5.3.7 Special Status Aquatic Species

5.3.7.1 Affected Environment

The U. S. Fish and Wildlife Service (USFWS) has designated nine aquatic species listed under the Endangered Species Act of 1973 (ESA) for analysis of effects from the LPP Project (USFWS Letter 3/16/09, confirmed 8/5/10 and 2/14/13). Critical habitats have been designated for five of the listed aquatic species.

5.3.7.1.1 Threatened, Endangered and Candidate Aquatic Species and Designated Critical Habitats.

Table 5-73 summarizes the threatened and endangered aquatic species listed by the USFWS under the ESA for the counties affected by the LPP Project pipeline, access roads and staging areas. Each species listing history, distribution, life history and ecology, and critical habitat, if designated, are considered separately. There are no candidate aquatic species identified by the USFWS in the counties affected by the LPP Project.

Table 5-73
Federally Listed Threatened and Endangered Aquatic Species by County

Common Name	Scientific Name	Listing Status[1]	State	County
Apache trout	*Oncorhynchus apache*	T	Arizona	Coconino
Bonytail chub[2]	*Gila elegans*	E	Utah Arizona	Kane Mohave[2]
Colorado pikeminnow	*Ptychocheilus lucius*	E	Utah	Kane
Humpback chub[2]	*Gila cypha*	E	Utah Arizona	Kane Coconino[2], Mohave[2]
Kanab ambersnail	*Oxyloma haydeni kanabensis*	E	Utah Arizona	Kane Coconino
Little Colorado spinedace	*Lepidomeda vittata*	T	Arizona	Coconino
Razorback sucker[2]	*Xyrauchen texanus*	E	Utah Arizona	Kane Coconino[2], Mohave[2]
Virgin River chub[2]	*Gila seminuda (=robusta)*	E	Utah Arizona	Washington[2] Mohave[2]
Woundfin[2]	*Plagopterus argentissimus*	E	Utah	Washington[2]

Notes:
[1] T = threatened, E = Endangered,
[2] Critical habitat designated for this species
Source: Fish and Wildlife Service, Species Listing Letters 3/16/09, 8/5/10, 2/14/13

5.3.7.1.1.1 Apache Trout.

Listing History and Status

Apache trout, was listed as endangered under the Endangered Species Conservation Act of 1967 due to "*destruction, drastic modification, or severe curtailment of their habitat*," and hybridization with introduced trout species (32 FR 4001). In 1975, the USFWS recommended a reclassification to threatened status. Apache trout is currently listed as threatened (FR 40 (137): 29863-29864). The Apache Trout Recovery Plan was first released in 1979 and revised in 1983 (USFWS 1983). The USFWS issued the Draft Apache Trout Recovery Plan, Second Revision in 2009.

Distribution

The Apache trout, Arizona's state fish, is distributed in the Salt River drainage from east-central Arizona and in the Gila River drainage into west New Mexico. The original distribution of Apache trout was described as upper Salt River drainage (Black and White Rivers), San Francisco River drainage (Blue River), and headwaters of Little Colorado River, Arizona (Miller 1972). Its current range is reported to be confined to the White Mountains and only on the Fort Apache Indian Reservation. Apache trout have been reported outside their historic range in a number of streams, including a pure population in North Canyon on the Kaibab National Forest. The LPP Project is not located in the vicinity of either of the known locations of the Apache trout.

Life History and Ecology

Apache trout evolved in streams primarily above 1,800 m (5,900 feet) elevation, within mixed conifer and ponderosa pine forests. Apache trout generally require water temperatures below 25° C (77° F). Adequate stream flow and/or shading are generally required to prevent lethal temperatures and ample stream flow helps maintain pools that are used frequently during periods of drought and temperature extremes. Apache trout require clean coarse gravel substrates for spawning. Recovery streams that are subject to land-use practices such as timber harvest/thinning, prescribed fire, and livestock grazing should be managed to maintain healthy riparian corridors that promote sufficient habitat conditions to allow for all life functions including spawning, hatching, rearing, foraging, loafing, migrating, and over-wintering. Prey of Apache trout consists mostly of invertebrates, which are typically abundant in healthy streams. Apache trout often use cover in the form of woody debris, pools, rocks/boulders, undercut streambanks, or overhanging vegetation at stream margins.

Designated Critical Habitat

There is no currently designated critical habitat for the Apache trout in the counties that would be crossed by the LPP Project, therefore, there would be No Effect to designated critical habitat.

5.3.7.1.1.2 Bonytail Chub.

Listing History and Status

Bonytail chub was listed under the federal ESA in 1980 (45 FR 27713), with a final determination of critical habitat on March 21, 1994 (59 FR 13374). The bonytail chub is listed as "endangered" under the federal ESA and by the State of Utah. Its Natural Heritage Status in Utah is S1-critically imperiled. The Bonytail Chub Recovery Plan was approved on May 16, 1984, with a revised plan approved September 4, 1990 (USFWS 1990a). An amendment to the recovery goals was approved in 2002 (USFWS 2002a).

Distribution

A small number of wild adult bonytail chub exist in Lake Mohave on the main stem Colorado River of the Lower Colorado River Basin (i.e., downstream of Glen Canyon Dam), and there are small numbers of wild individuals in the Green River and upper Colorado River sub-basins of the Upper Colorado River Basin (USFWS 2002a).

Life History and Ecology

Currently no self-sustaining populations of bonytail chub exist in the wild, and very few individuals have been caught throughout its range (USFWS 2002a). The bonytail chub is considered adapted to main stem rivers where it has been observed in pools and eddies. Similar to other closely related *Gila* sub-species, bonytail chub in rivers probably spawn in spring over rocky substrates, while spawning in reservoirs has been observed over rocky shoals and shorelines. There are no documented collections of bonytail chub from the affected area.

Designated Critical Habitat

The USFWS designated seven reaches of the Colorado River system as critical habitat for the bonytail chub in March 1994 (59 FR 13374). These reaches total 499 km (312 mi) as measured along the center line of the subject reaches. This represents approximately 14 percent of the historical habitat of the species. Critical habitat for the bonytail chub is designated for portions of the Colorado, Green, and Yampa Rivers in the Upper Basin and the Colorado River in the Lower Basin. Critical habitat encompasses the Colorado River from Hoover Dam to Davis Dam and another section of the Colorado River from the northern boundary of Havasu National Wildlife Refuge to Parker Dam including Lake Havasu in Mohave County, Arizona. Additional critical habitat is located in Colorado, Utah, Nevada, and California. There is no bonytail chub critical habitat in the project area. Therefore, there would be No Effect to designated critical habitat.

5.3.7.1.1.3 Colorado Pikeminnow.

Listing History and Status

The Colorado pikeminnow is listed as “endangered” under the federal ESA and by the State of Utah. This species was first included in the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001) and was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa). The Colorado squawfish (pikeminnow) was included in the United States List of Endangered Native Fish and Wildlife issued on June 4, 1973 (38 FR No. 106), and it received protection as endangered under Section 4(c)(3) of the original ESA of 1973. The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374). Its Natural Heritage Status in Utah is S1, critically imperiled.

Distribution

Wild, reproducing populations occur in the Green River and upper Colorado River sub-basins of the Upper Colorado River 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 sub-basin (USFWS 2002c). The species was extirpated from the Lower Colorado River Basin in the 1970s but has been reintroduced into the Gila River sub-basin, where it exists in small numbers in the Verde River (USFWS 2002c). Currently, three wild populations of Colorado pikeminnow are found in more than 1,000 miles of riverine habitat in the Green River, upper Colorado River, and San Juan River sub-basins (USFWS 2002c).

Life History and Ecology

The Colorado pikeminnow is a long-distance migratory species, moving many miles to and from spawning areas. Adults require pools, deep runs and eddy habitats maintained by high spring flows (USFWS 2002c). After hatching and emerging from spawning substrate, larvae drift downstream to nursery backwaters that are restructured by high spring flows and maintained by relatively stable base flows (USFWS 2002c).

Designated Critical Habitat

There is no currently designated critical habitat for the Colorado pikeminnow in the counties that would be crossed by the LPP Project, therefore, there would be No Effect to designated critical habitat.

5.3.7.1.1.4 Humpback Chub.

Listing History and Status

The humpback chub is listed as "endangered" under the federal ESA and by the State of Utah. This species was first included in the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001) and was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa). The humpback chub was included in the United States List of Endangered Native Fish and Wildlife issued on June 4, 1973 (38 FR No. 106), and it received protection as endangered under Section 4(c)(3) of the original ESA of 1973. The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374). Its Natural Heritage Status in Utah is S1, critically imperiled. Recovery goals for humpback chub, which amend and supplement the 1990 Recovery Plan, were finalized in 2002 (USFWS 2009).

Distribution

Six extant populations are known: the first five populations are in the Upper Colorado River Basin (i.e., upstream of Glen Canyon Dam), and the sixth population is in the Lower Colorado River Basin (USFWS 2009). Populations of humpback chub occur in the Little Colorado and Colorado rivers in the Grand Canyon, Black Rocks area of the Colorado River, Westwater Canyon, Cataract Canyon, Desolation/Grey Canyon, and Yampa Canyon (Valdez and Clemmer 1982, USFWS 1990, USFWS 2002). The largest population in the upper basin is in Westwater Canyon, with an estimated population size of about 2,400 adult fish. Humpback chub are currently rare in the Yampa River and in Cataract Canyon (Finney et al. 2004, McAda 2004, Jackson 2004a, 2004b, and Utah Division of Wildlife Resources 2004). Humpback chub in the lower Colorado River basin occurs in the Colorado River in Marble and Grand canyons, and in the lower ten miles of the Little Colorado River, constituting the Grand Canyon population, which also represents the lower basin recovery unit (USFWS 2009). In Grand Canyon, numbers of adult fish appear to have increased from about 4,500 to 5,700 in 2001 to an estimated 5,300 to 6,700 in 2006 (USGS 2007).

Life History and Ecology

Populations of humpback chub are restricted to deep, swift, canyon-bound regions of the mainstem and large tributaries of the Colorado River Basin (USFWS 2009). Adults require eddies and sheltered shoreline habitats maintained by high spring flows (USFWS 2009). Young fish require low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions (USFWS 2009). Humpback chub are typically omnivorous with a diet consisting of insects, crustaceans, plants, seeds, and occasionally small fish and reptiles. They appear to be opportunistic feeders, capable of switching diet according to available food sources. They ingest food items from the water's surface, mid-water column, and river bottom.

Designated Critical Habitat

Seven reaches of the Colorado River System were designated as critical habitat for the humpback chub over a total river length of 379 miles in the Yampa, Green, Colorado, and Little Colorado rivers in Arizona, Colorado and Utah. Designated reaches in the lower basin are the lower eight miles of the Little Colorado River and from River Mile (RM) 34 (Nautiloid Canyon) to RM 208 (Granite Park) along the Colorado River. The LPP Project area would not intersect with designated critical habitat and there would be No Effect to designated critical habitat.

5.3.7.1.1.5 Kanab Ambersnail.

Listing History and Status

The Kanab ambersnail is listed as endangered (57 FR 13657, April 17, 1992) without critical habitat. A Recovery Plan was published in 1995 (USFWS 1995a). The species has undergone a five-year status review (USFWS 2011). At the time of listing the Kanab ambersnail was determined to be endangered as a result of existing and potential habitat degredation resulting from private land development. A five-year review for this species was finalized in 2011. The five year review found that additional threats, including Colorado River flow management and climate change warrant no change in the listing stats of the species (USFWS 2011).

Distribution

Kanab ambersnail is a terrestrial land snail with a restricted distribution in Kane County, Utah and Coconino County, Arizona. The species inhabits perennially wet environments in seeps and springs draining sandstone or limestone cliffs with semi-aquatic vegetation (USFWS 2010). The currently known distribution of the Kanab ambersnail is restricted to three locations: two springs within the Grand Canyon and springs located at Three Lakes approximately six miles north of Kanab, Utah (USFWS 2010). The Three Lakes Canyon location is in Sections 19 and 30, Township 42 South, Range 6 West of the Salt Lake Meridian (USFWS 1995a).

Life History and Ecology

The Kanab ambersnail is found in semi-aquatic vegetation watered by springs or seeps at the base of sandstone or limestone cliffs at an elevation of approximately 884 m (2,900 ft). It requires either shallow standing water or a perennially wet soil surface. Grass or sedge cover is also necessary (USFWS 2010).

The Kanab ambersnail is vulnerable because of the rarity and small area of its habitat in the southwest and the small number of its populations. Threats include habitat alteration or destruction from development and heavy grazing; and possible illegal collecting; recreation; and high flows from Glen Canyon Dam affecting habitat in the Grand Canyon (USFWS 2010).

Designated Critical Habitat

There is no currently designated critical habitat for the Kanab ambersnail.

5.3.7.1.1.6 Little Colorado Spinedace.

Listing History and Status

The Little Colorado spinedace was listed as threatened with critical habitat designated on October 16, 1987 (USFWS 1987).

Distribution

The spinedace is a small (about four inch) minnow native to the Little Colorado River drainage. This fish occurs in disjunct populations throughout much of the Little Colorado River drainage in Apache, Coconino, and Navajo counties. Extensive collections summarized by Miller (1963) indicated that the spinedace had been extirpated from much of the historical range from 1939 to 1960. Although few collections were made of the species prior to 1939, the species is believed to have inhabited the northward flowing Little Colorado River tributaries of the Mogollon Rim, including the northern slopes of the White Mountains. Mitochondrial DNA work on the spinedace was initiated in the 1990s and indicated the existence of three sub-groups identifiable by geographic area (Tibbets *et al.* 1994): the East Clear Creek drainage, Chevelon Creek, and the upper Little Colorado River including Nutrioso and Rudd creeks.

Life History and Ecology

The Little Colorado spinedace is found in a variety of habitats, which is expected for a species adapted to fluctuating physical conditions (Blinn and Runck 1990, Miller 1963, Miller and Hubbs 1960, Nisselson and Blinn 1989). It is unclear whether occupancy of these habitats reflects the local preferences of the species or its ability to tolerate less-than-optimal conditions. Available information indicates that suitable habitat for the Little Colorado spinedace is characterized by clear, flowing pools with slow to moderate currents, moderate depths, and gravel substrates (Miller 1963, Minckley and Carufel 1967). Cover provided by undercut banks or large rocks is often a feature. Spinedace have also been found in pools and flowing water conditions over a variety of substrates, with or without aquatic vegetation, in turbid and clear water (Denova and Abarca 1992, Nisselson and Blinn 1991). Water temperatures in occupied habitats ranged from 58 to 78 degrees Fahrenheit (Miller 1963). Miller (1963) called the spinedace "trout like" in behavior and habitat requirements, and it is likely that prior to 1900 the spinedace used habitats now dominated by non-native salmonids.

Designated Critical Habitat

Forty-four stream miles of critical habitat are designated: 18 miles of East Clear Creek immediately upstream and 13 miles downstream from C.C. Cragin Reservoir (formerly called Blue Ridge Reservoir) in Coconino County; eight miles of Chevelon Creek in Navajo County; and five miles of Nutrioso Creek in Apache County. The LPP Project would have No Effect on designated critical habitat.

5.3.7.1.1.7 Razorback Sucker.

Listing History and Status

The razorback sucker was first proposed for listing under the Endangered Species Act (Act) on April 24, 1978, as a threatened species, but was later withdrawn for technical reasons. In March 1989, the Fish and Wildlife Service was petitioned by a consortium of environmental groups to list the razorback sucker as an endangered species. The Fish and Wildlife Service made a positive finding on the petition in June 1989, which was published in the Federal Register on August 15, 1989. A final rule was published on October 23, 1991, with an effective date of November 22, 1991 (56 FR 54957). Critical habitat was designated on March 21, 1994 (59 FR 13374). The Razorback Sucker Recovery Plan was released in 1998 (USFWS 1998). Recovery Goals were approved in 2002 (USFWS 2002b). Its Natural Heritage Status in both Arizona and Utah is S1, critically imperiled.

Distribution

Historically, razorback sucker were widely distributed in warm-water reaches of larger rivers of the Colorado River Basin from Mexico to Wyoming (USFWS 2002b). The species is endemic to the Colorado River Basin of the southwestern United States (USFWS 2002b). Razorback sucker are currently found in small numbers in the

Green River, upper Colorado River, and San Juan River sub-basins; lower Colorado River between Lake Havasu and Davis Dam; reservoirs of Lakes Mead and Mohave; in small tributaries of the Gila River sub-basin (Verde River, Salt River, and Fossil Creek); and in local areas under intensive management such as Cibola High Levee Pond, Achii Hanyo Native Fish Facility, and Parker Strip (USFWS 2002b). The lower Paria River may provide suitable habitat for razorback sucker near the confluence with the Colorado River in Grand Canyon.

Life History and Ecology

Habitats required by adults in rivers include deep runs, eddies, backwaters, and flooded off-channel environments in spring; runs and pools often in shallow water associated with submerged sandbars in summer; and low-velocity runs, pools, and eddies in winter (USFWS 2002b). Spring migrations of adult razorback sucker were associated with spawning in historic accounts, and a variety of local and long-distance movements and habitat-use patterns have been documented (USFWS 2002b). Young require nursery environments with quiet, warm, shallow water such as tributary mouths, backwaters or inundated floodplain habitats in rivers, and coves or shorelines in reservoirs (USFWS 2002b).

Designated Critical Habitat

Critical habitat was designated in 15 river reaches in the historical range of the razorback sucker on March 21, 1994, with an effective date of April 20, 1994. Critical habitat included portions of the Colorado, Duchesne, Green, Gunnison, San Juan, White, and Yampa rivers in the Upper Colorado River Basin, and the Colorado, Gila, Salt, and Verde rivers in the Lower Colorado River Basin. The LPP Project would have No Effect on designated critical habitat.

5.3.7.1.1.8 Virgin River Chub.

Listing History and Status

On August 23, 1978, the USFWS proposed listing the Virgin River chub as endangered and designating critical habitat (43 FR 37668). The USFWS withdrew this proposal (45 FR 64853; September 30, 1980), due to the 1978 amendments to the Act. On June 24, 1986, the USFWS again proposed the listing as endangered and the designation of critical habitat for the Virgin River chub (51 FR 22949). The final rule to list the Virgin River chub as endangered was published on August 24, 1989 (54 FR 35305). The Recovery Plan for Virgin River Fishes was approved on April 19, 1995. The Virgin River Resource Management and Recovery Program was established in 2002 to implement actions to recover, conserve, enhance and protect native species, including the Virgin River chub, in the Virgin River Basin and to enhance the ability to provide adequate water supplies for sustaining human needs (UDNR, 2002). The Recovery Action Plan includes the following objectives: describe baseline conditions, provide and protect instream flows, protect and enhance habitat, protect and enhance native species communities, maintain genetically appropriate brood stocks, determine ecological factors limiting abundance of native species, monitor habitat conditions and populations, and improve education and communication on resource issues (UDNR, 2002). The species is listed as a species of concern to the Arizona Game and Fish Department according to the Arizona Natural Heritage Listing on the AGFD website.

Distribution

The Virgin River chub was first collected in the 1870s from the Virgin River near Washington, Utah. Historically, it was collected in the mainstem Virgin River from Pah Tempe Springs, Utah, downstream to the confluence with the Colorado River in Nevada (Cope and Yarrow 1875; Cross 1975). Presently, the Virgin River chub occurs within the mainstem Virgin River from LaVerkin Springs, Utah, downstream to at least the Mesquite Diversion, located near the Arizona-Nevada border. Virgin River chub have not been collected below this point, except for a few individuals, since the late 1970's (Virgin River Fishes Data Base). The Virgin River chub also occurs within

the Moapa River in Nevada. A captive population of Virgin River chub is currently maintained at the Wahweap State Fish Hatchery as a refugium population and for propagation studies, as well as in the Toquerville Secondary Water System upper pond.

Life History and Ecology

Adult and juvenile Virgin River chub select deep runs or pools with slow to moderate velocities containing boulders or other instream cover over a sand substrate. Generally, larger fish occupy deeper habitats; however, there is no apparent correlation with velocity. Chub are generally found in velocities ranging up to 0.76 m/s (2.5 ft/s). Virgin River chub are omnivorous, showing considerable dietary shifts with age and season. In general, Virgin River chub feed mainly on debris and chironomids in February; Cladophora and debris in June; debris and Spyrogyra and Cladophora in September; and unidentified drift animals, dragonfly larvae, debris, and Cladophora in December.

Designated Critical Habitat

The area designated as critical habitat for the Virgin River chub is the mainstem Virgin River and its 100-year floodplain, extending from the confluence of LaVerkin Creek to Halfway Wash, Nevada. The 100-year floodplain, as defined by the FEMA, is an area of land that would be inundated by a flood having a one percent chance of occurring in any given year. It is the Federal standard for protection of life and property and is delineated and readily available on FEMA floodplain maps. This boundary was primarily chosen for two reasons: (1) The biological integrity and natural dynamics of the river system are maintained within this area (*i.e.,* allowing the river to meander within its main channel in response to large flow events, thereby recreating the mosaic of habitats necessary for the survival and recovery of Virgin River endangered fishes); and (2) conservation of the 100-year floodplain also helps protect the riparian areas and provide essential nutrient recharge to the Virgin River, which contributes to successful spawning and recruitment of endangered fishes. The LPP Project would have No Effect on the designated critical habitat.

5.3.7.1.1.9 Woundfin.

Listing History and Status

The USFWS listed woundfin as endangered on October 13, 1970 (35 FR 16047), and proposed critical habitat on November 2, 1977 (42 FR 57329). However, on March 6, 1979, the USFWS withdrew the proposal for critical habitat (44 FR 12382) due to the 1978 amendments to the Act, which required proposals to be withdrawn if not finalized within two years. A Woundfin Recovery Plan was originally approved in July 1979 and subsequently revised on March 1, 1984. The Recovery Plan for Virgin River Fishes was approved on April 19, 1995. The Virgin River Resource Management and Recovery Program was established in 2002 to implement actions to recover, conserve, enhance and protect native species, including the woundfin, in the Virgin River Basin and to enhance the ability to provide adequate water supplies for sustaining human needs (UDNR, 2002). The Recovery Action Plan includes the following objectives: describe baseline conditions, provide and protect instream flows, protect and enhance habitat, protect and enhance native species communities, maintain genetically appropriate brood stocks, determine ecological factors limiting abundance of native species, monitor habitat conditions and populations, and improve education and communication on resource issues (UDNR, 2002). The species is listed as a species of concern to the Arizona Game and Fish Department according to the Arizona Natural Heritage Listing on the AGFD website.

Distribution

On the basis of early records, the original range of woundfin extended from near the junction of the Salt and Verde Rivers at Tempe, Arizona, to the mouth of the Gila River at Yuma, Arizona (Gilbert and Scofield 1898).

Woundfin were also likely found in the mainstream Colorado River from Yuma ("Fort Yuma"; Jordan and Evermann 1896; Meek 1904; Follett 1961) upstream to the Virgin River in Nevada, Arizona, and Utah, and into LaVerkin Creek, a tributary to the Virgin River in Utah (Gilbert and Scofield 1898, Snyder 1915, Miller and Hubbs 1960, Cross 1975). Woundfin have been extirpated from almost all of their historical range except the mainstem Virgin River. Woundfin presently range from LaVerkin Springs (also called Pah Tempe Springs) on the mainstream of the Virgin River and the lower portion of LaVerkin Creek in Utah, downstream to Lake Mead. A single specimen was taken from the middle Moapa (Muddy) River, Clark County, Nevada, in the late 1960s (Deacon and Bradley 1972) but none have been collected there since, and the species is considered extirpated from this river. The species has been transplanted by the Arizona Game and Fish Department into the Paria River (Arizona Game and Fish Stocking Records, unpub. data). No woundfin were found during Paria River surveys in May 1974 and May 1975 (Arizona Game and Fish Stocking Records, unpub. data). In addition, a captive population was established in 1988 at Dexter National Fish Hatchery and Technology Center, New Mexico (now Southwestern Native Aquatic Resource and Recovery Center), to assist in research to develop rearing protocols, for propagation studies and to augment Virgin River populations.

Life History and Ecology

Adult and juvenile woundfin inhabit runs and quiet waters adjacent to riffles with sand and sand/gravel substrates. Adults are generally found in habitats with water depths between 0.15 and 0.43 meters (m) (0.5 and 1.4 feet (ft)) with velocities between 0.24 and 0.49 meters per second (m/s) (0.8 and 1.6 feet per second (ft/s)). Juveniles select areas with slower and deeper water, while larvae are found in backwaters and stream margins which are often associated with growths of filamentous algae. Spawning takes place during the period of declining spring flows.

Designated Critical Habitat

The area designated as critical habitat for woundfin is the mainstem Virgin River and its 100-year floodplain, extending from the confluence of LaVerkin Creek to Halfway Wash, Nevada. Refer to the discussion in the related portion of Section 5.3.7.1.1.8 for further information.

5.3.7.1.2 Federal Sensitive Species and State/Local Agency Species of Concern.

Five aquatic species inhabiting streams and rivers within the LPP Project study area have been listed as sensitive by federal agencies or species of concern by state and local agencies. These species are:

- Flannelmouth sucker (*Catostomus latipinnis*)
- Bluehead sucker *(Catostomus discobolus*)
- Speckled dace (*Rhinichthys osculus reliquus*)
- Desert sucker (*Catostomus clarkii*)
- Virgin spinedace (*Lepidomeda mollispinus*)

Sensitive species are usually rare within at least a portion of their range. Many are protected under certain state and/or Federal laws. Species designated as sensitive by the BLM must be native species found on BLM-administered lands for which the BLM has the capability to significantly affect the conservation status of the species through management, and either:

1. There is information that a species has recently undergone, is undergoing, or is predicted to undergo a downward trend such that the viability of the species or a distinct population segment of the species is at risk across all or a significant portion of the species
2. The species depends on ecological refugia or specialized or unique habitats on BLM-administered lands, and there is evidence that such areas are threatened with alteration such that the continued viability of the species in that area would be at risk.

All federally-designated candidate species, proposed species, and delisted species in the 5 years following delisting are included as BLM sensitive species.

5.3.7.1.2.1 Flannelmouth Sucker.

Flannelmouth sucker (*Catostomus latipinnis*) is endemic to the Colorado River Basin. Within the southwest there are populations in western Colorado and south-central Wyoming, but few of these populations are located on government lands. Flannelmouth sucker is protected under a Conservation Agreement (UDWR 2006a). The Virgin River provides habitat for flannelmouth sucker, which is listed by the BLM in Utah and Arizona as sensitive.

Flannelmouth sucker is a bottom feeder, consuming algae, other fragmented vegetation, seeds and invertebrates. Flannelmouth sucker live within moderate to large rivers and are typically threatened by nonnative species, hybridization, habitat alteration and blockage of migration routes. The primary threats to flannelmouth sucker are generally human-induced activities that divert water and change the flow regime in both tributary and main stem streams. Specific threats include (a) construction of passage barriers (e.g., diversion dams and reservoirs) that disconnect habitats and cause habitat fragmentation and (b) introduction of non-native species that are both predators on and competitors with the flannelmouth sucker. Other threats include modification of streambeds through channelization, landscape changes resulting from land use, and local degradation of riparian zones that reduces the natural functions of the stream ecosystem (UDWR 2005b).

The Flannelmouth sucker does not have a potential project nexus because suitable habitat in the Paria River is downstream from Highway 89 where the LPP Project alignment would cross the river. The Paria River is listed as a perennial stream by the USGS, however, the USGS streamflow records for the Paria River at Highway 89 demonstrate the river has periods during the summer months when there is no flow. The only potential effect of the temporary construction on the Paria River would be changes in water quality that could affect fish and habitat in downstream reaches. Construction of the pipeline crossing of the Paria River at Highway 89 would be performed during a period when there is no flow or low flow to avoid effects on surface water quality (turbidity and sediment transport).

5.3.7.1.2.2 Bluehead Sucker.

The bluehead sucker *(Catostomus discobolus*) is endemic to the Colorado River Basin. Historically, bluehead suckers occurred in streams and rivers in the Colorado River Basin as well as in the drainages of the upper Snake, Weber, and Bear rivers. Although this species sometimes occupies areas of suitable habitat in larger, low elevation, mainstem streams, it is most commonly collected in small or mid-sized tributaries of the Colorado River Basin. Most reaches of the basin receive heavy sediment loads, high annual peak flows, and low base flows. Little is known about the influence of these annual events, but healthy bluehead sucker populations have persisted in habitats with a wide range of annual flows, sediment transport and sediment deposition, providing that these physical events are associated with a natural flow regime.

The Paria River provides habitat for the bluehead sucker, which is listed in Utah and Arizona as sensitive. The bluehead sucker is protected under a Conservation Agreement (UDWR 2006b). Bluehead sucker feeds on the bottom of stream substrate and algae and typically inhabits large rivers and mountain streams in variable turbidity and temperature. Adult bluehead suckers exhibit a strong preference for specific habitat types (Holden and Stalnaker 1975). In-stream distribution is often related to the presence of rocky substrate which they prefer (Holden 1973). This species has been reported to typically be found in runs or riffles with rock or gravel substrate (Vanicek 1967, Holden and Stalnaker 1975, Carlson et al. 1979, Sublette et al. 1990). Juveniles have been collected from shallow riffles, backwaters, and eddies with silt or gravel substrate (Vanicek 1967). Dam construction and the associated alterations of the thermal and hydrological regimes have reduced bluehead sucker populations in both the Lower and Upper Colorado River basins (Vanicek et al. 1970).

The bluehead sucker does not have a potential project nexus because suitable habitat in the Paria River is downstream from Highway 89 where the LPP Project alignment would cross the river. The only potential effect of the temporary construction on the Paria River would be changes in surface water quality that could affect fish and habitat in downstream reaches. Construction of the pipeline crossing of the Paria River at Highway 89 would be performed during a period when there is no flow or low flow to avoid effects on surface water quality (turbidity and sediment transport).

5.3.7.1.2.3 Speckled Dace.

Speckled dace (*Rhinichthys osculus reliquus*) is listed only in Arizona as a BLM sensitive species and as a state sensitive species and inhabits the lower Paria and Virgin Rivers in Arizona. The speckled dace is a small minnow common in many western waters. In Utah, the species is quite common, occurring in many of the state's major streams and in numerous desert springs. Speckled dace has adapted to many different types of habitat, ranging from cold swift-flowing mountain headwaters to warm intermittent desert streams and springs.

Speckled dace is a bottom-dwelling species and is an important forage fish. The species is a benthic feeder, eating primarily insect larvae and other invertebrates, although algae and fish eggs are also consumed. The species spawns during the spring and summer over gravel areas that have been cleaned by territorial males. Speckled dace is a schooling species that is most active at night. In many parts of their range, speckled dace are important forage fish for sport fish species.

Speckled dace does not have a potential project nexus because suitable habitat in the Paria River is downstream from Highway 89 where the LPP Project pipeline would cross the river. The only potential effect of the temporary construction on the Paria River would be changes in surface water quality that could affect fish and habitat in downstream reaches. Construction of the pipeline crossing of the Paria River at Highway 89 would be performed during a period when there is no flow or low flow to avoid effects on surface water quality (turbidity and sediment transport).

5.3.7.1.2.4 Desert sucker.

Desert sucker (*Catostomus clarkii*) is a freshwater species of fish in the sucker family endemic to the Colorado River basin. Desert sucker occurs in the lower Colorado River basin, below the Grand Canyon, particularly in the Gila River, and in streams in the Virgin River basin, the White River basin and others. Their total range area is estimated at 128,000 km^2 (49,000 mi^2). This species is considered a state Wildlife Species of Concern in Arizona.

Desert sucker prefers riffles, rapids and flowing streams with gravelly bottoms. Desert sucker is a benthic (bottom dwelling) fish that primarily eats algae, although insects and other invertebrates are also occasionally consumed. Members of the species almost always occur in streams, where spawning occurs in riffles during winter and spring.

The species occurs in the Virgin River system in the southwestern corner of Utah and the northwestern corner of Arizona.

5.3.7.1.2.5 Virgin Spinedace.

Virgin spinedace (*Lepidomeda mollispinus*) is a cyprinid fish endemic to the Virgin River, a tributary of the Colorado River. Populations of Virgin spinedace currently exist in the mainstem Virgin River and eleven of its tributaries including East Fork Virgin River, Shunes Creek, North Fork Virgin River, North Creek, LaVerkin Creek, Ash Creek, Santa Clara River, Beaver Dam Wash, Coal Pits Wash, Moody Wash and Magotsu Creek. According to Addley and Hardy (1993), the largest populations occur in the upper mainstem above Quail Creek diversion and in drainages of the Santa Clara River and Beaver Dam Wash. Small populations exist in Ash Creek,

LaVerkin Creek, and the lower mainstem below LaVerkin Springs. The remaining areas contain intermediate-sized populations. Although the species has a very restricted range, most of the crucial habitat has been protected under a Conservation Agreement, and the species is not currently listed as endangered because the Conservation Agreement is in place (UDWR 2006).

Virgin spinedace are primarily insectivorous, feeding on a wide range of insects and occasionally plant material and organic debris (Rinne 1971, Greger and Deacon 1988; Angradi et al. 1991). Virgin spinedace feed on drifting prey in mid-water and at the surface. They usually maintain equilibrium in the midwater column, darting to the surface to capture prey in a manner similar to drift-feeding salmonids (Rinne 1971, Addley and Hardy 1993).

Virgin spinedace habitat modification and/or elimination has occurred primarily through human activities such as water depletion or diversion.

5.3.7.2 Environmental Effects

This section analyzes LPP Project effects on federally listed threatened and endangered aquatic species and designated critical habitat, federal sensitive species, and state and local agency aquatic species of concern.

5.3.7.2.1 Effects Determinations and Significance Criteria.

5.3.7.2.1.1 Federally Listed Species.

This section describes the criteria used to determine the magnitude of effects from the Proposed Action and alternatives. The ESA establishes the legal criteria for determining effects on federally threatened and endangered aquatic species. The following are accepted determinations of effects on listed species:

- No Effect: no effect on the listed species or designated critical habitat
- May Affect, Not Likely to Adversely Affect: effects on the listed species or designated critical habitat are insignificant and/or discountable. If effects are "beneficial" then this determination "category" applies.
- Likely to Adversely Affect: effects that would result in a short- or long-term incidental take of the listed species or designated critical habitat

Adverse effects on listed species include the following:

- Taking of threatened or endangered species
- Loss or degradation of utilized or potentially utilized habitat that would exceed the estimated level necessary to maintain viable populations or sub-populations of each species
- Actions that lead to long-term disturbance in species migration and dispersal, breeding behavior or pollination that would threaten the viability of the population or sub-population

Take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." Through regulations, the term "harm" is defined as "an act which actually kills or injures wildlife." Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." (USFWS 2010a)

Under ESA Section 7, federally listed species must be analyzed in a Biological Assessment (BA) and the findings submitted to the USFWS, which then makes a determination of effect and if there is an affect issues a Biological

Opinion (BO). If there is no effect and USFWS concurs, then no BO is issued. Incidental take – take that results from a Federal action, but is not the purpose of the action – may be allowed when the USFWS approves it through an incidental take statement. The statement includes the amount or extent of anticipated take due to the Federal action, reasonable and prudent measures to minimize the take, and terms and conditions that must be observed when implementing those measures (USFWS 2010a).

After the USFWS issues its biological opinion, the sponsoring Federal agency then decides how to proceed. If the BO determines that adverse effects would occur from the Proposed Action, the sponsoring agency can adopt the reasonable and prudent measures described in a BO incidental take statement and proceed with the project. If the USFWS makes a jeopardy determination, the Federal agency has several options (USFWS 2010a):

- implement one of the reasonable and prudent alternatives
- modify the proposed project and consult again with the USFWS
- decide not to undertake (or fund, or authorize) the project
- disagree with the opinion and proceed
- apply for an exemption

5.3.7.2.1.2 Federal Sensitive Species and State/Local Agencies Species of Concern.

Significance criteria for aquatic species of concern would be the same as those for general aquatic species:

- Project activities resulting in substantial disturbance to aquatic habitat or populations. A substantial disturbance is one that destroys a large area of utilized habitat, disturbs or displaces a resident population or sub-population, or results in losses of a large number of individuals of the species within the LPP Project study area. Disturbance may arise from direct construction effects on habitat or indirectly by noise or human activity that would reduce aquatic habitat values. Substantial disturbance is based on the status, population dynamics, behavior, habitat availability and quality for each species group relative to the type, intensity and duration of a specific effect. Species that are locally common or have a high reproductive potential and ability to re-colonize previously disturbed sites rapidly would have less potential effects than species with small populations, restricted to limited habitats, have low reproductive potential or limited ability to disperse out of or back into previously disturbed habitats.

5.3.7.2.2 Potential Effects and Alternatives Eliminated from Further Analysis.

5.3.7.2.2.1 Transmission Line Alignments.

Construction and/or operation of electrical power transmission line(s) would have no effect on special status aquatic resources species and habitats as a result of implementing the Proposed Action or alternatives and are not considered further. All of the transmission line alignments near aquatic habitats have existing roads which would be utilized during construction. No new roads would be constructed to access transmission line alignments that could be sources of sediment recruitment to streams and rivers.

5.3.7.2.2.2 Virgin River Critical and Crucial Habitat.

Critical habitat for Virgin River chub (*Gila seminuda (=robusta))* and woundfin (*Plagopterus argentissimus)* and crucial habitat for desert sucker (*Castastomus clarkia*) and Virgin spinedace (*Lepidomeda mollispinus*) along the Virgin River would not be directly or indirectly affected by the LPP construction or operation. LPP construction activities would terminate at Sand Hollow Reservoir more than three miles east of the Virgin River. LPP Project operation would supply raw water to Sand Hollow Reservoir for treatment in the Quail Creek Water Treatment Plant before distribution throughout the WCWCD service area. Following use in homes, businesses and

institutions, the wastewater would be treated in wastewater treatment facilities and then further treated in the wastewater reclamation facility for reuse as secondary irrigation water. This water would be stored in existing and approved reservoirs in the St. George metropolitan area and used for outdoor watering. The UDWRe has modeled the Virgin River using the Virgin River Daily Simulation Model (VRDSM) for future scenarios involving no LPP water and with LPP water to determine the potential for return flows to the Virgin River that could potentially affect designated critical habitat and riparian areas. The VRDSM results indicate that LPP return flows to the Virgin River would be within the measurement accuracy of the USGS gages on the Virgin River and changes in river flows would not be measurable. The VRDSM model results demonstrate no measurable changes (increases or decreases) in streamflows from the USGS gage at Virgin to the USGS gage near the Utah-Arizona state line by comparison of base case (full utilization of Virgin River water rights with current facilities) and LPP water deliveries to Sand Hollow Reservoir. Flow duration curves at key simulation nodes in the Virgin River compared between the future without the LPP and future with the LPP are statistically identical, indicating there would be no measurable difference in return flows to the river (see Section 5.3.3.2.2.2 in this chapter). The LPP Project construction and operation would have no effect on Virgin River chub or woundfin and would have no effect on critical habitat for Virgin River chub and woundfin, and no effects on crucial habitat for desert sucker and Virgin spinedace. Therefore, potential effects from LPP Project return flows on designated critical habitat for Virgin River chub (*Gila seminuda (=robusta))* and woundfin (*Plagopterus argentissimus)* and crucial habitat for desert sucker (*Catostomus clarkii*) and Virgin spinedace (*Lepidomeda mollispinus*) along the Virgin River are eliminated from further analysis. A detailed description and analysis of the VRDSM model results is included in the final Surface Water Resources Study Report (UDWRe 2016a).

5.3.7.2.2.3 Paria River Aquatic Habitat at Highway 89.

The reach of the lower Paria River which maintains perennial stream flow without interruption and contains suitable habitat for special status aquatic species is located miles downstream from Highway 89 where the Proposed Action and alternative alignments would cross the river. The special status aquatic species known to inhabit the lower Paria River include razorback sucker (*Xyrauchen texanus*), flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker *(Catostomus discobolus*) and speckled dace (*Rhinichthys osculus reliquus*). The Paria River is listed as a perennial stream by the U.S. Geological Survey (USGS), however, the USGS streamflow records for the Paria River at Highway 89 demonstrate the river has sustained periods during the summer months when there is no flow. The only potential effect of the temporary construction on the Paria River would be changes in water quality that could affect fish and habitat in downstream reaches. Construction of the pipeline crossing of the Paria River at Highway 89 would be performed during the summer period when there is no flow or low flow to avoid effects on surface water quality (turbidity and sediment transport). If the Paria River has low flows during the temporary construction of the pipeline crossing, then a temporary cofferdam would be constructed to divert the flow to another part of the 340-foot wide river bottom or through culvert pipes to avoid active construction in the flowing portion of the river. BMPs would be used to prevent potential water quality effects on flow in the Paria River during the pipeline crossing construction. These BMP's would include the following:

- Construction of the pipeline crossing of the Paria River would be performed when the streams are either at low flows or are dry.
- Silt fences and/or straw bales would be temporarily installed upstream or up-gradient of riparian areas to filter suspended sediments and bedload sediments to avoid sedimentation effects during construction. If necessary, silt fences and/or straw bales would be installed in series to control sediments and turbidity generated by construction activities. Silt fences would be removed and disposed of in approved landfills upon completion of the work.
- Temporary coffer dams would be constructed upstream of pipeline crossings for diversion of Paria River flows during construction. Stream flows would be diverted around in-channel work and excavation areas to control turbidity during construction of the pipeline crossings. Temporary coffer

dams would be removed from the stream following completion of the pipeline construction crossing and the aquatic habitat would be restored to preconstruction conditions.

- Equipment usage and operation within temporarily dewatered reaches of stream channels would be minimized to protect stream bed substrates.
- Construction equipment working within the temporarily dewatered reaches of stream channels would be checked and regularly monitored for leaking hydraulic fluid, oil, grease, and fuel. Any visible leaks would result in immediate removal of the leaking equipment from the stream channel work area and containment of the leakage within a containment pad in an upland area at least ¼ mile from the stream channel in order to isolate potential contaminants and prevent spills on soil and prevent contaminating stream substrates.
- All construction equipment refueling would be performed on upland areas at least ¼ mile from the stream channel within spill containment berms or pads to prevent fuel spills from contaminating stream substrates and the temporarily dewatered stream reaches.
- Construction trenches within dewatered stream reaches would be pumped as necessary to remove subsurface water. The water would be pumped into portable tanks for settling, and then land applied away from the streams for disposal.
- Silt fences would be installed across the stream channels within the dewatered construction areas downstream of the pipeline crossing excavation to capture sediments that may be mobilized by precipitation events during construction activities. The silt fence toe would be anchored into the stream bed with native material. The silt fence would be removed following completion of the pipeline crossing construction and native material used to anchor the silt fence toe would be returned to pre-construction conditions. Sediment trapped by the silt fence would be incorporated into the backfill and spoil material and distributed across the ROW as part of surface restoration operations.

Implementation of these BMPs would protect the baseline water quality of the Paria River during the temporary construction activities and avoid effects on downstream water quality in the lower Paria River. The LPP Project would have no effect on razorback chub or its critical habitat in the lower Paria River. With implementation of these BMPs, the Paria River at Highway 89 is eliminated from further analysis. More detailed stream flow information, data and analyses are provided in the final Surface Water Resources Study Report (UBWR 2016a). More detailed water quality information, data and analyses are provided in the final Surface Water Quality Study Report (UDWRe 2016b)

5.3.7.2.2.4 Interbasin Transfer of LPP Water.

The interbasin transfer of LPP water from Lake Powell to Sand Hollow Reservoir through the proposed pipeline could result in transfer of undesirable and invasive aquatic organisms from the upper Colorado River basin to the Virgin River basin. However, no LPP water would be discharged into the Virgin River or any of its tributary streams except during emergencies. All of the LPP Project water conveyed through the pipeline would flow into Sand Hollow Reservoir for the specific purpose of providing municipal and industrial (M&I) raw water supply for treatment in a water treatment facility and distribution as culinary water. Sand Hollow Reservoir is not currently designated as infested with quagga mussel or other species likely transported by recreational boats. The LPP Project would be designed to avoid transfer of aquatic organisms from Lake Powell to Sand Hollow Reservoir. The intake water would be dosed with an EPA-approved molluscicide in the intake tunnels and filtered in the intake pump station or other approved action would be taken to remove undesirable and invasive aquatic organisms. Potential effects of interbasin transfer of water carrying undesirable and invasive aquatic species are eliminated from further analysis.

5.3.7.2.2.5 LPP Project Diversions from Lake Powell and the Colorado River.

The proposed LPP Project diversions from Lake Powell could potentially affect special status aquatic resource species and habitats in the Colorado River downstream from Glen Canyon Dam. The federally listed species with critical habitat downstream of Glen Canyon Dam include the bonytail chub (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), and the razorback sucker (*Xyrauchen texanus*). Measurable changes in Glen Canyon Dam releases and water quality could affect these listed species and their designated critical habitat.

The UDWRe contracted with the Department of the Interior's designated expert agency, the Bureau of Reclamation (Reclamation) to simulate the potential effects of the LPP Project diversions from Lake Powell on reservoir levels, Glen Canyon Dam releases, and water quality in Lake Powell and in releases from Glen Canyon Dam. Reclamation performed several hydrologic modeling runs using Reclamation's long-term planning model, CRSS. The results of these model runs were provided to UDWRe for use in its planning studies for the Lake Powell Pipeline (LPP) Project to determine potential effects on the hydrology of the Colorado River system. Reclamation also provided water quality modeling results to UDWRe for use in its planning studies for the LPP Project to determine potential effects on water quality of the Colorado River system.

The results of hydrologic modeling runs are summarized in the following sections. More detailed analyses are provided in the final Surface Water Resources Study Report (UDWRe 2016a).

Colorado River Hydrologic Simulation Methodology

Hydrologic modeling of the Colorado River system for the period 2015 through 2060 was performed to determine the potential hydrologic effects of the alternatives. Modeling provides projections of potential future Colorado River system conditions (i.e., reservoir elevations, reservoir releases, river flows) for comparison of those conditions under the No Action alternative to conditions under the Proposed Action and other LPP alternatives. These comparisons are typically expressed in terms of the relative differences in probabilities between the No Action alternative and the LPP action alternatives. Hydrologic modeling also provides the basis for the analysis of the potential effect of each alternative on other environmental resources such as water quality and hydropower. Multiple simulations were performed in order to quantify the uncertainties of future conditions and as such, the modeling results are expressed in probabilistic terms because of the uncertainty with regard to future inflows into the system.

Two inflow hydrology data sets were modeled for the Proposed Action analyses and No Action alternative. The DNF inflow scenario uses data from the observed stream flow record (1906-2010). The climate change (CC) inflow scenario uses hydrologic data derived from climate change driven stream flow projections[1] to represent a range of possible future inflows under the assumption of climate change in the Colorado River Basin.

Proposed Action Analysis

The Proposed Action analysis assumes water use in the Colorado River basin would remain constant at current levels, except for reasonably foreseeable (pursuant to 43 CFR 46.30) future projects. Under the regulatory definition, a reasonably foreseeable future depletion is one which has state legislation, or a tribal resolution or federal Indian water settlement, or a federal finding of no significant effect (FONSI) or record of decision (ROD).

[1]Climate change data and information available at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html#Welcome

In the No Action analysis, the No Action alternative assumes that if the Lake Powell Pipeline is not developed, that water will not be developed somewhere else in the state. This analysis isolates the effect of adding a new project (Lake Powell Pipeline) to the mix of existing and reasonably foreseeable depletions in the Colorado River system.

The Proposed Action and LPP alternatives would each divert 86,249 acre-feet of water from the Colorado River system at Lake Powell. Diversions would begin in 2024 with an annual volume of 15,468 ac-ft per year and increase each year through 2048 to 86,249 acre feet. Diversions would be constant at 86,249 ac-ft per year from full build-out until the end of the model run (2048 through 2060).

No Action Alternative Analysis

The No Action alternative provides a baseline for comparison with the LPP action alternatives. The No Action alternative represents a projection of future conditions that could occur during the life of the proposed federal action without an action alternative being implemented. The No Action alternative assumes all Upper Basin depletions except those deemed reasonably foreseeable are held constant at 2015 depletion levels for the entire model run.

Summary of Potential Hydrologic Effects - Lake Powell Elevations

Under the Proposed Action and No Action alternatives, the Lake Powell elevations are projected to fluctuate between full and lower levels during the period of analysis (2015 through 2060). DNF was the primary inflow dataset used for the 2007 Shortage EIS and therefore the results of this analysis are more comparable to those performed for that EIS. The year 2027 is when reservoir operations in the simulation revert to the 2007 Shortage EIS No Action Alternative. For the 90th, 50th, and 10th percentiles, there would be minimal average differences in Lake Powell levels between the Proposed Action and No Action under the DNF inflow scenario. For the 90th, 50th, and 10th percentiles, there would be minimal average differences in Lake Powell levels between the Proposed Action and No Action under the CC inflow scenario. Most of the Lake Powell elevation differences round to 0 percent elevation change between the Proposed Action and No Action under the DNF and CC inflow hydrology. The DNF inflow hydrology for No Action would have an average 3.7-foot higher annual elevation difference than the Proposed Action at the 10th percentile, a -0.1 percent difference. The CC inflow hydrology for No Action would have an average 2-foot higher annual elevation difference than the Proposed Action at the 50th percentile, a -0.1 percent difference. The CC inflow hydrology would have slightly lower average annual elevation difference at the 10th percentile compared to the DNF inflow hydrology. The DNF inflow hydrology would have slightly lower average annual elevation difference at the 50th percentile compared to the CC inflow hydrology. The elevation differences in Lake Powell would be on an annual basis (over a one-year period) and not absolute or instantaneous.

The probability of Lake Powell elevations less than 3,490 feet msl (the approximate minimum elevation for operation of the Glen Canyon power plant) is nearly the same for both alternatives under the DNF inflow hydrology. The probability is -0.1 percent or less assuming direct natural inflows and 2.7 percent or less assuming CC inflow hydrology. Inflow scenario does not affect the differences between the Proposed Action and No Action Alternative. This indicates the Proposed Action and LPP alternatives would have little or no effect on the ability to generate power at Glen Canyon power plant.

Summary of Potential Hydrologic Effects - Glen Canyon Dam Releases

Direct natural flow was the primary inflow dataset used for the 2007 Shortage EIS and therefore the results of this analysis are more comparable to those performed for that EIS. The year 2027 is when reservoir operations in the simulation revert to the 2007 Shortage EIS No Action Alternative. For the 10th and 50th percentiles, there would be no difference in releases between the Proposed Action and No Action under the DNF inflow scenario. There

would be minimal differences in releases between the Proposed Action and No Action alternatives at the 90th percentile under the DNF inflow scenario.

The CC inflow simulations for the 86,249 acre-foot Proposed Action (pipeline) depletion and No Action alternative were simulated for the 10th, 50th and 90th percentiles from 2015 through 2060. For the 50th percentile, there would be no distinguishable difference in releases between the Proposed Action and No Action under the CC inflow scenario. There would be minimal differences in releases between the Proposed Action and No Action alternatives at the 10th and 90th percentiles under the CC inflow scenario.

Differences in annual Glen Canyon Dam releases were analyzed at the 10th, 50th, and 90th percentiles for the DNF and CC inflow hydrology scenarios under the Proposed Action and No Action. Most of the differences summarized round to 0 percent when compared with the large volume of water released to the Colorado River from Glen Canyon Dam. The DNF inflow hydrology for No Action would release an average of 69,202 ac-ft per year more than the Proposed Action at the 90th percentile, a -0.5 percent change. The CC inflow hydrology would have minimal differences between the Proposed Action and No Action. The CC inflow hydrology for No Action would release an average of 80,846 ac-ft per year more than the Proposed Action at the 10th percentile, a -1.2 percent change. The CC inflow hydrology for No Action would release an average of 61,593 ac-ft per year more than the Proposed Action at the 90th percentile, a -0.5 percent change. The CC inflow hydrology would yield slightly higher average differences at the 10th percentile compared to the DNF inflow hydrology.

Releases of greater than the annual minimum objective release of 8.23 million acre-feet would occur with nearly the same frequency (within 2.3 percent of the time) between the Proposed Action and No Action Alternative under the DNF inflow hydrology. Releases of greater than the annual minimum objective release of 8.23 million acre-feet would occur with nearly the same frequency (within 0.4 percent of the time) between the Proposed Action and No Action Alternative under the CC inflow hydrology.

Summary of Reclamation Hydrologic Modeling Results

The Reclamation hydrologic modeling of Lake Powell levels and Glen Canyon Dam releases demonstrate that the hydrologic effects of the Proposed Action and LPP alternatives would not be measurable, particularly within the variation of river flows resulting from Glen Canyon Dam water releases. The Reclamation model results indicate that the Proposed Action and LPP alternatives would not measurably or adversely affect river flows or hydrology in the Colorado River downstream from Glen Canyon Dam. The Proposed Action and LPP alternatives would have no effect on the four listed fish species in the Colorado River and would have no effect on their critical habitat. The potential hydrologic effects of the Proposed Action and LPP alternatives on the listed aquatic species and their critical habitat in the Colorado River are eliminated from further analysis.

Reclamation Water Quality Modeling Results

Computer modeling was utilized by Reclamation to evaluate potential effects of the Proposed Action and LPP alternatives on temperature, TDS, and other water quality parameters. The CRSS and Lake Powell CE-QUAL-W2 models were used to simulate water quality parameters in and below Lake Powell for the No Action Alternative and the Proposed Action (86,249 ac-ft per year) diversion from Lake Powell. Results of the Reclamation surface water quality modeling runs are summarized in the following sections. More detailed analyses are provided in the final Surface Water Quality Study Report (UDWRe 2016b).

CRSS Salinity Modeling Methods

The CRSS model is a rule-based simulation of operations in the Colorado River Basin based in the Riverware™ Modeling framework developed by CADSWES at the University of Colorado at Boulder. The version of the CRSS model that was used for the hydrological and operational simulations of the Lake Powell Pipeline was also

used to simulate salinity, or TDS, in the Colorado River Basin. The salinity model routes salinity through major stream reaches and seven reservoirs (Flaming Gorge, Starvation, Navajo, Powell, Mead, Mohave, and Havasu) in the Colorado River Basin. The model is intended for long-term simulations of salinity (15 to 20 years).

The model simulated the period 2015 to 2060 using two inflow hydrology scenarios, DNF and projected climate change inflows (CC). In the DNF scenario the historic record 1906-2006 was used to generate 101 simulations of the period 2015 to 2060. The CC scenario inflow hydrology was derived from climate change driven stream flow projections[2] to represent a range of possible future inflows under the assumption of climate change in the Colorado River Basin.

CE-QUAL-W2: Water Quality Modeling Methodology

CE-QUAL-W2 is a water quality model developed by the US Army Corps of Engineers for simulating hydrodynamics and water quality in long, narrow waterbodies such as reservoirs. The Lake Powell CE-QUAL-W2 Model calibrated to the historic time period 1989-2010 was used as the base for simulations of the Lake Powell Pipeline. The model simulates temperature, TDS, dissolved oxygen, nutrients, and algae in the reservoir and releases from Glen Canyon Dam.

The CE-QUAL-W2 simulations used results from the CRSS DNF hydrology simulations as inputs for tributary inflows and dam outflows in the water quality model scenarios. One of the 101 CRSS DNF hydrology simulations was selected to determine these inputs. From the simulation period 2015 to 2060, the years 2039 to 2060 were selected to use directly in the CE-QUAL-W2 model. This period was selected because the simulation years 2039 to 2060 corresponded to the natural flow years 1989-2010. This allowed other CE-QUAL-W2 inputs such as meteorology to use historical data.

Water Quality Modeling Results

Water quality results from the Proposed Action diversion scenario were compared to the No Action Alternative scenario to determine effects, if any, on water quality. Water quality modeling results included temperature and dissolved oxygen in Lake Powell at three locations, temperature, TDS, and dissolved oxygen below Glen Canyon Dam from the CE-QUAL-W2 modeling, and TDS along the Lower Colorado River from the CRSS modeling. Other water quality parameters were simulated by the CE-QUAL-W2 model including nutrients and phytoplankton but quantitative results are not presented for these parameters. Additionally, CE-QUAL-W2 modeling of Glen Canyon Dam release temperatures at varying elevations was performed as part of the "Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, Final Environmental Effect Statement" or Shortage Criteria EIS (DOI 2007). Results from that modeling are interpreted based on the projected changes in Lake Powell water surface elevations as a result of the proposed Lake Powell Pipeline.

Lake Powell

Lake Powell temperature and dissolved oxygen concentrations were evaluated at five day intervals for three reservoir locations and five depths. The three locations were above the dam, below the confluence of the San Juan River, and the upstream reservoir. The five depths were 5, 10, 25, 50, and 100 meters. Simulated reservoir temperatures for the 86,249 acre-foot Proposed Action simulation were compared with the No Action Alternative

[2]Climate change data and information available at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html#Welcome

simulation. Average temperatures at each depth modeled are between 0.04 and 0.19°C colder. Simulated reservoir dissolved oxygen (DO) concentrations for the 86,249 acre-foot Proposed Action simulations were compared with the No Action Alternative simulation and were 0.1 mg/L lower at 25 meters, 0.2 mg/L lower at 50 meters and 0.1 mg/L higher at 100 meters (Reclamation 2016). The DO concentrations for the 0 meter and 10 meter depths modeled for the pipeline simulation were the same as the No Action alternative. Appendix A in the Final Surface Water Quality Study Report presents the Reclamation Water Quality Modeling Documentation (UDWRe 2016b).

Glen Canyon Dam Releases

Modeled release results from Glen Canyon Dam for the No Action Alternative and Proposed Action pipeline simulations were evaluated for effects on temperature, TDS, and dissolved oxygen concentrations. Simulated mean dam release temperatures for the period 2045 to 2060 are shown in Table 5-74 by month. Generally, the Proposed Action scenario dam release temperatures are slightly colder in winter and spring months (colder by approximately 0.1°C) and slightly warmer (warmer by approximately 0.1°C) in summer and fall months compared with the No Action Alternative scenario. The temperature modeling results indicate the differences between the No Action Alternative and the Proposed Action would be 0.5°C or less, which would not be measurable in the Colorado River downstream of Glen Canyon Dam.

Table 5-74
Glen Canyon Dam Releases –Monthly Simulated Mean Temperatures (°C), 2045-2060

Month	No Action	Proposed Action	Difference
January	9.48	9.43	0.05
February	8.44	8.40	0.04
March	8.40	8.39	0.01
April	8.90	8.94	0.04
May	9.74	9.88	0.14
June	10.50	10.69	0.19
July	11.16	11.40	0.24
August	11.87	12.41	0.54
September	12.16	12.46	0.30
October	12.32	12.60	0.28
November	12.04	12.22	0.18
December	11.18	11.20	0.02

Glen Canyon Dam release temperatures often peak in October and simulated results for that month (Table 5-75) show that when the reservoir is at or near full pool elevations, as predicted from 2050 to 2056, water temperatures of releases from the dam for the Proposed Action scenario would be colder than in the No Action Alternative scenario. The release temperatures from the dam in the pipeline scenarios would be colder when the reservoir is near full capacity because of the removal of warm water from the upper, warm layer of the reservoir by the pipeline. Simulated release temperatures for the Proposed Action scenario would be warmer than the No Action Alternative scenario during summer and fall months when reservoir pool elevations would be below full pool. The largest differences between the Proposed Action scenario and the No Action Alternative scenario coincide with the lowest reservoir pool elevations. On average, the modeled results for the Proposed Action compared with the No Action Alternative would be within 0.29°C for the 2045-2060 period. For individual years, differences of up

to 0.65°C are predicted. Appendix A in the Final Surface Water Quality Study Report presents the Reclamation Water Quality Modeling Documentation (UDWRe 2016b).

Table 5-75
Glen Canyon Dam Releases – Simulated October Temperatures (°C), 2045-2060

Month	No Action	Proposed Action	Difference
Oct-41	11.67	11.89	0.22
Oct-42	11.60	11.81	0.21
Oct-43	11.59	11.92	0.33
Oct-44	11.39	11.61	0.22
Oct-45	12.74	13.17	0.43
Oct-46	10.41	10.56	0.15
Oct-47	10.75	10.91	0.16
Oct-48	10.36	10.43	0.07
Oct-49	10.89	11.02	0.13
Oct-50	10.24	10.37	0.13
Oct-51	9.78	9.91	0.13
Oct-52	11.19	11.31	0.12
Oct-53	13.73	13.87	0.14
Oct-54	16.93	17.58	0.65
Oct-55	15.45	15.91	0.46
Oct-56	14.34	14.45	0.11
Oct-57	13.46	13.98	0.52
Oct-58	13.40	13.76	0.36
Oct-59	13.09	13.45	0.36
Oct-60	13.39	14.03	0.64
Average	**12.32**	**12.60**	**0.29**

TDS results from the No Action alternative and Proposed Action models indicate that the average release TDS concentrations from 2045-2060 for the results of the three models would all be within 0.7 mg/L of each other. The Proposed Action average TDS values would be slightly higher than the No Action alternative. Appendix A in the Final Surface Water Quality Study Report presents the Reclamation Water Quality Modeling Documentation (UDWRe 2016b).

Dissolved oxygen results from the No Action alternative and Proposed Action models indicate that the average release dissolved oxygen concentrations from 2045-2060 for the two models would not vary. Appendix A in the Final Surface Water Quality Study Report presents the Reclamation Water Quality Modeling Documentation (UDWRe 2016b).

Summary of Reclamation Water Quality Modeling Results

The Reclamation water quality modeling of Lake Powell and Glen Canyon Dam releases demonstrate that the water quality effects of the Proposed Action and LPP alternatives would not be measurable, especially within the

variation of conditions resulting from Glen Canyon Dam water releases. The Reclamation water quality modeling results indicate that the Proposed Action and LPP alternatives would not measurably or adversely affect water quality in the Colorado River downstream from Glen Canyon Dam. The Proposed Action and LPP alternatives would have no effect on the four listed fish species in the Colorado River and would have no effect on their critical habitat. The potential water quality effects of the Proposed Action and LPP alternatives on the listed aquatic species and their critical habitat in the Colorado River are eliminated from further analysis.

5.3.7.2.2.6 Apache Trout.

Apache trout (*Oncorhynchus apache*) is historically and currently distributed in rivers and streams that would not be affected by Proposed Action or LPP alternative construction or operation. The Verde River and several tributary streams including North Canyon on the Kaibab National Forest are the closest habitat and location of known populations, which extend into southern Coconino County south of the Grand Canyon. The Proposed Action and LPP alternative features would cross through the northern half of Coconino County north of the Grand Canyon. The Proposed Action and LPP alternative construction and operation would have no effect on Apache trout or its habitat. Potential effects of the Proposed Action and LPP alternatives on Apache trout and its habitat are eliminated from further analysis.

5.3.7.2.2.7 Kanab Ambersnail.

Kanab ambersnail (*Oxyloma haydeni kanabensis*) is currently distributed in three known locations, including two springs within the Grand Canyon and at springs near Three Lakes six miles north of Kanab, Utah. The Proposed Action and LPP alternative construction would not occur within ten miles of any known Kanab ambersnail population. Proposed Action and LPP alternative operation would not measurably affect Colorado River flows in the Grand Canyon and would not affect the spring flows at known population locations. The Proposed Action and LPP alternative construction and operation would have no effect on Kanab ambersnail or its habitat. Potential effects of the Proposed Action and LPP alternatives on Kanab ambersnail and its habitat are eliminated from further analysis.

5.3.7.2.3 Proposed Action Effects.

The Proposed Action construction and operation would not have any direct or indirect effects on the Virgin River chub and woundfin. Hydrologic modeling results of the Virgin River using the VRDSM and incorporating projected future climate change conditions show no measurable difference in mean monthly flows and flow duration curves between the future without the LPP and future with the LPP (see Section 5.3.3.2.2.2). The Proposed Action construction and operation would not have any direct or indirect effects on the Virgin spinedace and desert sucker.

5.3.7.2.4 Existing Highway Alternative Effects.

The Existing Highway Alternative would have the same effects on listed Virgin River aquatic species and sensitive aquatic species as described for the Proposed Action in Section 5.3.7.2.3.

5.3.7.2.5 Southeast Corner Alternative Effects.

The Southeast Corner Alternative would have the same effects on listed Virgin River aquatic species and sensitive aquatic species as described for the Proposed Action in Section 5.3.7.2.3.

5.3.7.2.6 No Lake Powell Water Alternative Effects.

The No Lake Powell Water Alternative operation could have significant indirect effects on two listed aquatic species and could have significant indirect effects on two sensitive/species of concern in the Virgin River from reduced non-sewered return flows resulting from eliminating residential outdoor irrigation: Virgin River chub

(*Gila seminuda (=robusta*)), woundfin (*Plagopterus argentissimus*), desert sucker (*Catostomus clarkii*), and Virgin spinedace (*Lepidomeda mollispinus*).

5.3.7.2.6.1 Virgin River Chub.

Virgin River chub in the Virgin River from Hurricane, Utah to the Utah-Arizona state line could be adversely affected by reduced streamflows, increased stream temperatures, and changes in food supply resulting from eliminating residential outdoor irrigation. Virgin River streamflows in the St. George metropolitan area would be reduced during the summer and fall months because of the reduced groundwater recharge from eliminating residential outdoor irrigation. Critical habitat for the Virgin River chub could be adversely affected by reduced streamflows and a diminished riparian corridor along both sides of the river. These effects could adversely affect Virgin River chub and its designated critical habitat.

5.3.7.2.6.2 Woundfin.

Woundfin in the Virgin River from Hurricane, Utah to the Utah-Arizona state line could be adversely affected by reduced streamflows, increased stream temperatures, and changes in food supply resulting from eliminating residential outdoor irrigation. Virgin River streamflows in the St. George metropolitan area would be reduced during the summer and fall months because of the reduced groundwater recharge from eliminating residential outdoor irrigation. Critical habitat for woundfin could be adversely affected by reduced streamflows and a diminished riparian corridor along both sides of the river. These effects could adversely affect woundfin and its designated critical habitat.

5.3.7.2.6.3 Desert Sucker.

Desert sucker in the Virgin River from Hurricane, Utah to the Utah-Arizona state line could be adversely affected by reduced streamflows, increased stream temperatures, and changes in food supply resulting from eliminating residential outdoor irrigation. Virgin River streamflows in the St. George metropolitan area would be reduced during the summer and fall months because of the reduced groundwater recharge from eliminating residential outdoor irrigation. Crucial habitat for desert sucker could be adversely affected by reduced streamflows and a diminished riparian corridor along both sides of the river. These effects could adversely affect desert sucker and its crucial habitat.

5.3.7.2.6.4 Virgin Spinedace.

Virgin spinedace in LaVerkin Creek and the Virgin River from Hurricane, Utah to the Utah-Arizona state line could be adversely affected by reduced streamflows, increased stream temperatures, and changes in food supply resulting from eliminating residential outdoor irrigation. Virgin River streamflows in the St. George metropolitan area would be reduced during the summer and fall months because of the reduced groundwater recharge from eliminating residential outdoor irrigation. Crucial habitat for Virgin spinedace could be adversely affected by reduced streamflows and a diminished riparian corridor along both sides of the river. These effects could adversely affect Virgin spinedace and its crucial habitat.

5.3.7.3 No Action Alternative Effects

The No Action Alternative would have no effects on Virgin River chub and woundfin or their designated critical habitat. The No Action Alternative would have no effects on desert sucker and Virgin spinedace or their crucial habitat in the Virgin River corridor. Protection, Mitigation and Enhancement Measures

5.3.7.3.1 Proposed Action.

The Proposed Action construction and operation would have no measurable effect on listed aquatic species or their designated critical habitat in the Colorado River, Paria River and Virgin River. No conservation measures for protection of these species and designated critical habitat have been identified. The Proposed Action construction and operation would have no measurable effects on sensitive aquatic species or their crucial habitat. No protection, mitigation or enhancement measures have been identified.

5.3.7.3.2 Existing Highway Alternative.

The Existing Highway Alternative construction and operation would have no measurable effect on listed aquatic species or their designated critical habitat in the Colorado River, Paria River and Virgin River. No conservation measures for protection of these species and designated critical habitat have been identified. The Existing Highway construction and operation would have no measurable effects on sensitive aquatic species or their crucial habitat. No protection, mitigation or enhancement measures for protection of these species or their crucial habitat have been identified.

5.3.7.3.3 Southeast Corner Alternative.

The Southeast Corner Alternative construction and operation would have no measurable effect on listed aquatic species or their designated critical habitat in the Colorado River, Paria River and Virgin River. No conservation measures for protection of these species and designated critical habitat have been identified. The Southeast Corner construction and operation would have no measurable effects on sensitive aquatic species or their crucial habitat. No protection, mitigation or enhancement measures for protection of these species or crucial habitat have been identified.

5.3.7.3.4 No Lake Powell Water Alternative.

There are no conservation measures that would mitigate the potential significant, long-term, adverse indirect effects of the No Lake Powell Water Alternative on Virgin River chub and woundfin. Populations of these listed species could decrease in size and health within the Virgin River in the St. George metropolitan area. There are no mitigation measures to avoid, minimize or reduce the significant, permanent, adverse indirect effects of the No Lake Powell Water Alternative on desert sucker and Virgin spinedace. Populations of these species of concern could decrease in size and health within the Virgin River and its tributary streams in the St. George metropolitan area.

5.3.7.3.5 No Action Alternative.

No protection, mitigation, or enhancement measures would be implemented with the No Action Alternative.

5.3.7.4 Cumulative Effects

5.3.7.4.1 Proposed Action.

The Proposed Action construction and operation would have no measurable effects on special status aquatic species or their habitats, therefore there would be no measurable cumulative effects on special status aquatic species or their habitats.

5.3.7.4.2 Existing Highway Alternative.

The Existing Highway Alternative construction and operation would have no measurable effects on special status aquatic species or their habitats, therefore there would be no measurable cumulative effects on special status aquatic species or their habitats.

5.3.7.4.3 Southeast Corner Alternative.

The Southeast Corner Alternative construction and operation would have no measurable effects on special status aquatic species or their habitats, therefore there would be no measurable cumulative effects on special status aquatic species or their habitats.

5.3.7.4.4 No Lake Powell Water Alternative.

The No Lake Powell Water Alternative would have no measurable short-term cumulative effects on special status aquatic species and their habitats when combined with past, present and reasonably foreseeable future interrelated actions. It could have significant long-term indirect cumulative effects on special status aquatic species in the Virgin River when combined with the past, present and reasonably foreseeable effects of water diversion throughout the St. George metropolitan area.

5.3.7.4.5 No Action Alternative.

The No Action Alternative would have no cumulative effects on special status aquatic species or their habitats.

5.3.7.5 Unavoidable Adverse Effects

5.3.7.5.1 Proposed Action.

The Proposed Action would not have any measurable unavoidable adverse construction or operation effects on special status aquatic species or their habitats.

5.3.7.5.2 Existing Highway Alternative.

The Existing Highway Alternative would not have any measurable unavoidable adverse construction or operation effects on special status aquatic species or their habitats.

5.3.7.5.3 Southeast Corner Alternative.

The Southeast Corner Alternative would not have any measurable unavoidable adverse construction or operation effects on special status aquatic species or their habitats.

5.3.7.5.4 No Lake Powell Water Alternative.

The No Lake Powell Water Alternative would not have any unavoidable adverse construction effects on special status aquatic species or their habitats.

The No Lake Powell Water Alternative operation could have long-term unavoidable adverse effects on special status aquatic species and their habitat resulting from the indirect action of eliminating residential outdoor watering with potable water, which would reduce groundwater recharge in the St. George metropolitan area that reports back to the river during the summer and fall months. The Virgin River and its local tributary streams would have reduced streamflows through the St. George metropolitan area during the summer months, which could reduce habitat area, increase water temperatures, decrease DO concentrations, change the food supply for aquatic resources, and diminish the areal extent and functions of the riparian corridor from Hurricane to the Utah-Arizona state line. These could be significant long-term unavoidable adverse effects on Virgin River special status aquatic species, their habitats and the connected ecosystem.

5.3.7.5.5 No Action Alternative.

The No Action Alternative would have no unavoidable adverse effects on special status aquatic species or their habitats.

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