless there are safety concerns, e.g., a busy road. Proposals for new vehicle bridges should be accompanied by a transportation analysis demonstrating its need. Utilities can be clustered to minimize disturbance. New utilities crossing the river, including powerlines, where voltages permit, should be buried according to the below-grade utility BMPs discussed below. If above-ground utilities must be installed, they should be attached to existing infrastructure (as appropriate based on infrastructure owner and where voltages permit) and not placed on the bed of the channel.

New infrastructure should be located in areas to minimize impacts to fluvial or geomorphic processes.

Existing infrastructure impacting Public Trust resources should be considered for removal or moved to another area, where practicable.

Infrastructure should be designed or modified with BMPs to minimize fish entrapment.

Design and construction of new bridges

The clear span of bridges should cross the main channel without piers or other obstructions in the channel.

Bridges should not impact the 10-year (10% annual chance) flood flow depth, velocity, water surface elevation, and channel section.

Bridges should be located (if possible) on a straight channel segment and oriented perpendicular to the flow.

Bridges should provide enough freeboard above the 10-year flood flow event to allow for clear navigation.

Bridge underpasses should accommodate pedestrian travel, bicycle traffic, and wildlife passage where appropriate.

Locate bridges frequently enough to provide adequate access but not so frequently to affect riparian habitat and boater use.

Design and construction of new below-grade utilities

Below-grade utility crossings should be buried below the 100-year (1% annual chance) local scour depth plus the long-term scour (local and general scour), and below the typical dredge depth.

The depth should be maintained across the floodplain or beyond a public structure, which will protect the utility from exposure by bank erosion.

Design and construction of new outfall structures to the Colorado River

New outfall structures should provide for dissipation of excess energy prior to discharge to the river.

New outfall structures should have means for removal of settleable solids (e.g., sediment traps) prior to discharge.

New outfall structures should not impede navigation.

Design and construction of new proposed diversion dams and intake canals

Buried utility line along the Colorado River.

New diversion dams and canals should not impede navigation or passage of desirable fish species.

Proposed new dams should include a FEMA Conditional Letter of Map Revision, including mitigation of all adverse flooding impacts.

New diversion dams should contain structures to exclude fish and provide for dissipation of excess energy prior to flows entering the downstream river channel.

New diversion dams should have stable dam designs meeting all state dam safety requirements.

CWA and stream alteration permits should be obtained for new diversion dams.

Intake canals should be designed and installed to dissipate excess energy and erosion where water is diverted from the river.

Intake canal banks should be stable (preferably using bioengineering methods), thereby reducing contribution of sediment to the river.

Road construction or reconstruction below the OHWM on sovereign lands

Implement erosion- and sediment-control practices during project construction to protect water quality, such as silt fencing and straw wattles.

Implement dust control measures as needed.

Restore any vegetation or habitat damaged below the OHWM.

Figure 3.12. Best management practices for the permitting, construction, and removal of infrastructure in the planning area.

Cultural Resources

There is a higher likelihood of encountering intact historic and prehistoric cultural resources in river use classes with less development and fewer alterations. However, natural river meandering and other ongoing erosional processes can expose resources in almost any location or use class. Table 3.18 presents management goals and objectives for cultural resources that are common to all classes. Figure 3.13 provides a list of BMPs for cultural resources in the planning area.

Table 3.18. Cultural Resources Goals and Objectives Common to All Classes

Cultural Resources Goal 1: Recognize the importance of cultural resource protection on sovereign lands.
Objective: Collaborate with SHPO on the management of known cultural resources on Colorado River sovereign lands.
Objective: Consider how future projects using state funds would affect historic properties, according to Utah Code 9-8-404.
Objective: Adhere to Utah Code 9-9-401 through 9-9-406 regarding the discovery of human remains on sovereign lands.
Objective: Consider highlighting and developing protection strategies for cultural resources for public education and recreation purposes.
Objective: Develop and implement strategies to educate users about appropriate behaviors while observing and appreciating cultural resources.
Management Agencies: SHPO and tribal governments
Permitting Agencies: None
Intersecting Agencies: FFSL

Best Management Practices

For archaeological surveys, SHPO recommends resurveying areas if the previous survey is 10 or more years old, because the older survey may not use current inventory methods and requirements. For archaeological documentation, a full re-record is recommended when a previously documented site has significantly changed, when previous site forms have insufficient information, or if the current recorder or responsible agency feels a new record is necessary. When a previously documented site has associated records that are still acceptable, but minor changes or the fact that it has been recently visited/evaluated needs to be noted, an update is recommended as sufficient. New segments of linear features (e.g., canals, transmission lines, roads) that already have a Smithsonian Trinomial (a unique identifier assigned to an archaeological site) should be recorded under this category, but not in an abbreviated manner (Interagency Heritage Resources Work Group 2018).

Under Utah Code 9-8-307, "any person who discovers any archaeological resources on lands owned or controlled by the state or its subdivisions shall promptly report the discovery to the division." In addition, "any person who discovers any archaeological resources on privately owned lands shall promptly report the discovery to the division [Utah Division of State History]."

Before issuing any permits for projects adjacent to, over, or in the Colorado River, FFSL should notify SHPO before a project starts and before a permit is issued. Project notification will also allow FFSL to informally consult with SHPO on how to best complete FFSL's legal responsibilities regarding cultural resources. Treatment of unanticipated discoveries (i.e., cultural resources unexpectedly found during a project) in and along the Colorado River should be discussed during initial consultations to create a plan if these occur. For any Native American consultations, FFSL should follow the Utah Department of Natural Resources consultation plan created per the executive order issued by Governor Herbert on July 30, 2014.

It is illegal to damage, remove, or deface cultural resources.

Figure 3.13. Best management practices for cultural resources in the planning area.

Recreation

Public recreation is one of the components of the Public Trust FFSL is mandated to protect. The management goals and objectives for recreation seek to enhance and provide safe recreation experiences. The CRCMP does not intend to limit recreation but in some cases does support limited use in areas of high user conflict or certain areas of high wildlife habitat value. Table 3.19 presents management goals and objectives for recreation that are common to all classes. Figure 3.14 provides a list of BMPs for recreation in the planning area.

Table 3.19. Recreation Goals and Objectives Common to All Classes

Recreation Goal 1: Balance recreation needs, development, and protection of the natural environment.
Objective: Support the identification and development of areas where recreation infrastructure is most needed and is also appropriate, while reducing impacts to the natural environment and wildlife habitats.
Objective: Minimize the impacts of recreation infrastructure on the river environment and on existing and potential development (e.g., utility corridors) through authorization conditions.
Objective: Limit recreation, if needed, to protect sensitive areas or wildlife.
Objective: During the authorization process, ensure new development does not inhibit or negatively affect existing recreation or prevent future recreation infrastructure and access.
Objective: Coordinate with agencies, boating groups, and partners to make river stewardship materials available to recreation users (perhaps as part of river etiquette materials) (see Figure 3.18).
Management Agencies: FFSL, DSPR, BLM
Permitting Agencies: FFSL, DSPR, DWRi, USACE, USFWS, and BLM
Intersecting Agencies: County, municipal, and tribal governments; DWR; DWRe; and NPS
Recreation Goal 2: Reduce recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment.
Objective: Develop and implement a recreation resource management plan to provide specific solutions and management actions for recreation conflicts and crowding.
Objective: No authorizations will be issued for new commercial jet boat or other commercial motorized operations until a recreation resource management plan is complete.
Objective: No expansion of existing commercial jet boat or commercial motorized operations will be approved until a recreation resource management plan is complete.
Objective: Support state and local law enforcement efforts to minimize boater speeding and enforce wake rules.
Objective: Coordinate with agencies, boating groups, and partners to widely disseminate river etiquette materials (see Figure 3.18).
Objective: Consider limiting or prohibiting new recreation authorizations in areas of high recreation conflict.
Objective: Consider adding new restrictions or limitations to existing recreation authorizations to reduce user conflicts.
Objective: Coordinate with the BLM to ensure consistency in recreation permitting.
Management Agencies: FFSL, DSPR, BLM
Permitting Agencies: FFSL, DSPR, and BLM
Intersecting Agencies: County, municipal, and tribal governments; state and local law enforcement; and NPS
Recreation Goal 3: Encourage recreational opportunities in and along the Colorado River where appropriate and allow for a variety of recreation interests.
Objective: Coordinate with cities, counties, agencies, and partners to improve existing recreation infrastructure and to add recreation infrastructure where needed (e.g., boater access points, fishing platforms).
Objective: Coordinate with management partners to develop, disseminate, and update recreation information (e.g., brochures, website, and signage) when changes occur or as needed.
Objective: Coordinate with agencies, boating groups, and partners to develop stewardship and river etiquette materials and disseminate them widely.
Management Agencies: FFSL, DSPR, BLM
Permitting Agencies: FFSL and BLM
Intersecting Agencies: County, municipal, and tribal governments
Recreation Goal 4: Support development and maintenance of recreation infrastructure.
Objective: Support the improvement or removal of recreation infrastructure that is dysfunctional, obsolete, or incompatible with other uses or river classes as opportunities allow.
Objective: Limit new bridges and dams to protect aesthetic beauty, minimize navigational hazards, and promote a positive experience for recreationists on the river.
Management Agencies: FFSL and DSPR
Permitting Agencies: FFSL, BLM, and USFWS
Intersecting Agencies: County, municipal, and tribal governments and DWR
Recreation Goal 5: Integrate recreation and restoration opportunities in and along the river as appropriate.
Objective: Consider recreational navigation of the river when designing restoration projects.
Objective: Evaluate recreation authorization applications to determine if there are opportunities for restoration.
Management Agencies: FFSL and BLM
Permitting Agencies: FFSL, DWRi, and USACE
Intersecting Agencies: County, municipal, and tribal governments; DWR; DSPR; DWRe; and USFWS

Best Management Practices

Develop boater access points and portages with safe, flexible, and functional designs to meet user needs at different flow levels of the river and to accommodate boating parties of varying sizes and skill levels.

Use a sloping riverbank boat access design for boater access points, which allows for variable stream flows and stream levels, is easy to maintain, is inexpensive, and does not trap river debris. Concrete sloping ramps are preferred.

Locate bridges and boater access points in areas that already have human impacts and are easily visible from both the river and shore.

Consider the proximity of one facility to another as part of the authorization process, even though no minimum spacing is stipulated for recreation infrastructure such as boater access points.

Modify as needed structural water-conveyance devices with alternatives that allow for recreation improvements.

Ensure that recreation infrastructure protects as much native and sensitive habitat as feasible; enhance developed areas as needed with additional planting of native vegetation.

Avoid sensitive environments and encourage new recreation infrastructure construction in previously disturbed areas.

Choose recreation infrastructure that maintains river function and wildlife habitat, and that is sustainable and has a low environmental impact.

Ensure recreation infrastructure accounts for flooding.

Install trash and recycling receptacles near recreation infrastructure and at other places where users approach the river.

Consider installing restrooms near high-use recreation infrastructure.

Avoid creating barriers to wildlife movement with new recreation infrastructure.

Use NPS's design guide for canoe and kayak launches (NPS 2004), NPS's guidelines for designing and building access sites for carry-in watercraft (NPS and River Management Society 2018), or other relevant guidance as an information source for boat launch specifications and signage. Decision-making should account for local conditions.

Consider the preferred concept for boater access points, which includes associated parking with room for boat trailers, safe access to a concrete ramp such as wood stairs or gentle slopes, retention of structures along the ramp to protect banks, appropriate ramp slopes for boat launching and/or take-out, planting of vegetation to protect banks and provide aesthetic beauty, a nearby area for restrooms and waste bins, and convenient access to trail systems.

Refer to Figure 3.18 for suggested stewardship and river etiquette in the planning area.

Figure 3.14. Best management practices for recreation in the planning area.

Access

Management goals and objectives generally seek to facilitate safe access while protecting private landowners' rights adjacent to the river. Ensuring proper spacing of access points and minimizing impacts resulting from limited access (e.g., highly concentrated use, user conflicts, and habitat degradation) are a priority for FFSL. In support of public safety, private landowner access in the form of trails, boat docks, boat ramps, etc., are generally not permitted. Table 3.20 presents management goals and objectives for access that are common to all classes. Figure 3.15 provides a list of BMPs for access in the planning area.

Table 3.20. Access Goals and Objectives Common to All Classes

Access Goal 1: Balance needs for access with river protection.
Objective: Evaluate access points in an area before approving new access as part of an authorization application process.
Objective: Support development of new access points and associated amenities such as trash and recycling receptacles where appropriate through coordination with cities, counties, agencies, and partners.
Objective: Minimize the impacts of new access points on the river environment and Public Trust resources through appropriate design and siting during the authorization application process.
Objective: Work with cities, counties, and communities to identify the most appropriate locations for new access facilities and encourage the sharing of access points to minimize new infrastructure (e.g., bridges).
Management Agencies: FFSL, DSPR, DWR, DWQ, and BLM
Permitting Agencies: FFSL, DWRi, BLM, and USACE
Intersecting Agencies: County, municipal, and tribal governments

Access Goal 2: Ensure that new development does not unnecessarily impede access through the authorization process.
Objective: Evaluate authorization applications to confirm that projects do not limit, conflict with, or prevent current or future access (e.g., a low-clearance bridge may stop boaters, and construction of an outfall structure could prevent access for flood control).
Objective: Support siting new river access points in areas connecting to trails, campgrounds, and other recreation opportunities.
Management Agencies: FFSL, BLM
Permitting Agencies: FFSL, DWRi, BLM, and USACE
Intersecting Agencies: County, municipal, and tribal governments
Access Goal 3: Where possible, remove obstacles limiting or preventing access.
Objective: Improve navigation on the river through removal of navigational hazards.
Objective: Work to mitigate nonnative species that may impede river access (e.g., Russian olive, Russian knapweed, tamarisk).
Objective: Support the decommissioning of bridges and boater access points located in low-value areas or that are poorly designed.
Management Agencies: FFSL, DSPR, and DWR
Permitting Agencies: FFSL
Intersecting Agencies: County, municipal, and tribal governments

Best Management Practices

Develop boater access points and portages with safe, flexible, and functional designs to meet user needs at different flow levels of the river and to accommodate boating parties of varying sizes and skill levels.

Use a sloping riverbank boat access design for boater access points, which allows for variable stream flows and stream levels, is easy to maintain, is inexpensive, and does not trap river debris. Concrete sloping ramps are preferred.

Locate bridges and boater access points in areas that already have human impacts and are easily visible from both the river and shore.

Consider the proximity of one facility to another as part of the authorization application process, even though no minimum spacing is stipulated for recreation infrastructure such as boater access points.

Maintain or improve aesthetic beauty when designing new recreation facilities.

Support adherence to Americans with Disability Act accessibility guidelines in project designs.

Access information at the Potash boater access point

Modify as needed structural water-conveyance devices with alternatives that allow for recreation improvements.

Manage invasive and nuisance species through the authorization process where possible.

Within permits, require restoration of vertical riverbanks to a gentle relief using laying back dredge berms or levees where possible to reduce erosion and improve public access and safety.

To allow passage of boats, ensure that the clear span of new bridges crosses the main channel without piers or other obstructions in the channel.

Use NPS's design guide for canoe and kayak launches (NPS 2004), NPS's guidelines for designing and building access sites for carry-in watercraft (NPS and River Management Society 2018), or other relevant guidance as an information source for boat launch specifications and signage. Decision-making should account for local conditions.

Consider conflicting access uses when developing access points (e.g., boater access should consider nearby recreational fishing).

Work with local general plans, planning organizations, and stakeholders in the site selection of new utility facilities; avoid siting utilities in areas with flood.

Share rights-of-way with other utilities such as roads, canals, and railroads; use land adjacent to other infrastructure to minimize access points.

Refer to Figure 3.18 for suggested stewardship and river etiquette in the planning area.

Figure 3.15. Best management practices for access in the planning area.

Public Safety

Table 3.21 presents management goals and objectives for public safety that are common to all classes. Figure 3.16 provides a list of BMPs for public safety in the planning area.

Table 3.21. Public Safety Goals and Objectives Common to All Classes

Public Safety Goal 1: Improve boater safety by addressing navigational hazards.
Objective: Support removal of temporary navigational hazards such as garbage or large woody debris (if a significant hazard).
Objective: Mitigate permanent navigational hazards when possible or incorporate them into restoration projects in ways that allow for avoidance.
Objective: Support removal of abandoned fencing material and agricultural equipment from the river.
Management Agencies: FFSL, DSPR, and DWR
Permitting Agencies: FFSL and DWRi
Intersecting Agencies: County, municipal, and tribal governments
Public Safety Goal 2: Evaluate new authorization applications with public safety in mind and require any needed public safety measures (e.g., for navigation, fire prevention, or traffic control).
Objective: Review new infrastructure design to reduce the potential for navigational hazards (e.g., water flow can expose buried pipes, bridge height can affect boater clearance) or other public safety concerns.
Objective: Include specific public safety measures in authorizations where appropriate.
Management Agencies: FFSL and DSPR
Permitting Agencies: FFSL
Intersecting Agencies: County, municipal, and tribal governments; state and local law enforcement
Public Safety Goal 3: Address safety issues in the planning area.
Objective: Support state and local law enforcement efforts to minimize boater speeding and enforce wake rules.
Objective: Improve boater and recreation user safety by promoting safe boating practices, including appropriate safety equipment, in conjunction with DSPR.
Objective: Identify ways to reduce overcrowding in small sections of the river or at boater access points (e.g., promote the use of other river areas, encourage use on days with lower levels of recreation, encourage use at less popular times of day).
Objective: Partner with federal, state, and local agencies (e.g., DSPR, BLM, law enforcement) to address safety issues such as boat speed, fire, and flood. Consider jointly funding additional safety and enforcement personnel with other management agencies.
Objective: Develop and implement a recreation management plan to reduce recreation conflicts and improve public safety.
Objective: Support crime prevention and enforcement/patrolling by coordinating with other entities providing such services.
Objective: To ensure safe water quality, coordinate with DWQ to ensure compliance with Utah Water Quality Act regulations (Utah Administrative Code R317).
Management Agencies: FFSL, DSPR, and BLM
Permitting Agencies: FFSL, BLM, and DWQ
Intersection Agencies: County, municipal, and tribal governments; state and local law enforcement

Best Management Practices

Educate river users on safe boating practices (e.g., Utah Boating Act regulations, BLM requirements for boaters).

Carefully consider new infrastructure design to maintain enough clearance for boaters, and ensure maximum space for natural river movement (e.g., bridges can be constriction points and may cause flood control issues).

Within permit conditions, require restoration of vertical riverbanks to a gentler relief using laying back dredge berms or levees where possible. These measures will help reduce erosion and improve public access and safety. Refer to *Riparian Buffer Design Guidelines for Water Quality and Wildlife Habitat Functions on Agricultural Landscapes in the Intermountain West* (Johnson and Buffler 2008).

Locate boater access points in river eddies of sufficient size to accommodate several boats to protect the boaters and ramps from the river current and reduce erosion. Avoid steep slopes.

Use NPS's design guide for canoe and kayak launches (NPS 2004), NPS's guidelines for designing and building access sites for carry-in watercraft (NPS and River Management Society 2018), other agency design standards, and other relevant planning documents as guidance for safe boater access points and consider appropriate signage. Decision-making should account for local conditions.

Design surface trail infrastructure (e.g., bridges) in the planning area with appropriate passing widths. Limit or eliminate blind corners.

Educate adjacent landowners on defensible space measures to protect against fire.

Incorporate bioengineering methods to stabilize shorelines (and protect vegetation) for sheltering boater access points.

Contact the local health department to report flooding and other public health concerns. Direct other public safety concerns to local police departments.

Refer to Figure 3.18 for suggested stewardship and river etiquette in the planning area.

Figure 3.16. Best management practices for public safety in the planning area.

Education

Goals and objectives generally seek to support and expand educational programs and information about FFSL's role and jurisdiction and the value of the Colorado River. During the public involvement process, commenters also identified a need to educate river users about proper river etiquette, private property, and boating regulations. Table 3.22 presents management goals and objectives for education. Figure 3.17 provides a list of BMPs for education in the planning area.

Table 3.22. Education Goals and Objectives Common to All Classes

Education Goal 1: Support education about the importance of the Colorado River and the need to conserve it as a healthy, functioning ecosystem.
Objective: Support development of information and public awareness programs for adjacent landowners and authorization applicants on the importance of a healthy river ecosystem and how to reduce impacts to the river.
Objective: Support partnerships, research programs, and school education programs in the planning area; integrate research results into management and planning.
Management Agencies: FFSL, DSPR, BLM, NPS, and DWR
Permitting Agencies: FFSL and BLM
Intersecting Agencies: County, municipal, and tribal governments; UDAF; and NRCS
Education Goal 2: Expand informational material regarding FFSL's role in management, jurisdiction, and application of multiple-use management strategies of the Colorado River.
Objective: Provide potential applicants with a clear authorization application process through the FFSL website and other media.
Objective: Provide potential applicants with a clear understanding of FFSL's role in the management and jurisdiction of the Colorado River through the FFSL website and other media.
Management Agencies: FFSL
Permitting Agencies: FFSL
Intersecting Agencies: County, municipal, and tribal governments; DSPR; DWRi; DWQ; and BLM
Education Goal 3: Develop and provide information to river users on proper stewardship and river etiquette.
Objective: Coordinate with agencies, boating groups, and stakeholders to develop stewardship and river etiquette materials and disseminate them widely (see Figure 3.18).
Objective: Coordinate with agencies responsible for prevention and enforcement to ensure their familiarity with the materials and to assist with education efforts.
Management Agencies: FFSL, DSPR, BLM, and DWR
Permitting Agencies: FFSL and BLM
Intersecting Agencies: County, municipal, and tribal governments; UDAF; NRCS; and SHPO

Education Goal 4: Be informed about ongoing research efforts on the Colorado River.

Objective: Incorporate data and conclusions from ongoing research into management decisions.

Management Agencies: DWRe, DWR, UGS, UDAF, BLM, NPS, USFWS, USBR, other state and federal agencies, and private and collaborative groups

Permitting Agencies: FFSL

Intersecting Agencies: County, municipal, and tribal governments; Upper Colorado River Commission; Colorado Basin Salinity Control Forum and Council; Upper Colorado River Endangered Fish Recovery Program; and Glen Canyon Dam Adaptive Management Work Group

BEST MANAGEMENT PRACTICES

Coordinate with other agencies, universities, and conservation organizations to establish partnerships to meet education and research goals and objectives.

Regularly identify any research needs that could result in better management of the planning area.

Refer to Figure 3.18 for suggested stewardship and river etiquette in the planning area.

Educational signage along the Colorado River.

Figure 3.17. Best management practices for education in the planning area.

Figure 3.18 provides suggested stewardship and river etiquette in the planning area. These guidelines are suggestions only to help ensure a positive and safe river experience and to help protect the river ecosystem; they are not enforceable rules or requirements. They are compiled primarily from BLM guidelines for Idaho rivers (BLM 2014), USFS guidelines for the Snake River (USFS 2019), and *Highlights from Utah's Boating Laws & Rules* (DSPR 2015).

SUGGESTED STEWARDSHIP AND RIVER ETIQUETTE

Your actions directly affect the experience of others on the river. The following guidelines can help ensure a positive and safe river experience for everyone, while helping to protect the river ecosystem.

Boaters preparing for a trip out of the way of the boat ramp.

General protocol

Read the river guidebooks, permit guidelines (if one is required), and appropriate agency publications before you go.

Always respect the privacy and rights of private landowners. Do *not* assume you can get out anywhere along the river; know the boundaries of the public lands. Some land above the OHWM is private property and should be avoided unless you have permission from the landowners.

Pack out all trash and dispose of it or recycle it in appropriate receptacles. Do not dump it into the water or on adjacent land.

Do not feed, disturb, or harass wildlife. Do not trample vegetation or biological soil crusts. Do not pollute the water.

Be friendly, helpful, and considerate. Avoid confrontational behavior.

Be respectful of those around you. Keep voices, music, and other noise at low levels.

If you bring a dog, keep it under control and respect others. Clean up all dog waste and pack it out.

Respect paleontological, cultural, and archaeological sites. Do not disturb these sites. It is illegal to damage, remove, or deface such sites. Do not touch petroglyphs or pictographs.

Graffiti is absolutely prohibited (this includes graffiti on adjacent private property; carving on rocks, rock walls, or trees; and graffiti on pictographs and petroglyphs).

Don't touch agricultural equipment (e.g., pumps) in the river or on the banks of the river. Give it a wide berth.

Know your limits. Be aware of dangerous situations and avoid taking excessive risks.

Boat ramp manners

If the ramp is busy, be patient and wait your turn.

Use the ramp only for loading and unloading from boats from a vehicle or trailer. Complete your launch quickly.

Pack or unpack your boat to the side of the launch area. After your trip, clean your boat to the side of the launch area.

Allow others to go first if they have a loaded boat in the water and are ready to take off.

Once your boat is in the water, move it out of the way so that others can launch behind you.

Do not block a ramp with an unattended boat or vehicle.

River encounters

Communication and common sense are the key to successful interaction with other river users.

Give other boaters a lot of space, especially in rapids.

As a general rule, boats moving downstream have the right-of-way. However, they must not intentionally block navigation. Boats moving upstream through rapids should eddy out when possible and let the downstream craft pass. In addition, Utah's State Boating Act indicates that boaters in less maneuverable craft generally have the right-of-way (motorized boats are considered the most maneuverable). However, a motorized boat powering through a rapid may not be able to stop. An exception to these rules is when a boat has either committed to or entered a rapid from upstream or downstream. In this situation, all other craft should wait until the motorized boat is clear before proceeding.

Non-motorized boats should be aware that motorized boats can only travel in narrow channels in some sections of the river. When you see a motorized boat coming, pull to one side of the channel if possible and let it by.

Jet boats draw less water at higher speeds when the boat is on plane; they can't always slow down due to shallow water. Non-motorized boats should give the jet boat the deep channel if you have the choice.

Motorized boats should slow to no wake as they pass other boats and at boater access points.

Yield on the river where appropriate. If other parties are going faster, allow them to pass. If you are going faster than another party, group your boats together before passing.

Avoid making heavy waves or wakes. Utah's State Boating Act requires wakeless speed within 150 feet of another boat, a swimmer, water skiers, a shore fisherman, a designated swimming area, and boat launches and docks. Boaters who improperly create a wake may be cited with a Class C misdemeanor.

Avoid confrontational behavior.

Use caution when navigating narrow river channels to prevent collision with other boaters and wading anglers.

If you encounter anglers, give them plenty of space. They have a need for space and quiet.

Watch for swimmers and give them plenty of room.

Be cautious if anchoring. Drop anchor only in eddies and slower water. Keep a knife handy and be ready to sacrifice your anchor if necessary.

Camping

Small groups should leave large camps for bigger groups.

Sending a boat ahead to secure a camp is discouraged.

Follow applicable regulations for group size, disposal of human waste, the use of fire and firewood, and dishwashing.

Tread lightly: use low-impact camping and hiking practices. Stay on main trails and disturbed areas. Avoid fragile soils such as biological soil crusts.

Follow all permit conditions.

Figure 3.18. Suggested stewardship and river etiquette in the planning area.

3.6 Coordination Framework

Multiple cities, counties, and state and federal agencies are involved in management and permitting in the planning area. Although FFSL has management jurisdiction from top of bank to top of bank, we are responsible for considering the protection of navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality in keeping with the Public Trust. Because of this, FFSL has an interest in improving coordination with other agencies and Colorado River partners with respect to management, permitting, and research. Permitting new activities can have important implications on the management of the Colorado River. Research can inform and improve Colorado River management objectives and actions. Currently there is a need for more frequent coordination between and within these spheres. Table 3.23 lists the primary roles of state, federal, and other regulatory and coordinating bodies in permitting, management, and research on the Colorado River.

Table 3.23. Primary Roles of State, Federal, and other Regulatory and Coordinating Bodies in Permitting, Management, and Research on the Colorado River

Agency		Permitting and Compliance	Management	Research
Utah Department of Natural Resources	FFSL	X	X	X
	DOGM	X	X	
	DSPR	X	X	
	DWR	X	X	X
	DWRe		X	X
	DWRi	X		
	UGS	X		X
Other state agencies	DWQ	X	X	X
	SHPO	X	X	X
	SITLA	X	X	
	UDAF		X	X
	UDOT		X	
Federal agencies	BLM	X	X	X
	DOE		X	
	EPA		X	
	FEMA		X	X
	FERC	X	X	X
	NPS	X	X	X
	NRCS		X	X
	USACE	X		
	USBR	X	X	X
	USFWS	X	X	X
Tribal	Navajo Nation		X	
	Ute Mountain Ute Tribe		X	
Local government	Garfield County		X	
	Grand County		X	X
	Kane County		X	
	San Juan County		X	
	Municipalities		X	
Collaborative management groups	Colorado River Basin Salinity Control Forum and Council		X	X
	Glen Canyon Dam Adaptive Management Work Group		X	X
	Upper Colorado River Commission		X	X
	Upper Colorado River Endangered Fish Recovery Program		X	X

Broader geographic coordination is also required in management and permitting for the planning area. As described in Chapter 1, in addition to the Colorado River, FFSL has jurisdiction over the Green River, which flows into the Colorado River. In some cases, management activities, e.g., weed management, should be implemented at a scale that extends beyond the Colorado River and that includes coordination and support for activities on tributaries and adjacent lands.

Permitting

As illustrated in Chapter 1, Figure 1.2, multiple entities have jurisdiction over the Colorado River and its immediate environs. Each entity currently requires a different permit, in part because each focuses on a different aspect of river management, e.g., DWRi (water rights) and USACE (placement of fill below the OHWM).

Research and Management Implementation

The Utah State University Center for Colorado River Studies has goals of developing new tools and approaches to consider river-ecosystem outcomes of water supply decisions and evaluating a range of water supply management approaches. Their website lists recently published research, news, educational materials, links to partners, and provides educational materials. The collaborative management groups listed in Table 3.23 and organizations such as the Southeast Utah Riparian Partnership also have websites, with access to research and management strategies. Ongoing coordination of Colorado River research and its management implications is necessary for the success of projects such as noxious and invasive weeds management, restoration, and bank stabilization.

Recent research on the Colorado River ranges from topics such as flow regimes to endangered fish to climate change, and is implemented by academic researchers, state agencies, local governments, and stakeholder groups. Much of this research has practical application and may inform future management to improve water quality and fish and wildlife habitat conditions, among other aspects of the Public Trust. For large projects, partnerships are needed, with different actors taking on roles as champion, planner, funder, and implementer. Although the CRCMP does not prioritize specific projects, FFSL supports projects that produce information and data that can help manage and improve the conditions of the Public Trust resources: navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality.

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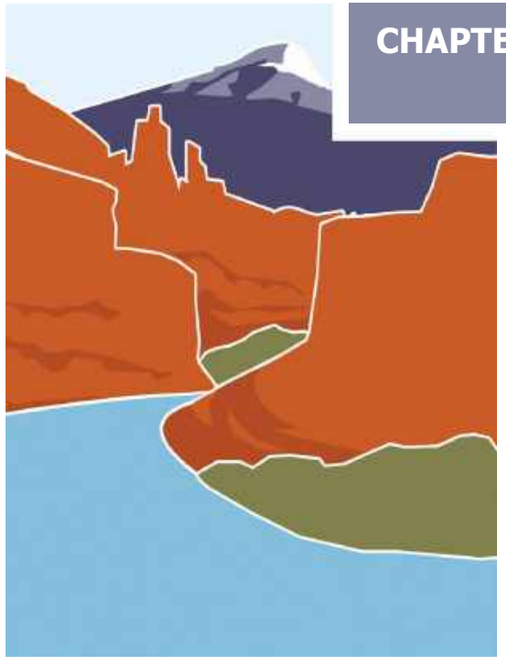

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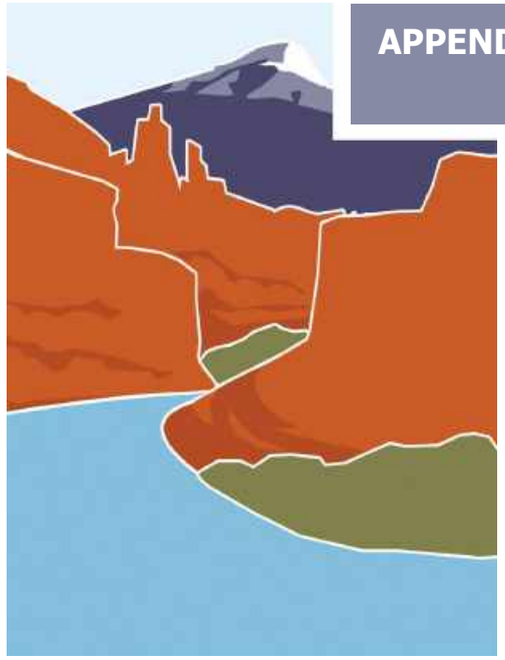

APPENDIX A – PUBLIC INVOLVEMENT AND PUBLIC COMMENTS

A.1 Public Involvement

The public outreach process for the 2020 *Colorado River Comprehensive Management Plan* (CRCMP) was structured to capture input and comments from five groups: 1) counties, 2) the general public, 3) federal agencies, 4) tribes, and 5) specific stakeholder groups. A summary of the outreach process for each group and comment themes and issues is presented below.

Public involvement for the CRCMP was combined with that of the *Green River Comprehensive Management Plan* (SWCA et al. 2020), which was developed concurrently. This summary focuses on those elements most applicable to the CRCMP.

Public Outreach Process

Counties

Because county governments often manage property up to the boundary of sovereign lands or apply zoning to these properties, the Utah Division of Forestry, Fire & State Lands (FFSL) made direct contact with county-elected officials and planning staff by email and telephone to present the rationale for the CRCMP and answer any questions about the process. Commissioners were invited to the public open houses described below. In addition, a meeting was scheduled with the county commissioners in each county. These meetings occurred in Kanab (Kane County), Panguitch (Garfield County), Monticello (San Juan County), and Moab (Grand County) on the same day as each public open house meeting.

General Public

Adjacent landowners, current lessees, the general public, key stakeholders, special interest groups, 501(c) and nonprofit organizations, counties, municipalities, and other interested government agencies all had the opportunity to attend public open houses during the kickoff and information-gathering phase of public involvement (public open house series #1) and after the publication of the draft CRCMP (public open house series #2).

PUBLIC OPEN HOUSE SERIES #1: KICKOFF AND INFORMATION-GATHERING

The first general public outreach event comprised open house meetings held during the information-gathering phase of the plan. The purposes of the public open houses were to describe and explain the CRCMP process, identify any available local information on river resources, and collect input on Colorado River issues and concerns. Feedback from the public open houses was used to frame the CRCMP's discussion of current conditions, identify issues requiring better management, and develop management goals and objectives. Five individual public open houses were held, one in each of the counties through which the river flows and one in Salt Lake City.

PUBLIC OPEN HOUSE: KANE COUNTY

Date and Time: Tuesday, April 10, 2018; 6:00 p.m. to 8:00 p.m.
Location: Kanab City Library in Kanab
Attendance: three individuals signed in to this meeting.

PUBLIC OPEN HOUSE: GARFIELD COUNTY

Date and Time: Wednesday, April 11, 2018; 6:00 p.m. to 8:00 p.m.
Location: Escalante Senior Center in Escalante
Attendance: two individuals signed in to this meeting.

PUBLIC OPEN HOUSE: SAN JUAN COUNTY

Date and Time: Tuesday, April 17, 2018; 6:00 p.m. to 8:00 p.m.
Location: San Juan County Administration Building in Monticello
Attendance: one individual signed in to this meeting.

PUBLIC OPEN HOUSE: GRAND COUNTY

Date and Time: Wednesday, April 18, 2018; 6:00 p.m. to 8:00 p.m.
Location: Grand County High School in Moab
Attendance: 18 individuals signed in to this meeting.

PUBLIC OPEN HOUSE: SALT LAKE CITY

Date and Time: Tuesday, May 22, 2018; 5:00 p.m. to 7:00 p.m.
Location: Department of Natural Resources Library in Salt Lake City, Utah
Attendance: four individuals signed in to this meeting.

An open house format was used for each meeting, with participants allowed to attend anytime during the meeting. A welcome table was set up to greet visitors, help them understand the purpose of the open house, and provide a mailing and/or email list for future notifications. During each open house, FFSL presented a slideshow that provided an overview of the planning process and outcome.

Materials at each open house included explanatory brochures, business cards with the CRCMP project website, large-format project overview boards on easels with key information, and large-format aerial maps showing the planning area. Participants were asked to provide written comments and input on a comment form, on the aerial maps, on some of the project overview boards, by letter, or by email. In addition, participants were given the option of leaving site-specific comments on an online comment map accessed through the project website (http://bit.ly/gcrcmp). The comment map allowed participants to drop a colored pin (green for ecosystem resources, blue for water resources, and orange for community resources) at a particular river location with an attached comment. Verbal comments from discussions at the public open houses were also noted.

PUBLIC OPEN HOUSE SERIES #2: DRAFT PLAN REVIEW

The second general public outreach event comprised open house meetings held after the publication of the draft CRCMP. The purposes of the meetings were to present the draft CRCMP and to provide information on how to comment. Four individual public open houses were held, one in each of the counties through which the river flows.

PUBLIC OPEN HOUSE: GARFIELD COUNTY

Date and Time: Tuesday, June 18, 2019; 5:00 p.m. to 7:00 p.m.
Location: Escalante Senior Center in Escalante
Attendance: 0 individual signed in to this meeting.

PUBLIC OPEN HOUSE: KANE COUNTY

Date and Time: Wednesday, June 19, 2019; 5:00 p.m. to 7:00 p.m.
Location: Kanab City Library in Kanab
Attendance: 5 individuals signed in to this meeting.

PUBLIC OPEN HOUSE: SAN JUAN COUNTY

Date and Time: Monday, June 24, 2019; 5:00 p.m. to 7:00 p.m.
Location: San Juan County Administration Building in Monticello
Attendance: 3 individuals signed in to this meeting.

PUBLIC OPEN HOUSE: GRAND COUNTY

Date and Time: Tuesday, June 25, 2019; 5:00 p.m. to 7:00 p.m.
Location: Grand Center in Moab
Attendance: 26 individuals signed in to this meeting.

The same open house format was used for public open house series #2. During each open house, FFSL presented a slideshow that provided an overview of the draft CRCMP and information about how to submit comments.

Materials at each open house included explanatory brochures, business cards with the CRCMP project website, and large-format project overview boards on easels with key information. Participants were asked to provide written comments and input on the draft CRCMP on a comment form, by letter, or by email. In addition, participants were given the option of leaving site-specific or plan-specific comments on the online comment map accessed through the project website. The comment map allowed participants to drop colored pins at a particular river location with an attached comment. It also provided a form to submit a plan-specific comment. Verbal comments from discussions at the public open houses were also noted.

Federal Agencies

Federal agencies manage property adjacent to the boundary of sovereign lands and may have overlapping jurisdiction with FFSL. FFSL made direct contact with federal agencies such as the U.S. Bureau of Land Management, U.S. National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Department of Energy, and the Office of Sen. Mike Lee through email to present an overview of the CRCMP process and invite staff to all of the public open houses. In addition, a working meeting was scheduled with federal agencies to allow for one-on-one discussions of agency-specific issues and concerns. The working meeting occurred in Moab (Grand County) on June 27, 2018, from 1:00 to 3:00 p.m.; six individuals signed in to the meeting. A second meeting was scheduled after the publication of the draft CRCMP to collect feedback on the plan. This meeting occurred in Moab on June 25, 2019, from 3:00 to 4:00 p.m.; 11 individuals signed in to the meeting.

Tribes

Because the Navajo Nation and the Ute Mountain Ute Tribe are considered adjacent landowners or stakeholders in the CRCMP process, FFSL reached out to tribal officials through email and by phone to explain the CRCMP process and invite tribal members to attend any of the public open houses. In addition, FFSL presented a slideshow that provided an overview of the CRCMP planning process and outcome on August 10, 2018, at the Utah Tribal Leaders meeting in Salt Lake City. After publication of the draft CRCMP, FFSL presented an overview of the draft plan and information on how to submit comments at a Utah Tribal Leaders meeting in Cedar City, Utah, on June 6, 2019.

Stakeholder Groups

All stakeholders interested in the Colorado River were invited to attend the public open houses in each county. In addition, a stakeholder workshop was scheduled to obtain more detailed information on management concerns and goals from the following stakeholder groups: recreation, agriculture/irrigation, environmental, and mineral/energy. Directed questions were prepared to use in small groups for guided discussion during the workshop; however, attendees preferred a more free-flowing conversation. The stakeholder workshop was held on June 27, 2018, in Moab from 5:00 to 7:00 p.m.; 22 attendees signed into the workshop (15 people representing recreation, one person representing agriculture/irrigation, one person representing environmental, and five persons not affiliated with a specific stakeholder group). An additional stakeholder meeting was held after the publication of the draft CRCMP on June 25, 2019, in Moab from 7:00 to 8:00 p.m. This meeting directly followed the public open house and included several of the attendees from the open house.

Public Outreach Process Comment Themes and Issues

Several letters and emails, multiple verbal comments, and multiple online comment map comments were received during the public outreach process (this does not include comments submitted during the formal public comment period and the second public open house series on the draft CRCMP, which are discussed below in Section A.2.). The input from all public outreach groups is summarized below by resource category.

Ecosystem Resources:

- Concerns about noxious weeds (e.g., tamarisk, knapweed, Russian olive) and poison ivy, and questions about how to get assistance for weed treatment
- Concerns about bank erosion, especially the potential for motorized boats to cause bank erosion
- Need for streambank restoration and bank stabilization in some areas; questions about how to coordinate these activities on private land adjacent to the river
- Need to ensure sufficient water flows for fish species
- Questions about which wildlife species are present and the current health of those species' populations (e.g., beaver, great blue heron)
- Concerns about the impact of motorized boats and other recreation on wildlife
- Need to consider the presence of designated critical habitat for federally listed species when making management decisions

Water Resources:

- Prioritize the protection of water quality
- Concerns about decreasing river flows and the protection of natural river flows
- Specific location information on such events as floods, a former dump, and spills (provided on the comment map)
- How should a fuel spill from motorized watercraft be reported?

Geology, Paleontology, Oil and Gas, and Other Mineral Resources

- Prohibit oil and gas leasing under the river
- Concerns about any changes to (removal of) FFSL's no surface occupancy classification
- How do leasing activities impact downstream resources?

Community Resources:

- Conflicts between motorized and non-motorized river users (specific areas of conflict were identified and different types of recreation limits and management strategies were suggested)
- Conflicts from increased recreational use; better management is needed
- Improve existing boater access points
- Create new boater access points
- Need for facilities such as toilets, trash receptacles, and signs at particular boater access points

- Safety concerns with motorized boats
- Concerns with the impact motorized boats have on the non-motorized experience
- Allow for continued multiple use of the river (motorized and non-motorized boats)
- Prohibit jet skis
- What is the FFSL permitting process for agriculture and irrigation stakeholders?
- Concerns about trespassing, graffiti, and littering on private lands adjacent to the river
- Educate river users on proper river etiquette (e.g., trespassing, boating regulations)
- Preserve the recreation experience by protecting canyons and viewsheds from development

A.2 Public Comment Period

A 50-day formal public comment period for the draft CRCMP began on May 31, 2019, and ended on July 19, 2019. Comments could be submitted at the second open house series, at federal or stakeholder meetings, online at the FFSL CRCMP website, by email, or by mail. FFSL received 36 written submissions commenting on the draft CRCMP. Numerous verbal comments were also noted at the open house series and at federal and stakeholder meetings. Comments pertained to jet boats, recreation, motorized and non-motorized use, commercial boating, bank erosion, boat ramps, permitting, wildlife, public safety, and CRCMP goals and objectives, to name a few. From the submissions, 92 individual comments were extracted for review of acceptance or non-acceptance. Individual comments are numbered per letter number (1–36). These individual comments are part of the project record and are included below in Table A-1 along with comment responses, as required by rule and statute Utah Administrative Code R652-90-600 (1)(b-d) and Utah Code 65-A-2-4. Verbal comments were generally consistent with those provided in the comment submissions.

Table A-1. Colorado River Comprehensive Management Plan Public Comments

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
1	Email, N/A	Adam Clark	Jet boats	1.1	I am someone that enjoys the Daily stretch of the Colorado many times throughout a rafting river season and I strongly believe that commercial jet boats do not belong on the Daily section of the river. They are eroding beaches and driving the Herons away from the rookery on mile 9. Historically commercial jet boats were not allowed on the daily section. They can have just as much fun and make just as much money if they are kept below the bridge.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete. In addition, the CRCMP contains an objective in Table 3.19 to "limit recreation, if needed, to protect sensitive areas and wildlife."
2	Email, paragraph 1	Anna Scherer	Recreation, motorized use	2.1	The recreational overusage of the Colorado River, especially on the Fisher Towers section outside of Moab, has come to a drastic high and must be managed. Calling for a limit, or an all out ban, on motorized boats on this section is not far fetched. All around Moab, public land is limited use. There are areas for non-motorized activity only and there are areas that allow motorized vehicles. This same concept should be applied to the Colorado River as well.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.
3	Comment card, paragraph 1	Anonymous	Jet boats, bank erosion, wildlife	3.1	I have concerns for jet boats on the river. Last year I was waked while on my paddleboard. The jet boat operator did not slow down. On other trips, I watched jet boats headed upstream, at high speed around blind corners in braided channels. My concerns are for: public safety, bank erosion/stabilization, channel stability, & wildlife. My concerns for bank erosion extend to bank/riparian corridor vegetation & habitat. In addition, the jet boats negatively impact my engagement of the river: noise and having to be on alert for craft traveling upstream.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. In addition, the CRCMP specifies goals and objectives in Table 3.4 to address problem areas of bank erosion and protect wildlife habitat, in Table 3.19 to protect sensitive areas and wildlife, and in Table 3.21 to address public safety issues.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
3	Comment card paragraph 2	Anonymous	Recreation, safety	3.2	Another concern I have is the increased use on the Moab Daily Corridor & insufficient monitoring to ensure folks have adequate personal safety equipment. More & more I see people in "toy" boats with no life jackets. I realize recreational programs are generally underfunded, but it would be nice to get a "ranger" or volunteer presence in the highly populated/used daily stretches to educate boaters on river rules & etiquette.	The Utah Division of State Parks and Recreation (DSPR) has primary responsibility for boating rules and enforcement (e.g., speeding, wakes, proper equipment); FFSL does not have jurisdiction to enforce boating rules. However, Table 3.21 in the CRCMP lists public safety goals and objectives, which include supporting state and local law enforcement efforts to minimize boater speeding and enforce wake rules, and improving boater safety by promoting safe boating practices in conjunction with the DSPR. FFSL will also consider jointly funding additional safety and enforcement personnel with other management agencies.
4	Email, paragraphs 2 and 3	Ariel Atkins	Recreation, data needs	4.1	I wholeheartedly agree that this decision should be methodical and supported by empirical data. Unfortunately, the resources to do certain data collection may never come. In the meantime, the river community seems to grow more outraged and discontent to cooperate and observe reasonable etiquette. I'm asking for your help, not to solve the river communities animosities, but to help define a process in which motivated/concerned citizens can take action. I have some ideas as well as some resources of time, but I don't want to go in a direction that isn't helpful or counter to the work that has already been done. I will admit that I'm not as informed as I'd like to be, that is also where I'm asking for your help in assisting me to understand where the public can be of service towards this goal. My main question of the evening was not answered tonight, perhaps it is my fault for not phrasing it correctly, but I want to understand what metric needs measured to bring forward empirical data that will result in a review of the permitting guidelines. If we are going to invest resources, lets be sure we are using the correct metrics!!	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP. Specific financial resources will be allocated for this effort, including funds to collect available data on subjects such as the types and numbers of recreation users on The Moab Daily segment. Although the public involvement process for development of the recreation resource management plan has not yet been defined, information will be provided to stakeholders as soon as it is. FFSL is happy to review any recreation data that you can provide or direct us to as part of this process. The CRCMP also includes goals and objectives to better educate river users on safe boating practices, stewardship, and river etiquette. FFSL will also consider jointly funding additional safety and enforcement personnel with other management agencies.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
5	Email, N/A	Carol Mayer	Motorized use, jet boats	5.1	Please do not allow motorized vehicles above the bridge in Moab. The river from Dewey Bridge to the boat ramp at the pedestrian bridge should be reserved for people powered/propelled by the speed of the river craft. The beauty and the peace of the river and the canyon is totally destroyed by jet boating. By permitting more commercial motorized vehicles (jet skis?) the exacerbation of fumes, pollution, shore degradation along with the loss of wildlife habitat and safety in our section of the river will forever change the experience that people have been coming to Moab to get…And please assess the numbers of vendors and the number of tours currently using the river and consider capping permits. It is a freeway on the water. This is not the way to revere the raw nature that the Colorado River brings to Moab. Without a comprehensive management plan things will only get worse out there.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. Specific financial resources will be allocated for this effort, including funds to collect available data on subjects such as the types and numbers of recreation users on The Moab Daily segment.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
6	Email, paragraphs 1 and 2	Carol Stockham	Safety, jet boats	6.1	I am writing this letter to officially inform you of an incident that occurred at the Moab Bridge Boat Ramp (Colorado River mile 65.1) on Thursday, June 27th, 2019 at approximately 1600 (4:00pm). The wake from the last launching jet boat (two or three jet boats launched from the ramp within a 10 minute period) caused at least 2 personal water craft (one 15' NRS raft and one 9' NRS SUP) to dislodge from the boat ramp and free-float into the river. Prior to being dislodged by the wake of the jet boat, the 15' NRS raft had been pulled 3' onto the boat ramp by three adult males and the SUP had been pulled at least 4.5' onto the ramp by its owner (me). Both vessels were safely secure and would not have moved from their positions without the wake of the jet boat disturbing them. The emergency action taken by myself and others was enough to capture and re-secure both water craft immediately. Unfortunately, the ball of my right foot was injured badly during the recovery (even though I was wearing shoes) and I lost a day of work today (06/28/19). Shelly Smith (former BLM) told me to report the dangers of jet boat use after I was almost run over by one while I was swimming in the "6-mile" area at dusk in 2013 (swam for my life when they continued toward me at full throttle even though I was waving and splashing water to alert them people were in the river). Again, I did not report it when a jet boat passed me with less than 2 feet separating us two years ago (someone actually took a picture of the close call that I still have on my phone somewhere). Yesterday, when the wake hit the boat ramp and the chaos ensued I started yelling "anyone with a phone or camera please start recording this. NOW!".	Thank you for your report. The DSPR has primary responsibility for boating rules and enforcement (e.g., speeding, wakes, proper equipment); FFSL does not have jurisdiction to enforce boating rules. However, Table 3.21 in the CRCMP specifies public safety goals and objectives, which include supporting state and local law enforcement efforts to minimize boater speeding and enforce wake rules, and improving boater safety by promoting safe boating practices in conjunction with the DSPR. FFSL also will consider jointly funding additional safety and enforcement personnel with other management agencies.
7	Email, N/A	Cassandra Paup	Motorized use, jet boats	7.1	In the past few years the quality of our river runs has been degraded by motorized boats being on the daily section of the river. Traditionally, non motorized rafts, like my own, only were allowed above the river bridge at Hwy 191. First jet skis and now a preponderance of Jet boats are encroaching. In addition to degrading the experience for non-motorized users, motorized boats scare wildlife off nests and increase erosion. While I believe in motorized users right to recreate on the Colorado, a designated area below the bridge would be best for rafters and wildlife. It might be useful to limit the number of motorized users per day as well.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
8	Email and online comment form, paragraphs 3, 4, 8	Jess Reilly-Moman	Jet boats, safety	8.1	My concerns for the CRCMP is the continued use of jet boats on the Colorado River. Because of the high speeds and large wakes, I do not feel that my family can safely recreate together on this treasured resource. I have multiple personal examples of experiences where I have been afraid for myself, for my daughter, and for my dogs. The wakes created by the boats have swamped my dogs while swimming, have caused my child to fall over when at the edge of the water when the water suddenly rose and swept under her feet, and I have had to quickly gather my dogs and myself onto my paddleboard to move out of the way of the jet boats. In addition, their wakes have traveled impressive distances to catch my family and me off guard as we attempted to recreate in the water or on shore. Most of the time the jetboats have slowed to no wake when they pass me, but other times they have simply not been able to see me, my family, or my dogs until it was too late. These experiences have altered my enjoyment of the river: I cannot visit without anxiety about my family's safety. It feels like a ticking time bomb, waiting for the moment that something goes awry. I have spent much of my adult life on and around boats and dealing with their engines and steering mechanisms. In addition to the existing frightening reports of jet boat crashes on the Colorado River, I understand and have witnessed in other boating contexts how failures can be difficult to predict, despite constant maintenance. A failure at speed could be catastrophic and life-threatening, as has already been shown on the Colorado. This leaves not only jet boat passengers unsafe, but endangers the lives of all those around them. This is a dice that gets rolled with every speedboat trip through the canyon, and the land and river managers are responsible for the lives of all users.	Thank you for your comments. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. Table 3.21 in the CRCMP lists public safety goals and objectives, which include supporting state and local law enforcement efforts to minimize boater speeding and enforce wake rules, and improving boater safety by promoting safe boating practices in conjunction with the DSPR. FFSL will also consider jointly funding additional safety and enforcement personnel with other management agencies.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
8	Email and online comment form, paragraphs 5, 6	Jess Reilly-Moman	Utah Boating Act, safety	8.2	I do not feel that the Utah State Boating Act, as cited on page 169, is sufficient to guide boating rules in the context of travel on the Colorado River, which sees high traffic of swimmers, dogs, children, and other boaters throughout the river and traveling without high horsepower downstream. However, even if this act were used, a case could be made that the Colorado River, and especially the Moab Daily section, functions as a "Swimming Area," and therefore should not see wakes. As mentioned above in my personal experience, the jet boats are not always able to see swimmers of all sizes and reduce their speed in time to meet this requirement of no wake within 150 feet. In addition, the wakes travel through the river, extending their reach disproportionally. In marinas and high traffic areas throughout the world, a strict NO WAKE zone is enforced. The Daily section of the Colorado sees significantly more traffic than most marinas and areas in which I have had to guide a motorized craft, especially with swimmers in the water that are easily visually obscured. High horsepower watercraft speeding through a marina or swimming area would be unacceptable, as should be the case here.	The DSPR has primary responsibility for boating rules and enforcement (e.g., speeding, wakes, proper equipment); FFSL does not have jurisdiction to enforce boating rules and cannot make changes to the Utah State Boating Act. However, the CRCMP contains objectives for FFSL to coordinate with other management agencies to disseminate river stewardship, etiquette, and recreation materials (Table 3.19), to include specific public safety measures in authorizations where appropriate (Table 3.21), to support state and local law enforcement efforts to minimize boater speeding and enforce wake rules (Table 3.21), and to partner with other agencies to address safety issues such as boat speed (Table 3.21).
8	Email and online comment form, paragraph 7	Jess Reilly-Moman	Jet boats, beaches, banks	8.3	In addition, the beaches and banks of the Colorado River are a natural phenomenon that provide recreational opportunities, as well as flood and erosion control not only for surrounding areas and roads, but those downstream. With the jet boats, a very small proportion of Colorado River users have an undetermined impact on this resource, and this warrants intensive scrutiny.	The CRCMP specifies goals and objectives in Table 3.4 to address problem areas of bank erosion and in Table 3.19 to protect sensitive areas and wildlife.
8	Email and online comment form, paragraph 9	Jess Reilly-Moman	Available data	8.4	Empirical data already exist to justify the limitation of high wake motorized travel in complaint numbers, which should be compiled (and coded) if this has not already been done. For additional data, I understand that the agencies likely do not have the temporal or monetary scope to collect it. However, if the agencies can provide the metrics, from social to environmental, there is a veritable army of citizen scientists willing to take on this task in Moab. Many of these volunteers are expert scientists, organizers, and data collectors already.	Thank you for the offer to help. As FFSL develops the recreation resource management plan, we will identify and collect appropriate recreation data to make scientifically sound management decisions.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
8	Email and online comment form, paragraph 10	Jess Reilly-Moman	Liability	8.5	Finally, as a consultant for the Adventure Travel Trade Association, AirBnB, and governments and aid organizations throughout the world who are developing adventure travel activities, I assist groups to include risk management into every element of sustainable social and ecological tourism development. Safety is the top priority, as well as the greatest liability, for interested parties. For example, the country of Jordan recently experienced the deaths of 11 children in a flash flood because there were no standards or risk management requirements within the canyoneering industry. There were no previous deaths in this industry, with the erroneous assumption that this statistic made it safe. The consequences of one incident were catastrophic. As a result, multiple high ranking agency officials were forced to resign, and others are currently on trial. The US, a highly litigious society, leaves risk management to specific agencies and companies. The permit issuers will be held liable for any incidents, particularly given the outcry over safety. Without changes, the agencies may find that current policy leaves them negligent and vulnerable to the inevitable catastrophic event.	Thank you for your comment. FFSL's public safety goals and objectives can be found in Table 3.21 of the CRCMP. Additional safety measures may be recommended in the recreation resource management plan.
8	Email and online comment form. paragraph 11	Jess Reilly-Moman	Management of motorized use	8.6	In regards to high wake motorized travel, specifically on the Daily section of the Colorado River, the agencies involved, at a minimum, should: Examine existing empirical data (complaints); Provide multiple avenues for self-recording empirical data (comment boxes, online surveys, etc.); Develop a professional and informed risk assessment and management strategy, with the goal of determining a threshold for unacceptable catastrophic risk; Understand the application and violations of current boating laws; Provide metrics for the collection of further data. Dedicated Colorado River users are ready to take action, but they first need to know what metrics, timeline, methods, and evaluative frameworks they should use.	FFSL plans to identify and collect appropriate recreation data as we develop the recreation resource management plan. We will consider comment boxes, online surveys, and other methods of data collection as part of the scope of work. We will reach out to the community for help as needed. Development of a risk assessment and management strategy is beyond the scope of the recreation resource management plan. FFSL does not have the authority to enforce the Utah State Boating Act but will work with the DSPR to do so.
9	Email, N/A	Kiley Miller	Jet boats	9.1	Get rid of the jet boats & the Canyonlands by night boat as well. Both are so incredibly impactful & disrespectful of the environment and other user groups.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
10	Email, paragraph 3	Living Rivers/Colorado RiverKeeper	Management, public involvement	10.1	We understand the CRCMP of 2019 is an adaptive management program for a time-period of 10-years. In the contents of the Final CRCMP and the Decision Document we expect to read how this adaptive management program will be executed; how it will perform its duties and how the public and science community will be involved. For example, we expect that a diverse working group of citizens will be established, and that regular meetings will be convened for this group activity, and that positive outcomes will then be delivered in a timely fashion, and with the goal of improving the integrity of the Colorado and Green rivers in Utah. We expect this program to be adequately funded on an annual basis and that the administration of this program is supported by qualified staff.	The CRCMP is a comprehensive management plan, not an adaptive management plan. However, the management goals and objectives in the plan are designed to be flexible and broad to account for various on-the-ground conditions. The CRCMP can be amended to address changing conditions if warranted, pursuant to FFSL's governing laws. FFSL planning processes provide for public participation. There have been multiple opportunities for the public to participate in the development of the CRCMP, as detailed in Appendix A of the CRCMP.
10	Email, paragraph 4	Living Rivers/Colorado RiverKeeper	Appeals process	10.2	We also understand that this program has an appeal process and assume that this appeal process will allow the public to have their grievances addressed. This appeal process should be well-defined in the final documents.	There is a process for aggrieved parties to appeal the CRCMP per state rule (Utah Administrative Code R652-9). The record of decision for the CRCMP will provide instructions on how to file a petition for administrative review.
10	Email, paragraph 4	Living Rivers/Colorado RiverKeeper	CRCMP revision	10.3	Finally, in 2029, we expect the program to be reconsulted by the public in a timely manner for the purpose of producing a revised Decision Document and that the scoping process begin at least one-year prior.	The CRCMP has an intended life span of 10 years and will be amended as a need is determined and resources are available.
10	Email, paragraphs 5, 6	Living Rivers/Colorado RiverKeeper	Goals, objectives	10.4	We understand that the objectives of this AMP might range somewhere between a low-tier and a high tier. The performance of this program might also range between short-term and long-term planning. Because water resources are such a precious gift in these uncertain times, we ask that this program achieve the highest of standards for the best possible management practices. Suggested Goals & Objectives of the Adaptive Management Program Adapt to the extremes of the hydrologic cycle Consider no surface occupation in the zone of a probable maximum flood Remove jeopardy of endangered species Reduce salinity, selenium and accidental toxic spills Reclaim abandoned mines and well pads	The CRCMP is a comprehensive management plan, not an adaptive management plan. However, the management goals and objectives in the plan are designed to be flexible and broad to account for various on-the ground conditions. The CRCMP addresses the issues that are within the scope of FFSL's management activities. Goals and objectives for hydrology can be found in Table 3.7, goals and objective for floodplains can be found in Table 3.8, goals and objectives for wildlife can be found in Table 3.5, and goals and objectives for water quality can be found in Table 3.9. Abandoned mines and well pads are typically not located on sovereign lands of the Colorado River.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
11	Email, paragraphs 2, 3	Nancy Orr	Recreation, safety	11.1	I attended your first open house last year and witnessed the conflict between floaters vs motorized users ~ both sides got their hackles up. On river, I have seen floaters flipping off the jet boats, and the jet boaters driving unnecessarily close and fast to floaters. It is just a matter of time before the conflict escalates to more aggressive interaction, and since large motorized hard-hulled boats are involved, serious injury is in the offing. Despite the law, alcohol and drugs are a fact on the river. Even with sober actors, emotions can get out of control; a dehydrated and "hangry" person can be just as belligerent and dangerous as a drunk. Common courtesy disappears when perceived personal insult is involved, and turf wars always escalate. The potential for injury is there even without conflict ~ it's hard enough to see a kayaker from a raft, and we are no doubt nearly invisible to those further off the surface of the water in a motorized boat. I used to put in at the pedestrian bridge for upriver kayak workouts, but no longer feel safe doing so now that there are three Moab Jett boats and an increase in private jet boats, jet skis and powerboats. I would rather not meet my demise splattered across the hull of the river-equivalent of a Mack truck.	Thanks for your comments. Table 3.21 in the CRCMP lists public safety goals and objectives, which include supporting state and local law enforcement efforts to minimize boater speeding and enforce wake rules, and improving boater safety by promoting safe boating practices in conjunction with the DSPR. FFSL will also consider jointly funding additional safety and enforcement personnel with other management agencies.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
11	Email, paragraphs 4, 5, 6	Nancy Orr	Recreation, motorized and non-motorized use	11.2	With the ever-increasing numbers of both motorized and non-motorized users, it is time to start enforcing separation between the two groups. While I personally would like to see all motorized use restricted to downstream of the bridge, I understand the historical precedence of motorized use on the section up to the BLM takeout. Yes, there are people who float the section between BLM takeout and Gold Bar, but they are far fewer than the crowds who take out at BLM. At least with restriction to a specific section as motor-permissible, the people who choose to float there are on notice that they are voluntarily entering riskier territory that requires them to accept upstream travelers without bitching. In North Carolina, the Tsali trail system separates mountain bikers from hikers/equestrians by designating each loop as one use on odd days, and the competing use on even days (thus separating by both time and space.) On Grand Mesa the snowmobilers are separated from the ski-tourers by the highway (and families/dogs are further separated from skate skiers by trail designation.) Even scuba divers and kite boarders have separate designated areas in Bonaire so that surfacing divers are not decapitated by a fast-moving board. In each case, the collision danger posed by faster-moving sports has been mitigated through separation from those who enjoy a slower pace. These restrictions to avoid possible conflict are accepted by the folks who recreate in those areas as the cost of personal safety and reduction of aggravation. We may bristle at regulation, but avoiding altercation and possible injury is worth the sacrifice of a bit of personal freedom. It's time to put restrictions in place on our river to help prevent the tragic accidents that are inevitable if no preventive steps are taken. Preemptive action on your part now will help to avoid future tragedy.	As noted in the CRCMP, recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.
12	Email, N/A	Quentin Baker	Jet boats	12.1	No jet boats above 191 bridge On the Colorado River.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
13	Email, paragraph 1	San Juan County Commission	Consistency, philosophy, planning process	13.1	We have reviewed the Draft Comprehensive Management Plan and Mineral Leasing Plan for State sovereign lands of the Colorado River and find them to be consistent with the goals and policies of the San Juan County General Plan. We concur with the plans' overall management philosophy of multiple use, sustained yield and coordination with other land owners and agencies. We appreciate your efforts at public outreach during this planning process that including public meetings in San Juan County. We are appreciative of this opportunity to comment.	Thank you for taking the time to review the plans and for your comments.
14	Email, paragraph 3	River Runners for Wilderness	Carrying capacity	14.1	As such, we wholly support the management of all the river sections covered by these comprehensive plans for the preservation of aquatic and terrestrial wildlife. We must do everything we can to safeguard these precious resources from damaging activities, be they mineral extraction, agricultural development, bottomland "protection" by the creation of levies, or excessive visitation. Missing from these draft plans is any discussion of recreational carrying capacities. As such, these plans must address the need to create and identify carrying capacities for all the river sections covered in both the Green River and Colorado River comprehensive management plans.	As stated in Chapter 1 of the CRCMP, FFSL recognizes that protection of navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality must be given due consideration and balanced against the need for, justification of, or benefit from any proposed use (Utah Administrative Code R652-2-200). By statute, FFSL is required to manage for these five Public Trust values. FFSL plans to address the issue of recreational carrying capacity in the upcoming development of a recreation resource management plan.
14	Email, paragraph 4	River Runners for Wilderness	Education	14.2	We wholeheartedly support continued educational efforts on the part of the Utah Department of Natural Resources to educate river runners about best camp practices with regards to packing out human waste and ash from fires. Educational goals as spelled out on page 213-14 of the GRCMP and ps 201-02 of the CRCMP are a good step in that direction.	Thank you for your comment.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
14	Email, paragraph 5	River Runners for Wilderness	Terminology	14.3	Both the CRCMP and GRCMP use the terms "private boaters" and "commercial operators." These terms are misleading. "Commercial operators" are private businesses conducting guided river tours. "Private boaters" are do-it-yourself river runners, public boaters or self-guided river runners. The terminology in these management plans should reflect actual practice. For example, the section "The Moab Daily" on page 160 of the CRCMP states "Commercial outfitters offered 51,355 non-motorized river trips to visitors on The Moab Daily segment in 2011. The BLM estimates daily private use on this section is 50% of the commercial use numbers, which would be 25,677 private non-motorized boaters in 2011 (BLM 2012)." In fact, private businesses conducting guided non-motorized river tours manage 51,355 clients on non-motorized trips, while 25,677 do-it-yourself river runners traveled the same section on non-motorized watercraft. The GRCMP defines "General Permits" on page 18 are for general public use or for private use such as private property. The same concepts apply for the general public who recreates on their own verses private business conducting for-profit and non-profit guided services.	Definitions for the terms *private boater* and *commercial outfitter* or *commercial operator* have been added to the Recreation section in Chapter 2 of the CRCMP.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
14	Email, paragraphs 6, 7, 16	River Runners for Wilderness	River history	14.4	On pages 45 and 46 of the CRCMP and page 58 of the GRCMP, the history of river running is briefly covered in a combined total of three short paragraphs. Those paragraphs are dedicated to John Wesley Powell and Norm Nevills in the CRCMP, and Bus Hatch in the GRCMP. A simple search of the word "boat" shows that this word (including boat, boats, boater, boaters, and boating) is used 245 times in the GRCMC and 283 times in the CRCMP. The incredibly brief historic reviews of river running is most curious, given that river running is the largest recreational activity occurring in the areas of these management plans. The sections on river history must include additional historical content, based on recent publications recounting the history of river running. Any review of river history must include recreational river trips conducted by river runners free of commercially guided services. The history of do-it-yourself (DIY) river running is entirely missing in the river history paragraphs on page 44-45 of the CRCMP and page 58 of the GRCMP. The CRCMP jumps from the Powell Expedition of 1869 to the few Nevills conducted trips in the 1940's on the Green and Colorado River, missing the 1938 Clover Expedition on which Norm Nevills played a part. The GRCMP focusses solely on Bus Hatch. In the GRCMP, there is no mention of A.K. Reynolds, who was conducting commercial river trips in Lodore Canyon through Dinosaur National Monument in 1950, before Bus Hatch received a concessions permit to do so in Dinosaur National Monument (Big Water Little Boats; Moulty Fulmer and the First Grand Canyon Dory on the Wild Colorado River, Tom Martin, Vishnu Temple Press, Flagstaff, AZ, 2012, p 79). On both the Colorado and Green rivers covered by these comprehensive management plans, there were many hundreds of earlier river trips than the Nevills and Hatch river trips, yet none of them are mentioned or even hinted at. You should also be aware that both Norm Nevills and Bus Hatch actively worked to keep do-it-yourself river runners off the rivers they operated their private businesses on. As such, they are far from the best examples of river runners for these management plans. the Green and Colorado Rivers covered by these two plans has a robust and dynamic river running history completely apart from John Wesley Powell, Norn Nevills and Bus Hatch. Please correct this oversite that left out the very significant history of river running in these management plans.	Thank you for your comment. The CRCMP provides a very brief overview of river running history only and is not meant to provide an in-depth look at the history of river running. Other resources are available for those who are interested in learning more about this topic.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
15	Email, paragraph 2	Tory Hill	Commercial boating	15.1	I understand the need for commercial boating and the rafting companies right to do business. Does that mean that we as private boaters have no rights to have our experience. For years I have watched the commercial trip size and numbers increase to what is now the Disneyland Daily. I have seen 300 people in under 1/2 mile at peak times. We started putting in even earlier and even later to let the commercials take over in the day. Take Over is not an exaggeration. They take over the ramps and act like they are the only ones out there. They now all have multiple trips daily. I saw an outfitter this year launch a Cat trip from Hittle Bottom at high water in the evening and have the entire ramp so full of J rigs, trucks and a generator that there was no way we would launch from there for at least an hour, even if we asked them to move or make room. The generator noise was deafening.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. The recreation resource management plan will collect data on the number of commercial and private boaters using the river and help address issues with the increased volume of both types of users. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.
15	Email, paragraphs 3, 4, 7	Tory Hill	Jet boats	15.2	And now the jet boats. In the beginning there was one commercial jet boat. Now there are four or even more. Next year will there be eight? There is no longer any time of the day that you will not have to be inundated by the noise, the wake, the interruption of the peace of the river by commercial jet boats. Even if you put on in the very early morning you will see them. If you put on late in the day you will see them. There is a speed limit for every other motorized vehicle. I have seen Moab Jett going upriver at 65 miles an hour. Not only are they going too fast for safety they are continually driving at one another and flying over each other's wake. What other form of playing chicken in a motorized vehicle is even legal? I have seen them going 60 and then suddenly spin a donut and almost flip the boat. They have already injured people by hitting sandbars and even the bank of the river. When they pass you going up river they have to slow down and they continually rev their motors and spew their exhaust. You hear and smell them for a long time and then they come back or another one comes. Or both. All the while their passengers and the boatmen are watching you like you are the wildlife or you are the big disturbance on their river trip. For the last few years I have quit floating to the take out at mile 10.5 and take out instead at Rocky Rapid mile 15.5 cutting my trip by 5 miles just to avoid the jet boats. Now I see that a commercial operation is up running all the way to New Rapid! Why are they not stopping at Red Cliffs like the others? Did you permit this? There are not many places in all the miles of the Colorado for rafters, kayakers, canoes and paddle borders to access the river for a daily run. Whereas there are miles and miles of river available to jet boaters below the Moab bridge.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete. The DSPR has primary responsibility for boating rules and enforcement (e.g., speeding, wakes, proper equipment); FFSL does not have jurisdiction to enforce boating rules. However, Table 3.21 in the CRCMP lists public safety goals and objectives, which include supporting state and local law enforcement efforts to minimize boater speeding and enforce wake rules, and improving boater safety by promoting safe boating practices in conjunction with the DSPR. FFSL will also consider jointly funding additional safety and enforcement personnel with other management agencies. The two FFSL-permitted commercial jet boat companies that operate above the U.S. Highway 191 bridge are required to turn around at the Red Cliffs Lodge boat ramp or earlier. Any jet boat that is upriver from the Red Cliffs Lodge boat ramp is violating the terms of its permit. The two jet boat companies operate a total of five jet boats. Non-commercial motorized boats are allowed to operate the entire length of The Moab Daily segment per the Utah Boating Act.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
15	Email, paragraphs 5, 6	Tory Hill	Wildlife, beaches	15.3	In the years that the jets have been operating I have seen the Heron rookery at mile nine go from a thriving rookery of up to 10 nests to what this year was 1 nest and I did not see any young birds. There used to be some nice beaches between miles 12 and 15 and now what you have is a small or tiny beach with a huge cut bank from the wakes of the jet boats. They can be as high as 3 or 4 feet. The swimming beach below Big Bend has also been deteriorating yearly. You say there is no proof of erosion but ask any local private boater what they have witnessed and they will confirm it too.	Multiple factors contribute to bank and beach erosion on the Colorado River. The CRCMP specifies goals and objectives in Table 3.4 to address problem areas of bank erosion and protect wildlife habitat, and in Table 3.19 to protect sensitive areas and wildlife.
15	Email, paragraph 8	Tory Hill	Recreation, commercial use, jet boats	15.4	In closing I am asking that you put a reasonable limit on the commercial rafting numbers and keep the commercial jet boats below the Moab bridge. If not the bridge at least keep them below the rookery at mile 9. Maybe you could even consider hours of operation for all commercials to be such that we private boaters have a few hours of the day that we don't have to deal with them.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.
16	Email, paragraphs 3, 4	Sarah Stock	Recreation, motorized use, jet boats	16.1	As Moab fills to the brim with eager visitors, the river is still miraculously a place where near solitude can be reached. The beauty of it is that even if hundreds of people are on the river at the same time, they are all traveling in the same direction, at roughly the same pace, so each party can experience the river like they are alone on it. That is, unless a high powered jet boat comes screaming upstream on the river, encountering and annoying each party along the entire stretch of river. And what if there is another? And another? And then they come back downstream, passing each boat again on their way back? High speed motorized travel has a huge impact on the experience of downstream boaters, increases beach and shoreline erosion, and impacts riparian and aquatic life as well.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.

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16	Email, paragraphs 5, 6, 7, 8	Sarah Stock	Commercial use, permitting	16.2	As you can probably surmise, I am opposed to the permitting of upstream commercial travel on the Moab daily section of the Colorado River. I am not alone in this. Residents of Castle Valley and Moab have been communicating with BLM and the Division of Forestry, Fire, and State Lands about this issue for years. In that time, Moab Jett has expanded the number of trips each day, acquired more boats, and now owns a massive, extremely loud, higher powered jet boat than ever before. What is the Division of Forestry, Fire, and State Lands (FFSL) going to do about this ceaseless conflict? In order to foster a sustainable river system that supports multiple uses, the FFSL, cannot in good conscience permit high-speed upstream travel. The Moab Daily is floated by a diversity of water users including those using stand-up paddle boards, canoes, inner tubes, only life jackets, and small kayaks. There are community beaches along this stretch where people, including children, swim in eddies, and swim in the current and small rapids with life jackets. It is dangerous to have a high-speed craft in the same water, especially where waves and speed impair the boat captain's view of the water. This year during high water, I also witnessed other companies putting in large motor boats at the BLM take-out and traveling upstream from there with customers. Where will it end? There must be regulations prohibiting upstream commercial travel on this section of the Colorado River if we are to preserve the special resource that we all share.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.
16	Email, paragraph 9	Sarah Stock	Recreation, upstream travel	16.3	In order to reduce user conflicts, improve public safety, ensure safe access for diverse stakeholders, and creatively manage growing recreational use on the Moab Daily section of the Colorado River as is outlined in the Draft Comprehensive Management Plan for the Colorado River, I urge the staff at FFSL to limit the amount of upstream travel occurring on the Daily section. The Moab BLM separates conflicting recreational uses on public lands. They do not permit horseback trail rides in the same area as mountain bike focus areas or popular 4-Wheel Drive routes. There is a simple solution to the conflicting uses on the Moab Daily. Permit motorized jet boat tours only downstream of the bridge on 191.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.

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17	Email, paragraph 1	Kalen Jones	Recreation, motorized use	17.1	The Colorado River from the 191 bridge upstream to Onion Creek is a treasure, providing accessible opportunities for quiet recreation to residents and visitors alike, and supporting many rafting companies. Many developed campsites front on this stretch of the Colorado, which previously provided a peaceful and scenic backdrop. For much of the thirty years I have lived in Moab this stretch of river was almost exclusively used by non-motorized downstream vessels, including by myself, and has grown increasingly popular with SUPs, as well as the more traditional rafts, kayaks, and canoes. In the last few years the experience has been degraded with frequent high speed, high capacity, up and downstream motorized traffic. Moab is a poster child for overtourism. There are so many people visiting now, it is time to be more deliberative about which experiences we preserve and create for our residents and visitors. The river downstream of the 191 bridge is utilized primarily by motorized craft, with little conflict. Please 'zone' the river to preserve the traditional, and highly popular, downstream floating experience upstream of 191 bridge.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.
18	Email, paragraphs 1, 2, 3	Pam Hackley	Recreation, motorized use, safety	18.1	A friend, Kalen Jones, shared his comments with me and I am reiterating them here as I cannot say it much better - the difference being I have been rafting this stretch of water (and beyond) since 1978 and have lived in Castle Valley for 20 years: "…For much of the thirty years I have lived in Moab this stretch of river was almost exclusively used by non-motorized downstream vessels, including by myself, and has grown increasingly popular with SUPs, as well as the more traditional rafts, kayaks, and canoes. In the last few years the experience has been degraded with frequent high speed, high capacity, up and downstream motorized traffic…The river downstream of the 191 bridge is utilized primarily by motorized craft, with little conflict. Please 'zone' the river to preserve the traditional, and highly popular, downstream floating experience upstream of the 191 bridge." And I would add: I know that the motor companies are respectful of boaters and swimmers but that I am very concerned with so many people using this stretch of water that the combo of modes of motors and human-power that the potential for a tragic accident that could be avoided had motorized use been precluded.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete. Table 3.21 in the CRCMP lists public safety goals and objectives, which include supporting state and local law enforcement efforts to minimize boater speeding and enforce wake rules, and improving boater safety by promoting safe boating practices in conjunction with the DSPR.

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19	Email, N/A	Thomas H. Mader	Recreation, motorized use, safety	19.1	I am a Moab resident who has watched the Colorado River go from a quiet environment to a noisy one. I would greatly appreciate it if we could keep the Daily section open for non-motorized traffic only. We do not need jet-boats in this area! They are noisy and dangerous to children and adults on the river. I lived for many years in Alaska. The Kenai River is a good example of how to handle motorized and non-motorized traffic. The upper Kenai is reserved for floating only with no use of motors. This area is for quiet fishing or floating. The Lower Kenai is for motorized boat traffic. It is designed for those who enjoy motorized boating. People who live and play in these areas accept the noise and potential danger.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for additional objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete. Table 3.21 in the CRCMP lists public safety goals and objectives, which include supporting state and local law enforcement efforts to minimize boater speeding and enforce wake rules, and improving boater safety by promoting safe boating practices in conjunction with the DSPR.
20	Email, paragraphs 1, 2, 3, 4, 5	Sara Melnicoff	Recreation, motorized use, noise, safety	20.1	Some things just don't go together. Quiet enjoyment of the Daily section of the Colorado River, and motorized jet-boats is a prime example. Noise pollution, the possibility of accidents, and the general carnival atmosphere created by the overcrowding of this normally semi-serene section of the river are all good reasons to restrict motorized craft from this section. Noise pollution is a serious health threat. http://www.nonoise.org/aboutno.htm The more we can all contribute to the quiet, the better things will be for many of us. I myself, have stopped going to many of my favorite places around Moab because the noise, destruction of trails and untouched land, and overcrowding make it too sad for me. Let's keep this stretch of the river free of motorized noise and start a great trend!	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.
21	Email, paragraph 1	TJ Cook, Utah Division of Wildlife Resources (DWR)	Native plant species for restoration	21.1	**Table 2.4 Native plant species in the planning area recommended for restoration** DWR would encourage including several additional species to help with restoration, including New Mexico privet, Utah bee plant, globemallow, coneflower, and milkvetch. Chokecherry, alkali buttercup, Lewis flax, and western white clematis also would be good plant species to include for effective restoration efforts.	The suggested species have been added to Table 2.4, with the exception of coneflower.

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21	Email, paragraph 2	TJ Cook, DWR	Fish	21.2	**Figure 2.22 Abundant and common native and nonnative fish species map** This map could be misunderstood without explaining that certain sections of the river, which were left off of the abundant map, could provide important habitats for native fish. Unless the reader takes in the whole plan, he or she may conclude, erroneously, that no fish exists in that stretch and that it therefore does not need to be considered for potential impacts.	A note has been added to the map explaining that "Sections of the Colorado River not shown on this map also provide important habitat for native fish."
21	Email, paragraph 3	TJ Cook, DWR	Wildlife	21.3	**Table 2.7 Special-status wildlife species** Willow flycatchers as a species could occur through all river segments. Whether or not they are southwestern willow flycatchers is unknown; however, this area is mapped by United States Fish and Wildlife Service as southwestern willow flycatcher habitat, and probably should be included in the table. Kit fox should match on all river sections, as the foxes are likely to occur adjacent to all stretches. Mogollon vole should be removed from the table as it is no longer on the Utah Sensitive Species List or included as a species of greatest conservation need ("SGCN") in the 2015-2025 Utah Wildlife Action Plan. Other presence/absence changes for specific river sections are still being analyzed. UDWR [DWR] will coordinate with FFSL staff on species-specific information.	FFSL previously discussed the southwestern willow flycatcher with DWR and consulted with a southwestern willow flycatcher expert. No change has been made to the table for this species. The suggested changes have been made for kit fox and Mogollon vole.
21	Email, paragraph 4	TJ Cook, DWR	Fish	21.4	**Table 2.8 Presence/absence changes for specific river sections are still being analyzed** DWR will coordinate with FFSL staff on species-specific information.	FFSL previously reviewed Table 2.8 and made changes in coordination with DWR. No additional changes have been made to this table.
21	Email, paragraph 5	TJ Cook, DWR	Fish	21.5	**Conservation Agreement Fish Species** In both the bluehead sucker and flannelmouth sucker sections, it currently reads: "The flannelmouth sucker is found…but is reduced in abundance in some areas because of predation and hybridization with the white sucker." In order to clarify that white sucker are not predating on flannelmouth sucker or bluehead sucker DWR suggests the addition of an Oxford comma, or editing the sentence to say "..is reduced in abundance in some areas because of hybridization with the white sucker, and predation.	Edits have been made to this sentence for clarification.

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22	Email, N/A	Darcey Brown	Recreation, motorized use	22.1	I would prefer that there is no motorized traffic on the Colorado River upstream or downstream from Moab. I was on a SUP downriver and was overturned by a motor boat speeding up after it passed me and lost my sunglasses. Recently driving the river road, I saw four motor boats in ten minutes. It's bad enough to have monster search lights on trucks driving at a snail's pace, but motors on the upper section!!! We are bombarded 24-7 by motorized noise in town, surely the river should be a sanctuary.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.
23	Email, paragraph 2	Dave Focardi	Recreation, motorized use	23.1	I would suggest leaving high speed commercial upstream motorized traffic below the 191 bridge, and preserve the non motorized section above. Downstream travel that utilizes motors is fine, and even traditional. Since those boaters don't repeatedly pass the non motorized boaters the impact is minimal. The commercial high speed upstream traffic causes repeated interactions with non motorized boaters that are unpleasant, and do not reflect the preferred experience of the rafter, kayaker, sup-er etc.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.
24	Email, paragraphs 1, 2	Leta Vaughn, Mary Beth Fitzburgh	Recreation, jet boats	24.1	I am writing concerning the daily section of the Colorado River. I have been a long time user of that section of the river. It used to be a peaceful raft/kayak trip, but with the jet boats constantly blasting past it makes for an unpleasant experience. We also frequently hang out on the beaches and swim in the eddy and have watched a family of otters swim next to us. Then the jet boats show up and chase them around trying to get pictures for their clients. I would like to see the jetboats not allowed anywhere above Take Out beach. There is plenty of river below where they can do what they do.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.
25	Email, N/A	Sue deVall	Recreation, motorized use	25.1	This should NEVER have been permitted. Campers along the River as well as folks floating this section are negatively impacted. I have been boating the Daily privately for years and believe that the section above Take Out Beach should non-motorized.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.

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26	Email, paragraphs 1, 2, 3	Thea Nording	Recreation, motorized use	26.1	For many years the Colorado River from the 191 bridge upstream to Onion Creek has been used for quiet river recreation, and campsites along this stretch have provided a peaceful and scenic experience. Both locals and visitors have enjoyed many years of rafting, kayaking and canoeing this stretch of river. In recent years it has also become a popular stretch of river for SUP use. In the last few years frequent high speed, high capacity, up and downstream motorized traffic, the most disturbing being the thrill-seeking "Spin & Splash" trips, have degraded a once peaceful experience to something akin to an amusement park. This kind of use is totally inappropriate and hazardous to traditional non-motorized users. Please zone the river to preserve the traditional, and highly popular, downstream floating experience upstream of the 191 bridge, and limit motorized use to below the 191 bridge.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. No authorizations will be issued by FFSL for new commercial motorized operations or expansions of existing commercial motorized operations until the recreation resource management plan is complete.
27	Email, paragraph 8	American Whitewater	Desired future conditions for water resources	27.1	Section 3.3 Water Resources: American Whitewater strongly supports all desired future conditions for water resources. Naturalized and seasonally variable flow and floodplain connectivity provide recreational opportunities and maintain river access and beaches for camping or picnicking.	Thank you for your comment.
27	Email, paragraph 9	American Whitewater	Use determinations	27.2	Table 3.2 Use Determination for Proposed Actions by River Use Class: Dams proposed on Class 1, 2, or 3 river segments should not be found allowable if they are determined to impact river recreation, navigability, or flow regime.	FFSL is obligated to manage sovereign lands and resources for the protection of the Public Trust values, which include navigability and recreation. A dam may not be allowed in a Class 1, 2, or 3 area if a site-specific analysis indicates that it is inconsistent with the protection of the Public Trust. No change to the CRCMP has been made.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
27	Email, paragraph 10	American Whitewater	Hydrology goals and objectives	27.3	Table 3.7 Hydrology Goals and Objections Common to All Classes: American Whitewater suggests the addition of a fifth Hydrology goal as indicated below. There are many recreational benefits associated with hydrology. Regulated and predictable flow regimes allow for vegetation to impedes on access and channel width. Beach maintenance is achieved with flows that support sediment supply and transport. This addition Hydrology Goal expands the hydrological benefits beyond the aquatic and riparian habitats. Hydrology Goal 5: Recognize the importance of flows supporting healthy recreational processes. Objective: Support research of preferential flows for all recreation types. Objective: Identify existing recreational use to develop metric for protection of that use Objective: Coordinate with agencies and partners to develop management strategies so projected declines to stream flows do not affect river recreation. Objective: Collaborate with and encourage management agencies and partners to promote healthy flow regimes, especially those supporting river recreation. Objective: Consider water quality during the authorization application process.	Based on your suggestions, FFSL has added a Hydrology Goal 5 to Table 3.7 of the CRCMP, along with three supporting objectives.
27	Email, paragraph 11	American Whitewater	Recreation objectives	27.4	Section 3.5 Community Resources - Recreation: American Whitewater supports the protection of areas of high wildlife habitat value or other sensitive areas. Camping and walking on banks in such sensitive areas should be avoided. However, paddling – canoeing, kayaking, and rafting – are likely some of the oldest forms of travel and exploration besides walking. Each river is a natural trail through the landscape, reflecting the character of the geology and natural beauty. Paddling is human-powered, place-based, low-impact, quiet, non-consumptive, skill-based, and Wilderness-compliant. With proper education and etiquette messaging, paddlesports should not be limited in sensitive areas.	It is possible that protection of a sensitive resource could require a temporary limitation on paddle sports. Any required recreation restrictions would be developed on a case-by-case basis, based on the particular resource protection need. No change to the CRCMP has been made.
27	Email, paragraph 12	American Whitewater	Recreation objectives	27.5	Table 3.19 Recreation Goals and Objectives Common to All Classes – Recreation Goal 4 Objective 2 "Limit new bridges and dams because they tend to degrade the experience of boaters on the river": American Whitewater strongly supports this objective.	Thank you for your comment.
27	Email, paragraph 13	American Whitewater	Access best management practices	27.6	Figure 3.15 Best Management Practices for access in the planning area: Camping opportunities should be identified between boater access points where those segments are over 10 miles apart.	This suggestion is outside FFSL's jurisdiction because we are not the adjacent upland landowner where camping would occur. No change to the CRCMP has been made.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
27	Email, paragraph 14	American Whitewater	Public safety objectives	27.7	Table 3.21 Public Safety Goals and Objectives Common to All Classes – Public Safety Goal 1 Objective 1 "Support removal or maintenance of temporary navigational hazards such as large woody debris and garbage": There are several considerations to be assessed when removing large woody debris for recreational safety. The ecological benefits of large woody debris need to be weighed against the threated posed to recreationists. Please see American Whitewater's guidance on integrating recreational boating considerations with in-stream modifications. https://www.americanwhitewater.org/content/Document/view/documentid/1006/	Edits have been made to this objective for clarification.
28	Online comment map	Randy Jorgen	Boat ramps	28.1	Maybe build one or two NARROW, downstream-angling canoe launch ramps at a big highway turnout above Grandstaff Canyon, to facilitate flatware small boat use (not commercial!)	Thank you for your comment.
29	Online comment form, paragraphs 1, 2	Liz Moran	Moab Uranium Mill Tailings Remedial Action (UMTRA) Project	29.1	Pg. 14 under U.S. Department of Energy- CHANGE: "As of May 2018, the UMTRA project had removed more than 9 million tons of the 16 million tons of tailings present, and the project is projected to be completed in 2034." SHOULD READ: "As of June 2019, the Moab UMTRA Project had removed more than 9.7 million tons of the 16 million tons of tailings present, and the project is projected to be completed in the 2030s."	Edits have been made as suggested.
29	Online comment form, paragraphs 3, 4, 5	Liz Moran	Moab UMTRA project	29.2	Pg. 128 Under Uranium- CHANGE: " Elevated concentrations of uranium and ammonia are present in the groundwater near the tailings piles, negatively affecting drinking water quality and endangered fish species." SHOULD READ: "Elevated concentrations of uranium and ammonia are present in the groundwater near the tailings pile, negatively impacting water quality and endangered fish species." (the aquifer beneath our site is not suitable for drinking water due naturally high salinity and the concentrations in the river are diluted less than 30 ft down-river, so we do not feel like it impacts drinking water).	Edits have been made as suggested.
30	Online comment form, paragraph 1	Dale Harris	Permits and authorizations	30.1	Most of my concerns have been covered in the draft. However, I would like to reiterate the importance of some of those again. As a land owner adjacent to the river, I question the requirement for a pumping permit. I have water rights issued from the Utah Division of Water Rights to use water out of the river which should be authorization enough.	FFSL is the executive authority for the management of sovereign lands and is required by law to establish conditions for the authorization and development of surface resources on sovereign lands. Use of sovereign lands, such as the bank of a portion of the Colorado River, for the installation of a pump requires a permit. A Utah Division of Water Rights (DWRi) permit allows use of the water; an FFSL permit allows use of the land for a structure or pump to access the water.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
30	Online comment form, paragraph 1	Dale Harris	Fees	30.2	Also, I'm opposed to a pumping fee required in conjunction with the pumping permit. Those fees could be raised at any time.	Fees are determined by the legislature and are not changed often. A typical FFSL authorization for an agricultural pump is issued for 10 years, and the authorization fee would cover the entire time period.
30	Online comment form, paragraph 2	Dale Harris	Jurisdiction	30.3	It seems like the layers of approval from various agencies for any alteration work along the river is overkill. I believe that approval from the Division of Water Rights and Corps of engineers should be enough.	FFSL understands the complexity involved when multiple agencies have jurisdiction and require different permits and authorizations. We know it can be very frustrating to understand what is required and go through the various hoops. However, alteration work on sovereign lands requires an authorization from FFSL as well. We are happy to help coordinate as much as possible with other managing agencies and are willing to discuss any issues with you at any time.
30	Online comment form, paragraph 3	Dale Harris	Noxious weeds	30.4	I have a concern as a private land owner with noxious weeds and their control in riparian areas along the river. It's costly and it is important on one's own land and to others downstream. Adjacent land owner management and control of their weeds is vital also.	Table 3.4, Wildlife Habitat Goal 4, in the CRCMP summarizes FFSL's management goals and objectives for noxious weeds. The fourth objective directs FFSL to coordinate with adjacent landowners interested in treating invasive and noxious weed infestations on their property. Please contact us if you are interested in treating invasive and noxious weeds.
30	Online comment form, paragraph 4	Dale Harris	Streambank stabilization and restoration	30.5	Stabilization & streambank restoration and improvement is almost impossible for small operators. I would like assistance for small restoration and riparian improvement projects on my land.	FFSL has goals and objectives in the CRCMP that support streambank stability and restoration. Please reach out to us for assistance.
31	Email, n/a	Alayne Yeoh	Recreation, jet boats, wildlife, safety	31.1	It seems like the jet boats and other outfitters are the only ones that matter in Moab anymore. We've been floating the daily for years enjoying the wildlife and peacefulness of the river. Not anymore! We saw one Heron on the 11 mile stretch we floated last week. We used to see a half dozen or more. The jet boat noise reverberates between the walls making a peaceful float impossible. Another concern is about the safety of the kayakers, paddle boards, tubers, swimmers, etc. On my last float I saw a jet boat get extremely close to a paddle boarder before they saw her. Is it going to take an injury or death before motorized craft is not allowed on the daily? There is plenty of river below the bridge for motorized use!	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. In addition, the CRCMP specifies goals and objectives in Table 3.4 to protect wildlife habitat and in Table 3.21 to address public safety issues.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
32	Email, paragraph 1	Aneth Wight	Motorized use, safety, wildlife, beaches	32.1	I just wanted to say that I feel that the Colorado River section from the Moab bridge upstream should be for non-motorized watercraft only. I am shocked that there hasn't been a serious accident/incident involving the jet boats and paddling folks. Those boats tear thru that section, and do stop when they see a boater, if they see them. Since their use of that river section, I haven't seen any more river otters, nor beavers, and the heron nests look empty. Their wake really destroys the nice beaches along that stretch of river too.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. In addition, the CRCMP specifies goals and objectives in Table 3.4 to address problem areas of bank erosion and protect wildlife habitat, in Table 3.19 to protect sensitive areas and wildlife, and in Table 3.21 to address public safety issues.
33	Email, paragraph 1	C. Bailey	Jet boats	33.1	Please consider keeping jet boat activity below the Bridge at Moab. The natural environment above the bridge is an asset.	Thank you for your comment. Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.
34	Email, paragraphs 1 and 2	Liz Ballenger	Recreation, motorized use	34.1	The Daily is becoming busier and busier with rafters, kayakers, and stand-up paddleboarders. The increase in tourism and recreation on the river shows no signs of waning. Thus, conflicts between motorized watercraft from MoabJet and others are also bound to increase- both in terms of safety concerns and also sheer annoyance to both motorized and non-motorized parties (it can't be much fun for MoabJet clients when their operators have to slow the boat to a crawl for every passing duckie!) So PLEASE, change the river management plan to stipulate no motorized use above the Colorado River bridge at hwy 191. Moab Jet and others can have just as much fun in the downstream section, at it will be much safer and a better experience for all the recreational users on the Daily section of river.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
35	Email, paragraphs 1 and 2	Sarah Topp	Jet boats	35.1	I am in opposition to allowing jet boat use on the upper section of the Colorado River for several reasons. 1 - It has been scientifically proven that jet boats injure the hearing ability of river otters and other underwater wildlife species (bank beaver as well) 2- The herons are being driven away from their rookery 3- The beaches are eroding in an unusual way, with steps being created on beaches 4 - Even though the jet boat company slows down when passing non-motorized users, it is a disruption to an otherwise peaceful activity. Studies have shown that stress levels from loud noise is a significant cause of disease in humans, especially those that are sensitive to loud and obtrusive noise 5 - Although the Jett company follows rules of etiquette on the river in order to keep their permit, this is not the case with other motorized users. I have seen jet skis and jet boat water skiers on the lower section above the bridge boat ramp and they do not slow down for non-motorized. This creates a potentially dangerous situation. 6 - I have seen what looked like Jett company boats above White's rapid. When did this change occur? Of course, as it stands, private jet boats can go anywhere they want. Please, please, please restrict the jet boats to the lower section of river.	Recreation conflicts, especially between motorized and non-motorized users on The Moab Daily segment, will be addressed through the upcoming development of a recreation resource management plan, which will provide specific solutions and management actions. Please see Table 3.19 in the CRCMP for FFSL's objectives to reduce recreation conflicts. In addition, the CRCMP specifies goals and objectives in Table 3.4 to address problem areas of bank erosion and protect wildlife habitat, in Table 3.19 to protect sensitive areas and wildlife, and in Table 3.21 to address public safety issues. The two FFSL-permitted commercial jet boat companies that operate upstream of the U.S. Highway 191 bridge are required to turn around at the Red Cliffs Lodge boat ramp or earlier. Any jet boat that is upriver from this boat ramp location is violating the terms of its permit. The two jet boat companies operate a total of five jet boats.
36	Email, Moab Field Office (MFO) comments, paragraph 1	Bureau of Land Management (BLM)	Technical edit	36.1	1. Page 154 Figure 2.54 Motorized vs. non-motorized river segments on the Colorado River -No motorized use is allowed above Cottonwood Wash regardless of the date per FR notice. The figure text mentions February to October dates -Commercial jet boats must stop at Red Cliffs Lodge. Technically the authorized jet boats must stop at the concrete boat ramp below Red Cliffs Lodge, and are not authorized to travel upstream through Whit's Rapid.	The text in Figure 2.54 has been clarified based on your suggestions.
36	Email, MFO comments, paragraph 2	BLM	Technical clarifications	36.2	2. Page 155 'Wakes from boat traffic can cause bank erosion. Wake effects can be significant in areas of restricted depth and width, and where the distance between vessel and bank is small.' -There are numerous locations where it is not possible for a vessel to proceed at wakeless speed within 150' ex. Goose Island, Big Sandy, Locals Beach -Kings Bottom and Goose Island Campgrounds are suffering from major bank erosion in the last three years. These campgrounds are at risk and need bank stabilization efforts to prevent further loss.	FFSL plans to look at the impacts of wakes on streambank erosion in more detail in the upcoming recreation resource management plan. We can look more closely at these areas (e.g., Goose Island, Big Sandy) during the recreation management plan process.

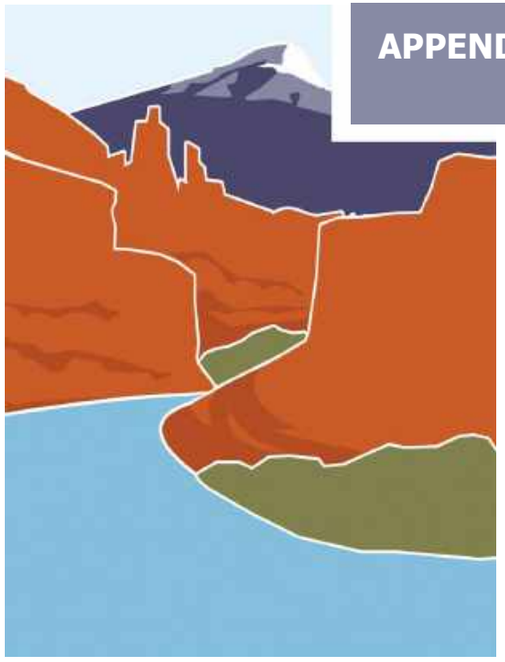
Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
36	Email, MFO comments, paragraph 2	BLM	Technical clarifications	36.3	FFSL developed recreational use rules for its navigable rivers (Utah Administrative Code R652-70-2400) If toilet facilities and trash receptacles area available between Castle Creek and the Potash boater access point, they may be used in place of reusable toilets and carrying out garbage. *This is not congruent with BLM regulations for overnight river trips will have and use a portable toilet system and pack out all waste and garbage.* The maximum group size for overnight river trips is 25 people *(From Cisco to Castle Creek BLM does not have a maximum group size limit)* Page 156: Only driftwood may be used as firewood. No cutting of firewood is allowed except in designated areas. *No collection of wood is allowed within the Colorado River corridor. There are no designated areas for cutting of firewood.* Page 156: FFSL prohibits camping on the beds of navigable rivers except in posted or designated areas (Utah Code 65A-3-1). *Where are these areas and how are islands classified?*	Changing FFSL's recreational use rules is beyond the scope of the CRCMP. However, FFSL will look at making rule changes on a case-by-case basis. No islands or sandbars have presently been posted or designated as open for camping by FFSL.
36	Email, MFO comments, paragraph 3	BLM	Technical edits	36.4	3. Page 158 Northern River Segments -At the time this plan was published FFSL does not issue commercial permits on the Westwater Canyon Wilderness Study Area segment (they are issued by the BLM*). BLM has a maximum allocation of 18 special recreation permits in Westwater Canyon. Each of the 18 has held a FFSL ROE permit for the past four or more years.* -*The BLM administers 22 commercial SRPs for the Cisco to Castle Creek segment* -BLM estimates that commercial river outfitters provide services to approximately 60,000 visitors in 2011. *The 22 commercial BLM SRPs had the following use of the Moab Daily/Cisco to Castle Creek section- 2018 had 56,123 users and 65,673 user days and in 2017 there were 56,804 users and 65,646 user days.*	Text has been edited. The second and third bullet points are located on page 160 of the CRCMP.
36	Email, MFO comments, paragraph 4	BLM	Technical edit	36.5	4. Page 158 Above Westwater -Please clarify that BLM, Colorado manages the 34 designated campsites along the permitted Ruby Horsethief section. Currently there are no designated campsites along the Utah section of the trip.	Text has been clarified as suggested.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
36	Email, MFO comments, paragraph 5	BLM	Technical edit	36.6	5. Page 159 Westwater Canyon Wilderness Study Area -There are seven campsites… *Please update to eleven individual campsites and one reservable group campsite.* -In 2011, the BLM reported 15,000 visitors to Westwater Ranger Canyon divided evenly between commercial river trips and private use on Westwater Canyon.	Text has been edited as suggested.
36	Email, MFO comments, paragraph 6	BLM	Technical edits	36.7	6. Page 160 The Moab Daily -Last paragraph, Commercial outfitters offered 51,355 non-motorized river trips to visitors on the Moab Daily segment in 2011. *Please update to reflect 2018 had 56,123 users and 65,673 user days and in 2017 there were 56,804 users and 65,646 user days* *-Does FFSL want to mention the Moab Daily Access Program partnership with BLM to increase access for adaptive sports organizations and educational institutions?* -Last sentence should include the BLM RMP decision that a permit system may be required if resource impacts are such that it is determined to be necessary.	Text has been edited as suggested. A discussion of the Moab Daily Access Program has been added to the "Access" section on page 169. The words "at this time" have been added to the last sentence.
36	Email, MFO comments, paragraph 7	BLM	Technical edits	36.8	7. Page 161 Community Resources *-BLM considers the Moab Daily section to begin at Cisco, not the Bald Eagle Campground (let's call Bald Eagle a camp site not campground)* -Upstream motorized boat travel from Cisco boater access point to the Westwater Ranger Station is not allowed between February 1 and October 15. *Upstream motorized travel is not allowed above Cottonwood Creek at any time during the year (with the exception of Search and Rescue operations and administrative needs).* -Commercial jet boat roundtrip tours operate in The Moab Daily segment. *BLM permits only one upstream motorized provider: Navtec.* -These jet boats operate on a river corridor with blind corners and limited area to maneuver. *There is a conflict between upstream motorized as in several locations there is not 150' available to meet the Utah State Boating Law requirements for wakeless speed.* -Last paragraph – *insert only into the* 'designated sites only on the north side of the river'.	The Moab Daily segment in the CRCMP is FFSL's own metric. "Bald Eagle Campground" has been changed to "Bald Eagle Campsite." Text has been edited as suggested. The text states that "These jet boats travel on a river corridor with blind corners and limited area to maneuver. Depending on river flows and the specific area, jet boats are forced to violate speed and proximity boating regulations." Text has been edited as suggested.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
36	Email, MFO comments, paragraph 8	BLM	Technical edits	36.9	8. Page 162 Community Resources -The matrix should be updated to reflect the following additions: •Restrooms are also available at Cisco, Fish Ford, Rocky Rapid, Sandy, Take Out (remove the word Beach), Poison Spider Trailhead and Corona Arch Trailhead •Correct the spelling of Jaycee Park Campground (not Jaysee) and include that it is a trailhead •Kane Creek Campground – I believe that this is referring to the Kane Springs Campground which is privately owned. •Correct the spelling of Gold Bar Campground (not Goldbar) •Potash is also privately owned	Text has been edited as suggested or clarifications have been made. The word "Takeout Beach" is in common usage and on river maps; it has not been changed.
36	Email, MFO comments, paragraph 9	BLM	Technical edit	36.10	9. Page 163 Community Resources - Meander Canyon -The preferred alternative included installing informational signs… None of these upgrades have occurred. *Some have indeed occurred.*	Text has been clarified as suggested.
36	Email, MFO comments, paragraph 10	BLM	Technical edits	36.11	10. Page 165 Community Resources – Trails *-The trails listed are physically located outside of the mean high water at the time of statehood and are therefore outside of the FFSL jurisdiction.*	Text has been clarified.
36	Email, MFO comments, paragraph 11	BLM	Technical edits	36.12	11. Page 166 Recreation Management Concerns -Conflicts between motorized and non-motorized use, primarily on The Moab Daily segment. *Add Meander Canyon to the first bullet.* -Bank erosion, primarily from motorized wakes. *Specify bank erosion to developed recreation facilities such as boat ramps, campgrounds (Goose Island, Grandstaff, Kings Bottom), trailheads*	This is a summary of resource issues and themes identified during public outreach. No changes to the text have been made.
36	Email, MFO comments, paragraph 12	BLM	Technical edits	36.13	12. Page 167 Community Resources -The BLM does not require permits for river users on The Moab Daily segment. *Insert the word private for river users as organized groups and commercial entities are required to have permits.* -Further Reading- include the BLM Three Rivers Withdrawal	Text has been clarified. The Three Rivers Withdrawal has been added to the Further Reading box.
36	Email, MFO comments, paragraph 13	BLM	Technical edits	36.14	13. Page 171 Educational Materials - Interpretive and informational signs would likely be placed outside of the mean high water mark at the time of statehood, or outside of the FFSL jurisdiction. *Hopefully these signs would be developed in partnership with review time for partner agencies?*	Yes. Note that the text states that FFSL would support the implementation of a coordinated signage system, not that we would initiate or install the system. The education goals and objectives in Table 3.22 specify coordination with appropriate agencies in the development of stewardship and river etiquette materials.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
36	Email, MFO comments, paragraph 14	BLM	Technical edit	36.15	14. Page 172 Figure 2.62 User groups in the planning area -Government *specify out BLM and NPS*	The graphic has been changed to include the word "federal."
36	Email, MFO comments, paragraph 15	BLM	Technical edit	36.16	15. Page 181 Table 3.4 *-Add BLM to the Management and Permitting Agencies*	Text has been edited as suggested.
36	Email, MFO comments, paragraph 16	BLM	Technical edit	36.17	16. Page 181 Table 3.5 *-Add BLM to the Management and Permitting Agencies*	Text has been edited as suggested.
36	Email, MFO comments, paragraph 17	BLM	Technical edit	36.18	17. Page 185 and 187 Water Resources *-Add BLM to the Management, Permitting, Intersecting Agencies*	"BLM" has been added to the management and permitting agencies. Intersecting agencies are typically different than the management and permitting agencies.
36	Email, MFO comments, paragraph 18	BLM	Technical edit	36.19	18. Page 193 Infrastructure Table 3.17 *-Add BLM to the Management and Permitting (outside of the FFSL jurisdiction)and Intersecting Agencies*	"BLM" has been added to the management and permitting agencies. Intersecting agencies are typically different than the management and permitting agencies.
36	Email, MFO comments, paragraph 19	BLM	Technical edit	36.20	19. Page 197 Table 3.19 Recreation Goals and Objectives Common to All Classes -Goal 1, 2 and 3 *add BLM to Management and Permitting (outside of the FFSL jurisdiction)and Intersecting Agencies*	"BLM" has been added to the management and permitting agencies. Intersecting agencies are typically different than the management and permitting agencies.
36	Email, MFO comments, paragraph 20	BLM	Technical edits	36.21	20. Page 198 Community Resources – Access -Best Management Practices – *Mention of coordination with the BLM to identify and develop* new access points, new trash and recycling receptacles near recreation infrastructure and at other places where users approach the river. *-Add BLM to Management and Permitting (outside of the FFSL jurisdiction)and Intersecting Agencies*	The second objective under Access Goal 1 in Table 3.20 has been modified in response to your suggestion. "BLM" has been added to the management and permitting agencies. Intersecting agencies are typically different than the management and permitting agencies.
36	Email, MFO comments, paragraph 21	BLM	Technical edit	36.22	21. Page 199 Community Resources Access Goal 2 *-Add BLM to Management and Permitting (outside of the FFSL jurisdiction)and Intersecting Agencies*	"BLM" has been added to the management and permitting agencies. Intersecting agencies are typically different than the management and permitting agencies.

Submission Number	Comment Type and Location	Commenter	Topic	Comment Number	Comment	Disposition/Response to Comment
36	Email, MFO comments, paragraph 22	BLM	Etiquette	36.23	22. Page 203 River Encounters -Camping 'Sending a boat ahead to secure a camp is not allowed'. *What regulation prohibit this action?*	The text has been edited to read "Sending a boat ahead to secure a camp is discouraged."
36	Email, MFO comments, paragraph 23	BLM	Miscellaneous	36.24	Items to consider: • need to consider the BLM 3 rivers withdrawal along Colorado and Green Rivers; • need to consider the potential impact of WSR designation on Green River; • as Brian Mueller noted during the June agency meeting, there is a need to better define on public maps river segments which are currently not adjudicated; • need to consider implications of new wilderness designation on west side of Labyrinth Canyon along the Green River; • need to define high water mark (extent of sovereignty) more precisely; "bank" may be hard to define (a moving target); • BLM is awaiting a draft MOU from FFSL that will facilitate collaborative and complimentary management of the Green and Colorado Rivers. This MOU will provide specifics and be a working document that will provide objectives and goals as well as how the two agencies will work together to achieve the best possible management of the unique resources.	The Three Rivers Withdrawal is discussed on page 137 of the CRCMP. The Wild and Scenic River designation is discussed on page 9 of the GRCMP. Maps have been reviewed to ensure that they indicate which segments of the river are currently not adjudicated. The new wilderness designation is discussed on page 10 of the GRCMP. Please see Section 1.2 of the CRCMP for an explanation of the ordinary high water mark (OHWM) and sovereign land boundaries. The subsection titled Colorado River Management explains how the OHWM definition is practically applied. Thank you for your comment on the MOU (memorandum of understanding).



APPENDIX B – LIST OF PREPARERS

Table B-1. List of Preparers for the Colorado River Comprehensive Management Plan

First Name	Last Name	Title/Role
SWCA Environmental Consultants		
Tom	Hale	Project manager
Gretchen	Semerad	Project manager
Linda	Burfitt	Lead editor
Ralph	Burrillo	Cultural resources lead
Diane	Bush	Technical editor
Dave	Epstein	Water resources lead
Jeremy	Eyre	Geology, paleontology, mineral resources lead
Reilly	Jensen	Graphic designer
Rachel	Johnson	Geographic information system specialist
Kerri	Linehan	Technical editor
Audrey	McCulley	Ecosystems lead
Debbi	Smith	Formatter
Rich	Valdez	Fisheries subject matter expert
Independent Consultant		
Jack	Schmidt	River geomorphology advisor
Alex	Walker	Fluvial geomorphologist
CRSA		
Melissa	Fryer	Design renderings lead
J. Kelly	Gillman	Planning lead
Susie	Petheram	Communications strategy coordinator (former)
River Science Institute, Inc.		
John	Gangemi	River-based recreation advisor
Hansen, Allen & Luce, Inc.		
Greg	Poole	Water resources engineer

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