United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

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Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

RE: Transmittal of Biological Opinion for the Ruby Pipeline Project (Docket Number CP09-54-000)

Dear Ms. Bose:

This document transmits the Fish and Wildlife Service's (Service) biological opinion (BO) on the Federal Energy Regulatory Commission's (FERC) proposed issuance of a final license for the Ruby Pipeline Project (Project), which is located in Wyoming, Utah, Nevada, and Oregon, and its effect on the following listed species and critical habitats: the Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha)*, razorback sucker (*Xyrauchen texanus*), bonytail chub (*Gila elegans*), Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi)*, Warner sucker (*Catostomus warnerensis*), Modoc sucker (*Catostomus microps)*, Lost River sucker (*Deltistes luxatus*), and shortnose sucker (*Chasmistes brevirostris*), proposed critical habitat for the Lost River sucker and the shortnose sucker, and designated critical habitat for Warner sucker and the four Colorado River fishes referenced above. This BO was developed in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. et seq.), and based on our review of your Revised Biological Assessment (BA). Your request for formal consultation was received by the Service on January 20, 2010.

This BO is based on information gathered from multiple sources including the Project's BA and Final Environmental Impact Statement. We also obtained information from 2009 to present via our participation in numerous Project-related meetings, telephone calls, and electronic mailings with FERC staff, Project representatives, and other government agencies. This document was prepared by the Service's Oregon Fish and Wildlife Office in coordination with Service Regional Offices in Regions 1, 6, and 8, as well as the Wyoming, Utah, Nevada, Oregon, and Klamath

Falls Field Offices of the Service. The Service's Region 6 had lead responsibility for preparing this BO. A complete decision record of this consultation is on file at the Service's Region 6 Regional Office in Denver, Colorado.

Consultation History

The history of this consultation includes numerous meetings and conference calls with representatives from Ruby Pipeline L.L.C (Ruby) and FERC, beginning with a face-to-face meeting between Ruby, FERC, and Service representatives on January 28-29, 2009.

During informal consultation, Service staff reviewed an April 2009 draft of the BA prepared by Ruby.

The Service provided additional reviews, dated July 31, 2009, and January 4, 2010, of two different versions of FERC's draft BA. In both of these Service reviews we included requests for additional information and specificity regarding waterbody crossings, waterbody crossing restoration, and monitoring of waterbody crossings post-restoration.

On January 7, 2010, FERC responded to the Service's January 4, 2010, comments on the draft BA, and indicated that FERC would not provide additional specificity or commitments regarding waterbody crossings, waterbody crossing restoration, and monitoring of waterbody crossings post-restoration. FERC also indicated the Service was expected to address any remaining issues regarding waterbody crossings, waterbody crossing restoration, and monitoring of waterbody crossings post-restoration within the BO.

On January 8, 2010, the Service acknowledged receipt of FERC's January 7, 2010, responses, and indicated to FERC that we were willing to continue discussing waterbody crossing issues with FERC but would address, as necessary, any remaining waterbody crossing issues in the biological opinion.

The Service received a final BA and request to initiate formal consultation from FERC on January 20, 2010.

The Service received from FERC two revised determinations of effects for proposed critical habitat for Lost River sucker and shortnose sucker, and designated critical habitat for Warner sucker, dated February 3, 2010, and February 12, 2010, respectively.

Through a Service letter dated February 25, 2010, we informed FERC that the BA was complete and we agreed to initiate formal consultation.

In addition to the BA's indication that the Bureau of Land Management (BLM), Bureau of Reclamation (USBR), and Forest Service were federal action agencies associated with the Project, and each of these agencies manage lands and waters that will be crossed by the Project, on March 5, 2010, the Service received from FERC a request to include the Corps of Engineers (Corps) as one of the federal action agencies in this consultation.

On April 20, 2010, the Service received from FERC revised determinations of effects for critical habitat for the four Colorado River fishes referenced above.

On April 30, 2010, the Service met with Ruby to discuss the draft BO.

On May 12, 2010, the Service shared a draft BO with FERC, Ruby, and federal action agencies for review and comment. All agency and Ruby reviews were received by the Service by May 27, 2010.

On May 27, 2010, the Service met internally to discuss all agency and Ruby comments and begin finalizing of the BO.

On May 28, 2010, the Service met with Ruby representatives to discuss Ruby's comments on the draft BO. Ruby clarified its intent to implement, for listed fishes waterbody crossings, established inwater construction windows and (if water is present at time of construction) dry-ditch waterbody crossing methods and fish salvage.

On June 3, 2010, the Service met with Ruby representatives to discuss edits to the draft BO and Incidental Take Statement.

Service Concurrence on ESA-Listed Species

The BA concluded that the Project's proposed action may affect, but is not likely to adversely affect (NLAA) black-footed ferret (*Mustela nigripes*) and Ute ladies'-tresses (*Spiranthes diluvialis*). We concur with FERC's NLAA conclusion for these ESA-listed species for the following reasons:

Black-footed Ferret

Ruby conducted surveys for white-tailed prairie dog colonies and black-footed ferret, within 0.5 mile of the pipeline right-of-way (ROW) between mile posts (MP) 12 and 29 in Wyoming and MPs 48 and 60 in Utah. The pipeline ROW between MPs 0 and 12 and MPs 29 and 48 had been previously block-cleared by the Service (Service 2004a); therefore, black-footed ferret surveys were not conducted by Ruby in these areas. White-tailed prairie dog surveys were conducted in July 2009 and black-footed ferret surveys were conducted in August and September 2009, using protocols described in Guidelines for Black-Footed Ferret Surveys (Service 1989). While surveys did identify numerous white-tailed prairie dog towns occurring in the proposed pipeline ROW in both Wyoming and Utah, none of these white-tailed prairie dog towns met the criteria of preferred habitat, per Service guidelines (Service 1989), for black-footed ferret. Additionally, no black-footed ferrets were observed during black-footed ferret protocol surveys.

Based on results of these completed white-tailed prairie dog and black-footed ferret protocol surveys in non-block-cleared habitats, as well as previous Service-approved block-clearing of all other habitats along the pipeline route in Wyoming and Utah, the Service concurs that the Project's pipeline construction and operations are not likely to adversely affect black-footed ferret.

Ute Ladies'-tresses

Ruby conducted surveys in 2008 and 2009 within suitable Ute ladies'-tresses habitat in Wyoming and Utah, per Service guidance and/or protocol (Service 1992). No Ute ladies'-tresses were identified during the mid-July to August 2008 or August to September 2009 surveys. Only limited, marginal- to moderate-quality habitat for this species was observed. No surveyed sites provided high potential for Ute ladies'-tresses. Ruby has committed to pre-construction surveys to ensure that no Ute ladies'-tresses populations were overlooked during the initial surveys and no new colonies have established since surveys were completed. The BA indicated that the Project will not be allowed to start construction in any area where Ute ladies'-tresses are identified during the Project's pre-construction surveys until additional consultation with the Service is completed.

Based on results of these completed Ute ladies'-tresses protocol surveys, Ruby's commitment to conduct pre-construction surveys, and FERC's prohibition that will condition Project construction until additional consultation with the Service is completed in any area where Ute ladies'-tresses are identified during pre-construction surveys, the Service concurs that the Project's pipeline construction and operations are not likely to adversely affect Ute ladies'-tresses.

BIOLOGICAL OPINION

Description of the Proposed Action

Background

FERC's BA (FERC 2010a) generally and broadly describes the Ruby pipeline construction and operation proposed action. The BA's proposed action is incorporated herein by reference. The following is a more specific description of FERC's proposed action that is pertinent to ESA-listed species (namely the Colorado pikeminnow, humpback chub, razorback sucker, bonytail chub, Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker) and designated critical habitat. This proposed action was extracted from multiple sources, including the BA, the Final Environmental Impact Statement (FEIS; FERC 2010b), Ruby's Plan of Development (Ruby 2010a) and various resource reports (Ruby 2009a, 2009b), and additional information from Ruby on waterbody crossings and blasting plans (Ecology and Environment 2010a, 2010b, 2010c).

Ruby filed an application with FERC in Docket Number CP09-54-000 under Section 7 of the Natural Gas Act (NGA), as amended, and parts 157 and 284 of FERC's regulations. On April 5, 2010, Ruby was granted a Certificate of Public Convenience and Necessity (Certificate) for the construction and operation of the Ruby Pipeline Project.

Condition 1 of the April 5, 2010 Certificate indicates Ruby shall follow the construction procedures and mitigation measures described in its application, supplemental filings (including responses to staff data requests), and as identified in the EIS. Ruby already has committed to one measure identified within the FEIS, the Endangered Species Conservation Action Plan (Ruby 2010b), that is pertinent to this consultation. On May 3, 2010, the Service formally acknowledged the beneficial nature of Ruby's voluntary conservation commitments to the recovery of listed species (Service 2010). While Ruby has committed to implementing these voluntary ESA conservation commitments, and the FERC certificate Condition 1 will require the implementation of these conservation actions, FERC did not propose Ruby's voluntary Endangered Species Conservation Action Plan conservation commitments as part of the BA's proposed action. The Service considers these voluntary conservation actions to be reasonably certain to occur, to be implemented by Ruby in the future, and will therefore analyze their effects within the Cumulative Effects and Conclusion sections, below. The Service will continue to provide technical assistance to Ruby during implementation of these beneficial ESA conservation actions.

Project Design

Ruby proposes to construct and operate a natural gas pipeline that would begin near the Opal Hub in Lincoln County, Wyoming and proceed westerly through Wyoming, Utah, Nevada, and Oregon, terminating near the Oregon-California state line in Klamath County, Oregon. The Project will involve the construction and operation of approximately 675.2 miles of 42-inch-diameter mainline pipeline, approximately 2.6 miles of 42-inch-diameter lateral pipeline, an electric–powered compressor station, three natural gas-powered compressor stations, five meter stations containing interconnects to other pipeline systems, 44 mainline valves, 20 pig launchers and receivers, and four new communication towers. Ruby proposes to begin construction in 2010 and place the pipeline in service by March 2011; however, the actual schedule is dependent on the completeness of information submitted by Ruby, seasonal weather conditions, and receipt of required federal authorizations. The Project will follow several plans included in the Project's Final Environmental Impact Statement to provide best management practices (BMPs) during the course of pipeline construction and operation. These plans include, but are not limited to, the Project's Upland Erosion Control, Revegetation, and Maintenance Plan; Wetland and Waterbody Construction and Mitigation Procedures Plan; Hydrostatic Test Plan; Fugitive Dust Control Plan; Restoration and Revegetation Plans for Wyoming, Utah, Nevada, and Oregon; Blasting Plan; Preliminary Wetland Mitigation Plan; and Noxious and Invasive Weed Control Plan.

A 115-foot-wide construction ROW will be authorized for a majority of the pipeline route. The Project would use a narrower ROW when crossing most wetlands, certain forested riparian areas, and playas. However, in limited, non-wetland areas, the construction ROW width may be expanded by up to 25 feet to accommodate full construction ROW topsoil segregation or to ensure safe construction where required by topographic conditions (such as steep side-slopes) or soil limitations. The extra width could also be used for temporary storage of timber, slash, stumps, surface rock, or snow; or in non-wetland, non-forested areas for truck turn-arounds where no reasonable alternative access exists.

The Project would use several temporary extra workspaces, staging areas, and water appropriation sites. Most temporary extra workspaces would add 80 feet onto the 115-foot-wide construction ROW, effectively creating a 195-foot-wide work area. Staging areas would vary in size and, in many instances, would widen the construction ROW beyond temporary extra workspaces for short distances. Water appropriation sites, like staging areas, would be located on and off the construction ROW to facilitate well drilling and water appropriation for hydrostatic testing, dust abatement, and equipment cleaning. The Hams Fork River, on lands managed by BLM, is the only water withdrawal source in the Project's action area known to contain or be tributary to ESA-listed fish habitat.

The Project would use seven contractor construction yards, 16 pipe storage/staging/stringing yards, one construction camp, and one temporary housing facility. Contractor and pipe yards typically would be located away from the construction ROW and would be used for stockpiling pipe, storing materials, staging work, fabricating accessories, repairing equipment, housing mobile offices, and parking vehicles.

The Project would use existing public and private roads to gain access to the Project area. Many of the existing county and state roads are presently in a condition that can accommodate construction traffic without significant modification or improvement. Some roads, however, are small or impassable and are not currently suitable for construction traffic. The Project has proposed to improve unsuitable access roads through grading, filling, and/or widening. About 585 roads would need to be graded or widened up to a total road width of 30 feet, with extra width of up to 25 feet beyond the existing road edge at sharp turns. Additionally, the Project would construct new roads where existing roads do not provide adequate access.

In total, construction of the proposed project would affect a total of about 16,829.7 acres of land, including 13,725.6 acres of open land, 1,257.7 acres of forested land, 1,046.0 acres of agricultural land, 605.1 acres of developed land, 206 acres of riparian land, and 195.4 acres of open water. About 402.2 miles (59.6 percent) of the pipeline ROW would be collocated with (*i.e.*, overlap or abut) or would be offset from other existing road or utility ROWs. Following construction, the Project would retain a 50-foot-wide permanent ROW to operate the pipeline.

Waterbody Crossings

The Project would cross 1,069 perennial, intermittent, and ephemeral waterbodies within 11 major watershed basins. Ruby proposes to use dry-ditch methods for all waterbody crossings that are known to, or have the potential to be utilized by sensitive fish species; however, several different dry-ditch methods would be used depending on site- and waterbody-specific conditions.

Tables 1 through 3 show each crossing that is in or connected to an ESA-listed sucker stream or designated or proposed sucker critical habitat. Waterbody crossings in currently-occupied streams and critical habitat are in bold. The Project crosses occupied Warner sucker habitat as well as designated critical habitat for Warner sucker habitat in Twelvemile and Twentymile creeks, as well as tributaries to these creeks that connect to Warner sucker occupied and critical habitat. The Project crosses occupied habitat and proposed critical habitat for Lost River sucker and shortnose sucker in two branches of Willow Creek. The pipeline would also cross the Lost River, which contain occupied habitat for Lost River sucker and shortnose sucker. The Project crosses Thomas Creek approximately 18 miles downstream of the main area known to be occupied by Modoc sucker in upper Thomas Creek.

Table 4 lists the waterbody crossings that may affect Lahontan cutthroat trout. Historically occupied streams of Lahontan cutthroat trout are located between MP 286 (Burnt Creek) and MP 511 (Leonard Creek) in Nevada. The Project does not cross any stream segments that currently contain known populations of Lahontan cutthroat trout; however the pipeline would cross multiple streams in the Marys River, Gance Creek, Maggie Creek, and Rock Creek watersheds which contain occupied Lahontan cutthroat trout habitat either downstream or upstream of each crossing.

In addition to the pipeline crossings, certain access roads will cross streams. Ruby indicates most of these access roads already have existing above-water crossing features, and therefore only those crossings without an existing crossing structure would potentially require floodplain or inwater work (F. Robertson, 2010a, pers. comm.). Some access roads will require reinforcement to support the movement of pipe and equipment. Equipment mats may be placed across the stream for these access road crossings to provide equipment support. A one-time inwater and across floodplain pass would be limited to clearing equipment (no more than 10 pieces of equipment) and equipment necessary to install bridges across waterbodies. A minimum of 10 feet of vegetation would be preserved along the riverbanks until the construction bridge and/or pipeline have been installed. After construction is complete, the mats will be removed and the contour of the road, streambed, and banks restored to pre-construction conditions. These equipment mat crossings are represented in Tables 1 through 4 as "Equipment Mats" in the Proposed Crossing Method column.

Table 1. Waterbodies that may contain or are connected to Warner Suckers or their critical habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat/Critical Habitat	Blasting Potential[2]
581.9	Washoe	Unnamed trib. to Twelvemile Creek	P	10.0	Access road	Connects to Critical Habitat	No
582.0	Washoe	Tributary to Twelvemile Creek	E	5.0	Upland open cut	Connects to Critical Habitat	High
582.4	Washoe	Unnamed trib. to Twelvemile Creek	E	4.0	Access road	Connects to Critical Habitat	No
583.2	Washoe	Unnamed trib. to Twelvemile Creek	E	3.0	Upland open cut	Connects to Critical Habitat	High
583.9	Washoe	Unnamed trib. to Twelvemile Creek	E	6.0	Access road	Connects to Critical Habitat	No
583.9	Washoe	Tributary to Twelvemile Creek	E	3.0	Upland open cut	Connects to Critical Habitat	High

Table 1. Waterbodies that may contain or are connected to Warner Suckers or their critical habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat/Critical Habitat	Blasting Potential[2]
584.5	Washoe	Unnamed trib. to Twelvemile Creek	E	2.0	Upland open cut	Connects to Critical Habitat	High
585.0	Washoe	Unnamed trib. to Twelvemile Creek	E	2.0	Upland open cut	Connects to Critical Habitat	High
587.0	Washoe	Unnamed trib. to Twelvemile Creek	E	4.0	Access road	Connects to Critical Habitat	No
587.3	Washoe	Unnamed trib. to Twelvemile Creek	E	1.0	Access road	Connects to Critical Habitat	No
588.6	Washoe	Unnamed trib. to Twelvemile Creek	E	2.0	Access road	Connects to Critical Habitat	No
589.1	Washoe	Unnamed trib. to Twelvemile Creek	E	2.0	Access road	Connects to Critical Habitat	No
589.3	Washoe	Unnamed trib. to Twelvemile Creek	E	2.0	Access road	Connects to Critical Habitat	No
589.5	Washoe	Unnamed trib. to Twelvemile Creek	E	5.0	Access road	Connects to Critical Habitat	No
590.0	Washoe	Unnamed trib. to Twelvemile Creek	E	2.0	Access road	Connects to Critical Habitat	No
590.6	**Lake**	**Twelvemile Creek**	**P**	**30.0**	**Dam & Pump/Flume**	**Within Critical Habitat**	**Definite**
591.1	Lake	Unnamed Trib. to Twelvemile Creek	I	1.0	Equipment Mats for access road	Connects to Critical Habitat	No
591.5	Lake	Unnamed Trib. to Twelvemile Creek	E	2.2	Equipment Mats for access road	Connects to Critical Habitat	No
591.7	Lake	Unnamed Trib. to Twelvemile Creek	I	1.0	Open-cut (wet)	Connects to Critical Habitat	High
592.0	Lake	Tributary to Twelvemile Creek	E	2.0	Upland open cut	Connects to Critical Habitat	Low

Table 1. Waterbodies that may contain or are connected to Warner Suckers or their critical habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat/Critical Habitat	Blasting Potential[2]
592.1	Lake	Unnamed Trib. to Twelvemile Creek	I	1.5	Open-cut (wet)	Connects to Critical Habitat	Low
592.1	Lake	Unnamed Trib. to Twelvemile Creek	I	3.0	Upland open cut	Connects to Critical Habitat	Low
592.9	Lake	Unnamed Trib. to Twentymile Creek	I	1.0	Equipment Mats for access road	Connects to Critical Habitat	No
598.3	**Lake**	**Twentymile Creek**	**I**	**48.0**	**Upland open cut**	**Within Critical Habitat**	**Definite**

[1] P = Perennial, I = Intermittent, E = Ephemeral [2] E&E Blasting Potential Tables Revised 4/26/2010

Table 2. Waterbodies that may contain or are connected to Lost River and Shortnose Suckers or their proposed Critical Habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat/Critical Habitat	Blasting Potential[2]
642.0	**Lake**	**South Arm East Willow Creek**	**I**	**3.0**	**Upland open cut**	**Occupied, Within proposed Critical Habitat**	**High**
643.3	Lake	Unnamed Trib. to Willow Creek	E	1.0	Equipment Mats for access road	Connects to proposed Critical Habitat	No
644.7	Lake	Tributary to North Fork Willow Creek	E	1.5	Upland open cut	Connects to proposed Critical Habitat	Low
644.7	Lake	Tributary to North Fork Willow Creek	E	2.0	Upland open cut	Connects to proposed Critical Habitat	Low
644.8	Lake	Tributary to North Fork Willow Creek	E	1.0	Upland open cut	Connects to proposed Critical Habitat	Low
645.0	Lake	Tributary to North Fork Willow Creek	E	2.0	Upland open cut	Connects to proposed Critical Habitat	Low
645.1	**Lake**	**North Fork Willow Creek**	**I**	**2.0**	**Upland open cut**	**Occupied, Within proposed Critical Habitat**	**Low**

Table 2. Waterbodies that may contain or are connected to Lost River and Shortnose Suckers or their proposed Critical Habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat/Critical Habitat	Blasting Potential[2]
645.7	Lake	Tributary to North Fork Willow Creek	I	2.0	Upland open cut	Connects to proposed Critical Habitat	Low
647.8	Lake	Unnamed Trib. to Wild Horse Creek	E	2.3	Upland open cut	Connects to proposed Critical Habitat	High
648.1	Lake	Unnamed Trib. to Wild Horse Creek	E	2.0	Equipment Mats for access road	Connects to proposed Critical Habitat	No
648.1	Lake	Unnamed Trib. to Wild Horse Creek	E	3.0	Upland open cut	Connects to proposed Critical Habitat	High
648.3	Lake	Unnamed Trib. to Wild Horse Creek	E	28.0	Dam & Pump/Flume	Connects to proposed Critical Habitat	High
651.1	Klamath	Fourmile Creek	E	1.5	Open-cut (wet)	Connects to proposed Critical Habitat	Low
664.2	Klamath	East Branch Lost River	P	15.0	Dam & Pump/Flume	Connects to occupied habitat; Connects to proposed Critical Habitat	Definite
664.9	Klamath	Unnamed Trib. to East Branch Lost River	E	3.0	Upland open cut	Connects to occupied habitat and proposed Critical Habitat	High
667.8	**Klamath**	**Lost River**	**P**	**360.0**	**Dam & Pump/Flume**	**In occupied habitat; Connects to proposed Critical Habitat**	**Definite**

[1] P = Perennial, I = Intermittent, E = Ephemeral [2] E&E Blasting Potential Tables Revised 4/26/2010

Table 3. Waterbodies that may contain or are connected to Modoc Sucker habitat.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
622.4	**Lake**	**Thomas Creek**	**P**	**40.0**	**Dam & Pump/Flume**	**Connects to occupied habitat**	**Low**

[1] P = Perennial, I = Intermittent, E = Ephemeral [2] E&E Blasting Potential Tables Revised 4/26/2010

Table 4. Waterbodies that may contain or are connected to Lahontan Cutthroat Trout habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
298.8	Elko	Unnamed Trib. to Marys River	I	1.5	Dam & Pump/Flume	Connects to occupied habitat	Low
298.9	Elko	Unnamed Trib. to Marys River	I	1.5	Dam & Pump/Flume	Connects to occupied habitat	Low
299.1	Elko	Unnamed Trib. to Marys River	I	1.0	Dam & Pump/Flume	Connects to occupied habitat	Low
299.3	Elko	Unnamed Trib. to Marys River	P	4.5	Dam & Pump/Flume	Connects to occupied habitat	Low
299.9	Elko	Unnamed Trib. to Marys River	P	5.0	Dam & Pump/Flume	Connects to occupied habitat	Low
300.2	Elko	Unnamed Trib. to Marys River	E	1.0	Access road	Connects to occupied habitat	No
300.6	Elko	Unnamed Trib. to Marys River	E	1.0	Upland open cut	Connects to occupied habitat	Low
301.8	Elko	Mary's River	P	20.0	Dam & Pump/Flume	Connects to occupied habitat	Low
302.9	Elko	Tributary to Hot Springs Creek	I	2.5	Open-cut (wet)	Connects to occupied habitat	Low
303.1	Elko	Unnamed trib. to Hot Springs Creek	I	5.0	Access road	Connects to occupied habitat	No
303.5	Elko	Hot Springs Creek	I	12.0	Access road	Connects to occupied habitat	No
303.7	Elko	Tributary to Hot Springs Creek	I	0.0	Open-cut (wet)	Connects to occupied habitat	Low
303.7	Elko	Hot Springs Creek	I	2.5	Open-cut (wet)	Connects to occupied habitat	Low
303.7	Elko	Unnamed trib. to Hot Springs Creek	E	3.0	Access road	Connects to occupied habitat	No
304.2	Elko	Unnamed trib. to Hot Springs Creek	E	4.0	Upland open cut	Connects to occupied habitat	Low
304.6	Elko	Unnamed trib. to Hot Springs Creek	E	1.5	Upland open cut	Connects to occupied habitat	Low
304.8	Elko	Unnamed Trib. to Hot Springs Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
305.8	Elko	Unnamed trib. to Pole Creek	E	2.5	Access road	Connects to occupied habitat	No
306.1	Elko	Unnamed trib. to Pole Creek	E	4.0	Access road	Connects to occupied habitat	No
306.4	Elko	Pole Creek	E	4.0	Access road	Connects to occupied habitat	No
306.5	Elko	Pole Creek	E	3.0	Access road	Connects to occupied habitat	No
306.5	Elko	Pole Creek	E	2.0	Access road	Connects to occupied habitat	No
306.5	Elko	Unnamed trib. to Pole Creek	E	0.8	Access road	Connects to occupied habitat	No

Table 4. Waterbodies that may contain or are connected to Lahontan Cutthroat Trout habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
306.7	Elko	Tributary to Pole Creek	E	1.0	Upland open cut	Connects to occupied habitat	High
307.5	Elko	Tributary to Pole Creek	E	2.0	Upland open cut	Connects to occupied habitat	High
307.8	Elko	Tributary to Pole Creek	E	2.0	Upland open cut	Connects to occupied habitat	High
309.5	Elko	Pole Creek	I	20.0	Access road	Connects to occupied habitat	No Access road
309.9	Elko	Unnamed Trib. to Pole Creek	E	2.5	Upland open cut	Connects to occupied habitat	Low
310.1	Elko	Unnamed Trib. to Pole Creek	E	2.5	Upland open cut	Connects to occupied habitat	Low
310.6	Elko	Unnamed Trib. to Pole Creek	E	12.0	Upland open cut	Connects to occupied habitat	Low
311.2	Elko	Pole Creek	P	8.0	Access road	Connects to occupied habitat	No Access road
324.9	Elko	Unnamed Trib. to Pie Creek	E	1.5	Access road	Connects to occupied habitat	No Access road
325.2	Elko	Unnamed Trib. to Pie Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
325.3	Elko	Tributary to Pie Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
325.6	Elko	Tributary to Pie Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
325.9	Elko	Unnamed Trib. to Pie Creek	E	3.5	Upland open cut	Connects to occupied habitat	Low
326.1	Elko	Tributary to Pie Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
326.3	Elko	Unnamed Trib. to Pie Creek	E	3.0	Access road	Connects to occupied habitat	No
326.4	Elko	Unnamed Trib. to Pie Creek	E	2.5	Access road	Connects to occupied habitat	No
326.6	Elko	Unnamed Trib. to Pie Creek	I	3.0	Access road	Connects to occupied habitat	No
326.6	Elko	Tributary to Pie Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
326.7	Elko	Unnamed Trib. to Pie Creek	E	3.5	Access road	Connects to occupied habitat	No
326.8	Elko	Unnamed Trib. to Pie Creek	I	2.0	Open-cut (wet)	Connects to occupied habitat	Low
327.0	Elko	Pie Creek	P	8.0	Dam & Pump/Flume	Connects to occupied habitat	High
327.3	Elko	Unnamed Trib. to Pie Creek	E	2.0	Access road	Connects to occupied habitat	No
327.6	Elko	Tributary to Pie Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low

Table 4. Waterbodies that may contain or are connected to Lahontan Cutthroat Trout habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
327.6	Elko	Tributary to Pie Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
328.9	Elko	Badger Creek	I	16.0	Dam & Pump/Flume	Connects to occupied habitat	Low
329.0	Elko	Badger Creek	I	4.0	Dam & Pump/Flume	Connects to occupied habitat	Low
329.1	Elko	Badger Creek	I	10.0	Dam & Pump/Flume	Connects to occupied habitat	Low
329.4	Elko	Unnamed Trib. to Pie Creek	E	4.0	Access road	Connects to occupied habitat	No
329.5	Elko	Pie Creek	P	21.0	Dam & Pump/Flume	Connects to occupied habitat	Low
329.7	Elko	Tributary to Pie Creek	I	12.0	Dam & Pump/Flume	Connects to occupied habitat	Low
330.5	Elko	Unnamed Trib. to Pie Creek	E	1.0	Access road	Connects to occupied habitat	No
330.5	Elko	Tributary to Gance Creek	I	3.0	Dam & Pump/Flume	Connects to occupied habitat	Low
331.0	Elko	Gance Creek	P	12.0	Dam & Pump/Flume	Connects to occupied habitat	Low
331.9	Elko	Gance Creek	P	30.0	Dam & Pump/Flume	Connects to occupied habitat	Low
331.9	Elko	Unnamed Trib. to Mahala Creek	E	2.0	Access road	Connects to occupied habitat	No
332.2	Elko	Unnamed Trib. to Gance Creek	E	1.0	Access road	Connects to occupied habitat	No
332.8	Elko	Unnamed Trib. to Pie Creek	E	1.3	Access road	Connects to occupied habitat	No
332.9	Elko	Unnamed Trib. to Pie Creek	E	2.0	Access road	Connects to occupied habitat	No
333.2	Elko	Unnamed Trib. to Pie Creek	E	10.0	Access road	Connects to occupied habitat	No
333.2	Elko	Unnamed Trib. to Pie Creek	E	6.0	Upland open cut	Connects to occupied habitat	Low
333.2	Elko	Unnamed Trib. to Pie Creek	E	0.6	Access road	Connects to occupied habitat	No
333.2	Elko	Unnamed Trib. to Pie Creek	E	0.8	Access road	Connects to occupied habitat	No
333.3	Elko	Tributary to Pie Creek	E	4.0	Upland open cut	Connects to occupied habitat	Low
333.7	Elko	Unnamed Trib. to Pie Creek	E	1.5	Access road	Connects to occupied habitat	No
334.5	Elko	Tributary to Spring Branch Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low

Table 4. Waterbodies that may contain or are connected to Lahontan Cutthroat Trout habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
334.5	Elko	Tributary to Spring Branch Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
334.7	Elko	Unnamed Trib. to Spring Branch	E	2.5	Access road	Connects to occupied habitat	No
334.8	Elko	Unnamed Trib. to Spring Branch	E	0.4	Access road	Connects to occupied habitat	No
334.8	Elko	Tributary to Spring Branch Creek	E	3.0	Upland open cut	Connects to occupied habitat	High
334.9	Elko	Spring Branch Creek	P	13.0	Dam & Pump/Flume	Connects to occupied habitat	High
334.9	Elko	Spring Branch Creek	P	15.0	Dam & Pump/Flume	Connects to occupied habitat	High
335.3	Elko	Unnamed Trib. to Pie Creek	I	6.0	Open-cut (wet)	Connects to occupied habitat	Low
335.5	Elko	East Adobe Creek	I	6.0	Open-cut (wet)	Connects to occupied habitat	Low
335.5	Elko	Unnamed Trib. to East Adobe Creek	E	0.0	Upland open cut	Connects to occupied habitat	Low
335.5	Elko	Unnamed Trib. to East Adobe Creek	E	0.0	Upland open cut	Connects to occupied habitat	Low
335.5	Elko	Unnamed Trib. to East Adobe Creek	E	0.0	Upland open cut	Connects to occupied habitat	Low
335.5	Elko	Unnamed Trib. to East Adobe Creek	E	1.0	Upland open cut	Connects to occupied habitat	Low
335.7	Elko	Pie Creek	P	10.0	Dam & Pump/Flume	Connects to occupied habitat	Low
335.7	Elko	Pie Creek	P	4.0	Dam & Pump/Flume	Connects to occupied habitat	Low
337.8	Elko	Unnamed Trib. to Eagle Rock Creek	E	2.5	Access road	Connects to occupied habitat	No
337.8	Elko	Tributary to Pie Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
338.8	Elko	Unnamed Trib. to Eagle Rock Creek	I	12.0	Open-cut (wet)	Connects to occupied habitat	Low
339.2	Elko	Unnamed Trib. to Eagle Rock Creek	I	2.5	Access road	Connects to occupied habitat	No
339.9	Elko	Eagle Rock Creek	P	10.0	Access road	Connects to occupied habitat	No
340.1	Elko	Unnamed Trib. to Eagle Rock Creek	E	4.0	Upland open cut	Connects to occupied habitat	Low
340.8	Elko	Eagle Rock Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
340.9	Elko	Eagle Rock Creek	E	10.0	Access road	Connects to occupied habitat	No

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Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
341.0	Elko	Tributary to Eagle Rock Creek	E	1.0	Upland open cut	Connects to occupied habitat	Low
341.5	Elko	Tributary to Eagle Rock Creek	E	10.0	Upland open cut	Connects to occupied habitat	High
341.9	Elko	Tributary to Eagle Rock Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
342.2	Elko	Unnamed Trib. to Eagle Rock Creek	P	7.0	Access road	Connects to occupied habitat	No
342.6	Elko	Tributary to Eagle Rock Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
343.8	Elko	Unnamed Trib. to Maggie Creek	I	1.5	Access road	Connects to occupied habitat	No
343.9	Elko	Maggie Creek	P	4.0	Dam & Pump/Flume	Connects to occupied habitat	High
344.2	Elko	Maggie Creek	I	3.0	Dam & Pump/Flume	Connects to occupied habitat	High
344.6	Elko	Maggie Creek	I	4.0	Dam & Pump/Flume	Connects to occupied habitat	Low
344.7	Elko	Unnamed Trib. to Maggie Creek	I	3.0	Dam & Pump/Flume	Connects to occupied habitat	Low
344.8	Elko	Maggie Creek	I	3.0	Dam & Pump/Flume	Connects to occupied habitat	Low
345.0	Elko	Tributary to Maggie Creek	E	3.0	Upland open cut	Connects to occupied habitat	High
345.1	Elko	Tributary to Maggie Creek	E	4.0	Upland open cut	Connects to occupied habitat	High
345.6	Elko	Unnamed Trib. to Maggie Creek	I	3.0	Dam & Pump/Flume	Connects to occupied habitat	Low
345.6	Elko	Unnamed Trib. to Maggie Creek	I	1.0	Dam & Pump/Flume	Connects to occupied habitat	Low
345.8	Elko	Unnamed Trib. to Maggie Creek	I	6.0	Dam & Pump/Flume	Connects to occupied habitat	Low
345.9	Elko	Unnamed Trib. to Maggie Creek	E	1.0	Upland open cut	Connects to occupied habitat	High
346.4	Elko	Tributary to Maggie Creek	I	2.0	Dam & Pump/Flume	Connects to occupied habitat	High
346.5	Elko	Unnamed Trib. to Maggie Creek	I	2.0	Dam & Pump/Flume	Connects to occupied habitat	Low
346.5	Elko	Unnamed Trib. to Maggie Creek	I	1.0	Dam & Pump/Flume	Connects to occupied habitat	Low
346.6	Elko	Unnamed Trib. to Maggie Creek	I	3.0	Dam & Pump/Flume	Connects to occupied habitat	High
347.6	Elko	Unnamed Trib. to Maggie Creek	I	2.0	Dam & Pump/Flume	Connects to occupied habitat	High
347.6	Elko	Unnamed Trib. to Maggie Creek	I	3.0	Dam & Pump/Flume	Connects to occupied habitat	Low

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Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
347.6	Elko	Unnamed Trib. to Maggie Creek	I	2.0	Dam & Pump/Flume	Connects to occupied habitat	Low
347.7	Elko	Unnamed Trib. to Maggie Creek	I	4.0	Dam & Pump/Flume	Connects to occupied habitat	Low
347.9	Elko	Unnamed Trib. to Maggie Creek	I	2.0	Dam & Pump/Flume	Connects to occupied habitat	Low
347.9	Elko	Unnamed Trib. to Maggie Creek	I	1.0	Dam & Pump/Flume	Connects to occupied habitat	High
348.8	Elko	Unnamed Trib. to Dip Creek	P	1.0	Open-cut (wet)	Connects to occupied habitat	High
359.6	Elko	Unnamed Trib. to Willow Creek	P	2.5	Open-cut (wet)	Connects to occupied habitat	Low
359.7	Elko	Unnamed Trib. to Willow Creek	E	2.5	Upland open cut	Connects to occupied habitat	Low
359.7	Elko	Unnamed Trib. to Willow Creek	I	2.0	Open-cut (wet)	Connects to occupied habitat	Low
360.7	Elko	Unnamed Trib. to Willow Creek	I	4.0	Open-cut (wet)	Connects to occupied habitat	High
361.5	Elko	Unnamed Trib. to Willow Creek	P	2.0	Open-cut (wet)	Connects to occupied habitat	High
363.2	Elko	Willow Creek	I	20.0	Access road	Connects to occupied habitat	No
363.3	Elko	Rattlesnake Creek	P	15.0	Open-cut (wet)	Connects to occupied habitat	High
363.5	Elko	Unnamed Trib. to Willow Creek	I	6.8	Open-cut (wet)	Connects to occupied habitat	Low
363.5	Elko	Rattlesnake Creek	P	6.0	Open-cut (wet)	Connects to occupied habitat	Low
364.0	Elko	Unnamed Trib. to Willow Creek	P	7.0	Open-cut (wet)	Connects to occupied habitat	Low
364.4	Elko	Willow Creek	P	8.0	Open-cut (wet)	Connects to occupied habitat	High
364.9	Elko	Unnamed Trib. to Willow Creek	I	1.0	Open-cut (wet)	Connects to occupied habitat	Low
365.4	Elko	Unnamed Trib. to Willow Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
365.9	Elko	Trib. to China Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
366.0	Elko	China Creak	E	2.0	Upland open cut	Connects to occupied habitat	Low
366.5	Elko	Unnamed Trib. to China Creek	E	1.0	Upland open cut	Connects to occupied habitat	Low
366.6	Elko	Unnamed Trib. to China Creek	E	1.5	Upland open cut	Connects to occupied habitat	Low
366.8	Elko	Unnamed Trib. to China Creek	E	1.0	Upland open cut	Connects to occupied habitat	Low

Table 4. Waterbodies that may contain or are connected to Lahontan Cutthroat Trout habitat. Access road crossings that do not require blasting are designated as such.

Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
367.2	Elko	Unnamed Trib. to Willow Creek	E	1.0	Access road	Connects to occupied habitat	No
367.3	Elko	Unnamed Trib. to Willow Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
367.5	Elko	Unnamed Trib. to Willow Creek	E	1.5	Upland open cut	Connects to occupied habitat	Low
368.0	Elko	Unnamed Trib. to Willow Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
369.0	Elko	Unnamed Trib. to Willow Creek	E	20.0	Upland open cut	Connects to occupied habitat	Low
369.7	Elko	Unnamed Trib. to Hot Creek	P	7.0	Access road	Connects to occupied habitat	No
369.7	Elko	Unnamed Trib. to Hot Creek	I	2.0	Access road	Connects to occupied habitat	No
369.7	Elko	Unnamed Trib. to Hot Creek	P	10.0	Access road	Connects to occupied habitat	No
369.7	Elko	Hot Creek	P	2.0	Access road	Connects to occupied habitat	No
370.0	Elko	Hot Creek	P	2.0	Open-cut (wet)	Connects to occupied habitat	Low
370.0	Elko	Unnamed Trib. to Hot Creek	P	3.0	Access road	Connects to occupied habitat	No
370.1	Elko	Unnamed Trib. to Hot Creek	E	3.0	Access road	Connects to occupied habitat	No
370.1	Elko	Unnamed Trib. to Hot Creek	I	3.5	Access road	Connects to occupied habitat	No
370.1	Elko	Unnamed Trib. to Willow Creek	E	2.5	Upland open cut	Connects to occupied habitat	Low
371.2	Elko	Unnamed Trib. to Willow Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
378.7	Elko	Unnamed Trib. to Rock Creek	E	4.0	Upland open cut	Connects to occupied habitat	Low
379.7	Elko	Rock Creek	P	30.0	Open-cut (wet)	Connects to occupied habitat	Low
381.3	Elko	Unnamed Trib. to High Line Canal	I	10.0	Open-cut (wet)	Connects to occupied habitat	Low
382.2	Elko	Unnamed Trib. to Rock Creek	E	3.0	Upland open cut	Connects to occupied habitat	Low
382.8	Elko	Unnamed Trib. to High Line Canal	E	5.0	Upland open cut	Connects to occupied habitat	Low
383.6	Elko	Unnamed Trib. to High Line Canal	E	4.0	Upland open cut	Connects to occupied habitat	Low
384.5	Elko	Midas Creek	I	3.5	Open-cut (wet)	Connects to occupied habitat	Low
384.6	Elko	Unnamed Trib. to Hot Lake	E	9.0	Access road	Connects to occupied habitat	No

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Crossing Location (MP)	County	Stream Name	Flow Type[1]	Wetted Width (ft)	Proposed Crossing Method	Occupied Habitat	Blasting Potential[2]
385.7	Elko	Unnamed Trib. to Rock Creek	E	2.0	Access road	Connects to occupied habitat	No
385.7	Elko	Unnamed Trib. to Rock Creek	E	6.0	Access road	Connects to occupied habitat	No
385.7	Elko	Unnamed Trib. to Rock Creek	E	10.0	Access road	Connects to occupied habitat	No
385.7	Elko	Unnamed Trib. to Hot Lake - Squaw Valley	E	3.0	Upland open cut	Connects to occupied habitat	Low
385.9	Elko	Unnamed Trib. to Hot Lake - Squaw Valley	E	2.0	Upland open cut	Connects to occupied habitat	Low
385.9	Elko	Unnamed Trib. to Rock Creek	E	13.0	Access road	Connects to occupied habitat	No
386.4	Elko	Unnamed Trib. to Hot Lake - Squaw Valley	E	3.0	Upland open cut	Connects to occupied habitat	High
435.4	Humboldt	Big Cottonwood Creek	E	2.0	Upland open cut	Connects to occupied habitat	Low
435.6	Humboldt	Tributary to Big Cottonwood Creek	E	4.0	Upland open cut	Connects to occupied habitat	Low

[1] P = Perennial, I = Intermittent, E = Ephemeral [2] E&E Blasting Potential Tables Revised 4/26/2010

Instream construction in listed fishes habitats would be restricted to the timing windows, developed from specific agency comments on the Project's proposed construction activities, to minimize the possibility of interference with fish migration and spawning. Table 5 shows the proposed inwater construction work window for waterbody crossings as they relate to the various listed fish species.

Table 5. Inwater work window for listed fish stream crossings

Species	Inwater Work Window
Lahontan Cutthroat Trout	July 1 - December 31
Warner Sucker	July 15- September 30
Lost River Sucker, Shortnose Sucker	July 1-January 31
Lost River Sucker, Shortnose Sucker (Lost River Crossing)	October 15-January 31
Modoc Sucker	July 15- September 30

Construction Process at Waterbody Crossings

Standard pipeline construction techniques would be employed along the entire project route. These techniques typically involve survey and staking, clearing and grading, trenching, pipe stringing, bending, and welding; lowering-in and backfilling; hydrostatic testing; and cleanup and restoration, as briefly described below. Ruby would thoroughly clean construction equipment prior to use to prevent the importation of invasive plant species to the project area.

Prior to ROW construction activities, up to 10 vegetation clearing vehicles will be allowed to drive in a one-way direction across streams and floodplains, including waterbodies containing water at time of vegetation clearing, without installation and use of temporary access bridges or other above-water structures. Equipment mats will be placed across certain streams where access roads cross the waterbody without any above-water structure, and therefore require reinforcement in the stream and floodplain to support the movement of pipe and equipment. Ruby indicates most access roads already have existing above-water crossing features, and therefore only those crossings without an existing crossing structure might potentially require floodplain or inwater work (F. Robertson, 2010a, pers. comm.)

In order to avoid potential turbidity and sedimentation caused by construction and vehicular traffic crossing waterbodies for access to and at the Project ROW, as necessary Ruby would install temporary equipment bridges across flowing waterbodies to allow for equipment passage. These bridges would remain in place for several months throughout construction activities. Bridges would be approximately 20 to 25 feet in width and constructed across the floodplain and in the stream channel using methods and materials such as clean rock or gravel and flumes, or perched above the water using timber mats, portable prefabricated bridges, and railcars. If excessively soft soils are encountered in the streambed, or if high water flows occur, portable bridges may be utilized at minor stream crossings in lieu of flume pipes. Equipment bridges would be designed to accommodate normal to high stream flow. Ruby will limit instream construction activity disturbance to the minimum extent possible. For waterbody crossing locations which require the installation of a temporary bridge, as well as implementation of a "dry-ditch" crossing method (dam-and-pump or flume), described in more detail below, instream disturbance is anticipated across the entire width of the 115-foot-wide construction ROW.

Survey and Staking. Survey crews will stake the limits of the 115-foot-wide construction ROW, the centerline of the proposed trench, and temporary extra workspaces and other approved work areas. All access roads, wetlands and other environmentally sensitive areas will be clearly marked using temporary signs or flagging. The Project would be allowed to use only approved construction work areas and access roads; use of other areas or roads would not be allowed without prior authorization. The width of the construction ROW will be limited to 75 feet in wetlands and woody riparian habitats, except where wetlands are within actively cultivated or rotated cropland or where additional ROW has been approved due to topographic conditions, stockpiling area requirements for topsoil segregation, crossing of adjacent waterbodies, and other construction and safety issues.

Clearing and Grading. Clearing and grading would remove vegetation and large rocks from the construction work area and level the ROW surface to allow operation of construction equipment. Vegetation generally would be cut or scraped flush with the surface of the ground, leaving rootstock in place where possible. Cut and scraped vegetation would be stored at the edge of the ROW during construction. Ruby would make an effort to preserve topsoil in sensitive areas affected by construction.

Trenching. Trenching involves the removal of soil and bedrock to create a trench into which the pipeline is placed. Depending on the type of trench excavation equipment used, the ditch width would vary from five to 15 feet or wider in some soils. The trench would be roughly 7 feet or greater in depth, depending on site-specific factors, such as topography, and the crossing of existing utilities and underground infrastructure, such as drain tiles.

To minimize turbidity caused by erosion at water crossing locations, trench spoil excavated from within streams flowing at the time of construction would be stored at least 50 feet from the top of the bank, unless this is impractical due to topography. Sediment barriers such as silt fences and straw/hay bales would be placed around the spoil piles to prevent spoil flow into the waterbody. For open-cut crossings of waterbodies that are dry at the time of crossing, Ruby would temporarily side-cast trench spoil into the dry waterbody until the trench is backfilled.

Three main trenching methods would be used at waterbody crossings: wet open-cut, upland open-cut, and dam-and-pump or flume crossing (Tables 1 through 4).

Wet Open-Cut

A wet open-cut crossing involves trenching through the waterbody while water continues to flow through the trenched area. Prior to initiating a wet open-cut crossing, Ruby would pre-fabricate pipe segments in adjacent temporary extra workspaces. Track hoes or other excavating equipment staged on one or both sides of the waterbody would be used to dig a trench in the flowing waterbody. Where the waterbody is too wide to excavate the trench from the banks, equipment would operate from within the waterbody. Equipment operating in the waterbody would be limited to that needed to construct the crossing. Spoil excavated from the trench would be placed a minimum of 10 feet from the edge of the waterbody or as required by federal land managing agencies on federal land. After pipe placement, the trench would be refilled with excavated materials.

Upland Open-Cut

The upland open-cut crossing method involves excavation and backfilling of the trench using backhoes or other excavation equipment working from the banks of or in the dry streambed. Trench spoil would be stored at least 10 feet from the banks. A section of pipe long enough to span the entire crossing would be fabricated on one bank and either pulled across the bottom to the opposite bank, floated across the stream, or carried into place and submerged into the trench. The trench would then be backfilled and the bottom of the watercourse and banks restored and stabilized. Sediment barriers, such as silt fencing, staked straw bales, or trench plugs, would be installed to prevent spoil and sediment-laden water from entering the waterbody from adjacent upland areas.

Dam-and-Pump/Flume Crossing

For a wet or flowing waterbody with sensitive fish species, Ruby would use a "dry-ditch" crossing method (dam-and-pump or flume), as appropriate. A flumed crossing involves installation of a temporary dam and a flume pipe to divert the entire stream flow over the construction area and allow for trenching of the crossing in dry or nearly dry conditions. Dams would be constructed of sand bags alone, sand bags with plastic sheeting, inflatable bladders, or similar materials to direct the flow into the flume pipe. Spoil removed during the trenching would be stored at least 10 feet away from the water's edge (topographic conditions permitting). A section of pipe long enough to span the entire crossing would be fabricated on one bank and slipped under the flume pipe to the opposite bank. The trench would be backfilled and the bottom of the watercourse and banks restored and stabilized before the flume pipe and dams are removed. Sediment barriers, such as silt fencing, staked straw bales, or trench plugs would be installed to prevent spoil and sediment-laden water from entering the waterbody from adjacent upland areas.

The dam-and-pump dry-ditch crossing method would involve damming the stream with sandbags or equivalent materials on both sides of the construction work area and pumping the stream flow around the construction zone. Excavation of the trench, installation of the pipeline, and restoration would be similar to that described above for the flumed crossing.

Blasting. Blasting would be required at certain locations to fracture bedrock and enable equipment to excavate the trench for the pipeline where the rock cannot be economically excavated by conventional means. Blasting may also be used at certain rock-walled streambanks to allow access to waterbody crossing by excavation equipment. Blasting may be required in locations of shallow bedrock in certain areas that are in or connected to ESA-listed fish habitat (Tables 1, 2, 3, and 4).

The primary purpose of blasting will be for open ditch excavation and to bury the pipeline approximately 6 feet below all stream channels. The width of all inwater blasting areas is expected to be less than 12 feet and the total length will vary based on the active channel width of each crossing.

Ruby would be required to use explosives in accordance with federal and state guidelines and permits to ensure a safe and controlled blast. The Project has developed a Blasting Plan which requires compliance with all instream blasting permit requirements and restricts blasting activities to instream timing windows to minimize the possibility of interference with fish migration and spawning. Several techniques and varieties of explosives are available for the proposed blasting activities; specifics will be dependent upon bedrock features and considerations for pipeline installation. Inwater blasting activities will be dependent upon water levels at the time of crossing. Essentially, Ruby proposes to drill holes through the bedrock features, pack dynamite into the holes, and detonate prior to pipeline installation. Following detonation, Ruby will excavate the pipeline trench and lay the pipe similar to non-blasting areas. At all water crossing locations with potential to support sensitive fish species, Ruby proposes to detonate blasting in a dry crossing environment. This will require the installation of a dry-ditch crossing method prior to the commencement of blasting activities.

The BA defers any additional ESA protective measures, and states: "Ruby should coordinate with the FWS, NDOW, and ODFW to determine if and how fish deterrence practices should be implemented before blasting takes place in any waterbody that has the potential to contain special status fish species. Ruby should file the results of its consultations with these agencies prior to crossing the affected waterbody".

Fish Passage and Salvage. For those streams with sensitive fish species where a dry crossing technique is proposed, Ruby will initiate a fish salvage attempt to minimize the taking of federally-listed fish. In addition to complying with this BO, Ruby is currently in the process of attaining scientific take permits from Oregon Department of Fish and Wildlife (ODFW) and Nevada Department of Wildlife (NDOW) for potential fish salvage activities. Fish salvage will be conducted by a qualified fisheries biologist using proper fish handling techniques. The local ODFW and NDOW fish biologists will be invited to participate in fish salvage activities.

Prior to the placement of the dam, Ruby will conduct one or more passes (dependent upon number and species of fish collected and availability of habitat) through the cross-section with a backpack electrofisher. If water depths or discharge is sufficient, Ruby may place a beach seine upstream and downstream of the crossing prior to electrofishing in order to isolate the work area. Based on the small size and hydrology (e.g. minimal water flows during the inwater work window) of the majority of the streams, seine placement is expected to be limited to a few crossings (e.g. Twelvemile Creek and Thomas Creek). Any fish captured will be placed in aerated buckets and transported downstream from the crossing within 15 minutes of capture. Once fish salvage has occurred throughout a work area, dams will be constructed and the work area dewatered. Once the work area is dewatered, an additional salvage effort will be conducted. This effort will involve additional backpack electrofishing or collection attempts with dip nets, if necessary, at the discretion of the qualified fisheries biologist onsite. If fish are missed during the salvage operations, they likely would suffer harm or mortality during waterbody crossing construction. The number of fish missed during the salvage operations would be minimized by using experienced biologists who are familiar with protocols designed to optimize removal efficiency for all conditions expected to be encountered at the crossing sites.

All pumps will be screened to avoid entrainment of listed fish following ODFW and NDOW requirements. Fish screens would be sized to avoid impingement and potential impacts to fish. This would include designing screen approach velocities to not exceed 0.4 cubic feet per second (cfs) for active (self-cleaning) pump screens and to not exceed 0.2 cfs for passive (screen with no self cleaning system) screens. Flow deflectors would be placed at the outlet end of flume pipes and pump hoses to prevent scouring downstream and the associated degradation of water quality and condition of the channels, beds, or banks of the downstream waterbody.

Fish passage would be maintained around the isolated work area at all times during construction. However, the dam-and-pump or flume crossing methods may result in some fish being trapped between the upstream and downstream dams of the waterbody crossing. An experienced fisheries biologist, familiar with fish capture and handling techniques, would relocate any fish that became trapped within the isolated work area to an area within the main river channel. Short-term stress and mortality of fish during relocation would be minimized through the use of careful handling techniques by a qualified fisheries biologist.

Backfilling of Trench. Upon completion of all activities associated with preparing the trench, the pipeline would then be lowered into the trench by a series of side-boom tractors (tracked vehicles with hoists on one side and counterweights on the other) which would carefully lift the pipeline and place it on the bottom of the trench. Once the pipe is sufficiently covered with suitable material, the excavated rocky soil would be used for backfill within the original rocky soil horizon. Successive layers of soil would be compacted until the trench is completely backfilled and leveled to its original contours. Finally, the dam-and-pump/flume crossing structures will be disassembled.

To minimize turbidity associated with the construction and removal of the dam-and-pump and flume crossing, Ruby would ensure any built up sediment behind the dam crossing was removed, prior to removal of the dam to reduce sediment flushing and temporary downstream impacts to waterbodies.

Hydrostatic Testing. Prior to placing the pipeline in service, Ruby will verify the integrity of the pipeline by conducting a series of hydrostatic tests. To do this, Ruby will use both ground water and surface water sources to fill sections of the pipe, raising the pressure to a level above the pipeline's operating pressure for a specified period of time. Water will also be used for dust abatement during construction and to conduct horizontal directional drilling. An estimated 64,268,784 gallons of water will be required from surface water sources for hydrostatic testing and dust abatement. All water obtained from surface waters would be discharged within the same hydrologic unit code watershed from which it was withdrawn. This would prevent the inadvertent transfer of pathogens or nonnative aquatic species between watersheds (e.g. New Zealand mud snail [*Potamopyrgus antipodarum*], whirling disease).

Surface water sources for water withdrawals do not contain listed fish. Surface waters will be withdrawn from the Hams Fork River, upstream from the upper Colorado River system, which contains listed fish and critical habitat. No populations of Colorado River fishes occur in the withdrawal area. All other waters for hydrostatic testing in listed fish basins will be removed from below-surface wells.

Ruby has consulted and continues to consult with state agencies regarding state requirements for water withdrawal and discharge. No chemicals would be used during testing of the pipe; however, where source waters have been identified as containing or potentially containing pathogens or nonnative aquatic species, and the discharge of those source waters have the potential to reach other surface waters that do not contain pathogens or nonnative aquatic species, Ruby would use industry-accepted and agency-approved biocides to appropriately treat the test water before discharge. All biocides used to treat test water would be neutralized prior to discharge. After hydrostatic testing, water would be discharged to the ground through an energy dissipation/filtration device. Ruby would regulate the rate of withdrawal of test water to avoid adverse impacts on aquatic resources or downstream flows. Ruby would discharge hydrostatic test water in a manner that precludes erosion. Where the discharge point is less than 0.5 miles from a perennial stream and the flow is more than 0.5 cfs, Ruby would discharge hydrostatic test water into a temporary sediment basin or structure consisting of both hay bales and/or silt fence for sediment control. Any contaminants in the discharge water will likely be present at levels below the required minimums. To ensure this, water will be collected and tested at a certified water testing laboratory. To help avoid erosion issues, the discharge locations will be nearly level or gently rolling vegetated upland areas. Sites with restrictive drainage features (e.g., shallow depth to clay or bedrock) will be avoided.

Cleanup and Restoration. Every reasonable effort will be made to complete final cleanup, including final grading and the installation of erosion control devices, within 20 days of backfilling. Permanent erosion control devices, such as slope breakers and riprap, would be installed to reduce the risk of erosion, and straw bales would be spread over the right-of-way. All streambed and banks would be restored to preconstruction conditions. Streams with gradual banks would be seeded with native grasses and mulched or protected by a jute blanket, subject to landowner or land management agency approval. For waterbodies with steeper banks, Ruby would implement mitigation measures such as erosion control fabric, wattles, root wads, or riprap. Any woody vegetation removed during the instream installation of pipe may be spread on the banks to help protect revegetation from livestock and wildlife, subject to landowner or land management agency approval.

Ruby would monitor the success of riparian habitat restoration for 5 years after construction. At the end of the 5-year period, Ruby would file a report identifying the status of the woody riparian restoration and the need for any additional restoration efforts.

Analytical Framework for the Jeopardy and Adverse Modification Analyses

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this BO relies on four components: 1) the Status of the Species, which evaluates the species range-wide condition, the factors responsible for that condition, and its survival and recovery needs; 2) the Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; 3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and 4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the species.

In accordance with section 7 regulations and policy, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the species current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of the survival and recovery of the species in the wild.

The jeopardy analysis in this BO places an emphasis on consideration of the range-wide survival and recovery needs of the species and the role of the action area in the survival and recovery of the species as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

In accordance with section 7 regulations and policy, the adverse modification analysis in this BO relies on four components: 1) the Status of Critical Habitat, which evaluates the rangewide condition of designated critical habitat for the species in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; 2) the Environmental Baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; 3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and 4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on species critical habitat are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the species.

The analysis in this BO places an emphasis on using the intended range-wide recovery function of species critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

Action Area

"Action area" is defined at 50 CFR 402 to mean "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the purposes of this consultation, the Service defines the action area along the linear path of the pipeline extending from Opal Hub in Lincoln County, Wyoming to the Oregon-California state line in Klamath County, Oregon where Project impacts may affect ESA-listed fish or designated critical habitat. The action area also includes locations of groundwater or surface water withdrawal, all compressor stations, meter stations, pigging facilities, mainline valve sites, pipe storage and contractor yards, electric power-lines, construction camps, temporary housing facilities, temporary workspace areas, and access roads associated with the Project where Project impacts may affect ESA-listed fish or designated critical habitat or proposed critical habitat. The action area includes seven major watershed basins including, from east to west, the Upper Green, Humboldt, North Lahontan, Black Rock Desert, Oregon Closed Basins, Upper Sacramento, and Klamath. Within these watershed basins the action area includes those portions of ESA-listed fish streams, tributaries to ESA-listed fish streams, streams with designated critical habitats, tributaries to streams with designated critical habitats, and streams biologically or geomorphologically connected to occupied listed fishes streams or critical habitat, where a Project waterbody crossing is proposed or other adverse Project impacts will occur.

Status of Species

Lahontan Cutthroat Trout

Species Description. Lahontan cutthroat trout is an inland subspecies (one of 14 recognized subspecies in the western United States) of cutthroat trout endemic to the Lahontan Basin of northern Nevada, eastern California, and southeastern Oregon. Cutthroat trout (*O. clarkii*) have the most extensive range of any inland trout species of western North America and occur in anadromous, non-anadromous, fluvial, and lacustrine populations (Behnke 1979). Differentiation of the species into approximately 14 recognized subspecies occurred during subsequent general desiccation and isolation of the Great Basin and Intermountain Regions since the end of the Pleistocene, and indicates presence of cutthroat trout in most of their historic range prior to the last major Pleistocene glacial advance (Loudenslager and Gall 1980; Behnke 1992). Relevant information on the status of the species, life history traits, population dynamics, and distribution, can be found in the 1995 Lahontan cutthroat trout Recovery Plan (Service 1995) and 5-year review (Service 2009a) which is summarized below.

Life History/Habitat. Lahontan cutthroat trout is an obligatory stream spawner. Spawning generally occurs in riffle areas over gravel substrate from March through July, depending on stream flow, elevation, and water temperature (La Rivers 1962; McAfee 1966; Lea 1968; Moyle 1976). Lahontan cutthroat trout spawning migrations have been observed in water temperatures from 41°F to 61°F (Lea 1968; Service 1977; Sigler et al. 1983; Cowan 1983). Individuals mature between 2 and 4 years of age and may live as long as 5 to 9 years. Post-spawning mortality rates as high as 90 percent have been reported for Lahontan cutthroat trout (Cowan 1982). Consecutive year spawning appears to be uncommon.

Lahontan cutthroat trout tolerate higher alkalinities than other trout species (Dickerson and Vinyard 1999a) and can survive wide daily temperature fluctuations of 25°F to 35°F (Coffin 1983). Dunham et al. (1999) note that most Lahontan cutthroat trout populations have a distribution limit corresponding closely to a maximum summer water temperature of 78°F, similar to results of laboratory experiments on thermal tolerance (Dickerson and Vinyard 1999b; Meeuwig et al. 2004). In some streams, Lahontan cutthroat trout have been observed in water temperatures exceeding 81°F (Dunham et al. 2003); however, in the laboratory, Dickerson and Vinyard (1999b) found that no Lahontan cutthroat trout survived more than two days while being held at 82°F and 64 percent died after seven days while being held at 79°F. Additionally, Lahontan cutthroat trout being held at 75°F weighed significantly less than fish being held below 75°F (Dickerson and Vinyard 1999b). Dunham et al. (1999) recommends that water temperatures for Lahontan cutthroat trout should not equal or exceed a daily maximum of 72°F to minimize risk of mortality and sublethal thermal stress. Populations in less than optimal habitat may be present in reduced numbers and age classes.

Population Dynamics. Many Lahontan cutthroat trout populations historically acted as metapopulations (Service 1995). The term metapopulation refers to a collection of discrete local breeding populations. Lahontan cutthroat trout metapopulation dynamics result when local breeding populations in tributary streams are interconnected by larger downstream habitats. Interaction among tributary populations may occur through "straying" or dispersal of resident and/or fluvial fish (Rieman and Dunham 2000; Neville et al. 2006; Peacock and Kirchoff 2007).

The presence of several populations increases the probability that at least one will survive through periods of disturbance, such as drought, and consequently protect the genetic variation available for adaptation to change (Dunham et al. 1997; Rieman and Dunham 2000). Models of metapopulation dynamics illustrate that some metapopulations may go extinct even in the presence of suitable habitat and that unoccupied suitable habitat may be important for long-term survival of the species (Fahrig and Merriam 1994; Lande 2002).

Loss of connectivity among local populations during the past 150 years has isolated many local Lahontan cutthroat trout populations and has increased the risk of local extinctions (Dunham et al. 1997; Fagan 2002; Frankham 2005; Peacock and Kirchoff 2007). Most Lahontan cutthroat trout populations are in isolated stream segments with no connectivity with other populations and consequently have a high risk of extinction from both deterministic (habitat loss, overexploitation, non-native species, or pollution) and stochastic (demographic, environmental, genetic, or catastrophic) processes (Frankham 2005, Service 2009a). Management directed towards metapopulation dynamics will require long-term improvement in habitat conditions and connectivity to achieve recovery objectives.

Lahontan cutthroat trout populations fluctuate significantly because of highly variable environmental conditions in the Great Basin and life history attributes of the subspecies (Dunham 1996; Ray et al. 2007). Because of this variability, other stressors such as poor habitat conditions and introductions of non-native salmonids can significantly depress Lahontan cutthroat trout populations and frequently cause localized extinctions. Degraded systems exhibit greatly reduced resiliency to accommodate natural disturbances such as floods, fire, and drought, thereby exacerbating the effects of those events which further reduces the persistence of these populations (Wilcox et al. 2006). These degraded conditions, combined with variability in Lahontan cutthroat trout numbers, places greater importance on the quantity and quality of the habitat needed for survival and recovery of Lahontan cutthroat trout.

Extensive demographic studies of Lahontan cutthroat trout in 13 streams indicate extreme year-to-year variability in numbers of each age class (ages 1–6) (Ray et al. 2007). This variability in numbers reflects variability in recruitment and survival among years. Data from several populations indicate that recruitment is strongly associated with average stream flow from March through June and that survival is a strong function of population density (Ray et al. 2007). Seasonal and annual changes in climatic conditions and stream discharge can lead to dramatic population expansions or contractions (Dunham 1996; Dunham et al. 1997), indicative of broader potential species occupancy over the 50+ year life of the Project.

Status and Distribution. Lahontan cutthroat trout was listed as endangered on October 13, 1970 (35 FR 16047), and subsequently reclassified as threatened on July 16, 1975, to facilitate management and permit via a 4(d) rule to allow for state-regulated sport harvest of these fish (40 FR 29863). There is no designated critical habitat for Lahontan cutthroat trout.

Lahontan cutthroat trout historically occupied large freshwater and alkaline lakes, small mountain streams and lakes, small tributary streams, and major rivers of the Lahontan Basin of northern Nevada, eastern California, and southern Oregon, including the Truckee, Carson, Walker, Susan, Humboldt, Quinn, Summit Lake/Black Rock Desert, and Coyote Lake watersheds (Service 1995). Large lakes included Lake Tahoe, Fallen Leaf Lake, and Cascade Lake in the Tahoe watershed; Donner Lake, Independence Lake, Winnemucca Lake (now dry), and Pyramid Lake in the Truckee River watershed; Walker Lake in the Walker River watershed; and Summit Lake in the Black Rock Desert watershed (Gerstung 1988). Other headwater lakes found in the Walker River watershed were also historically occupied (Gerstung 1988). The range of Lahontan cutthroat trout is divided into three basins, or Geographic Management Units (GMUs), based on geographical, ecological, behavioral, and genetic factors, and has been managed as such since 1995 (Service 2009a). The three basins (or GMUs) include: (1) Western Lahontan Basin (Western GMU) comprised of the Truckee, Carson, and Walker River watersheds; (2) Northwestern Lahontan Basin (Northwest GMU) comprised of the Quinn River, Black Rock Desert, and Coyote Lake watersheds; and (3) Eastern Lahontan Basin (Eastern GMU) comprised of the Humboldt River and tributaries (Service 2009a).

It is not known with certainty every stream and lake that were historically occupied by Lahontan cutthroat trout. For this status of species analysis, we assessed historically occupied habitat based on habitat believed to be occupied by Lahontan cutthroat trout at the time of the first European exploration of the Great Basin (approximately 1800) (May and Albeke 2008). Based on the May and Albeke (2008) protocol, we classified 11,046 km (6,864 mi) of stream habitat as potential historical Lahontan cutthroat trout habitat (Service 2009a). Headwater lakes were classified as historical habitat if they were not upstream of known barriers. An additional 127,274 surface hectares (ha) (314,502 surface acres (ac)) of lakes were known or had the potential of being occupied by Lahontan cutthroat trout (Service 2009a).

Lahontan cutthroat trout currently occupy approximately 944.8 km (587.7 mi), or 8.6 percent of streams in 16 different hydrologic units within their historical range (Service 2009a). Lahontan cutthroat trout occupy an additional 84.8 km (52.7 mi) of habitat in 11 hydrologic units outside their historical range (Out-of-Basin) for a total of 1,030.1 km (640.1 mi) of occupied stream habitat (Service 2009a).

The Lahontan cutthroat trout Recovery Plan (Service 1995) identified a need for development of ecosystem plans for the Truckee and Walker River basins. Subsequently, Short-Term Action Plans (Action Plans) for the Truckee and Walker River basins were published in 2003 (Service 2003a, 2003b) which represent a 3-year planning effort to develop the "ecosystem" based plan identified in the 1995 Recovery Plan. The Action Plans identify short-term activities and research that will further understanding of the conservation needs of Lahontan cutthroat trout specific to the Truckee and Walker River basins and utilize adaptive management to refine the long-term recovery strategy.

The Service also recently published the Lahontan cutthroat trout 5-year Review (Service 2009a) and concluded that the Lahontan cutthroat trout still meets the definition of threatened throughout its range. The status of Lahontan cutthroat trout in the Western and Northwestern Lahontan basins are the most tenuous due to having a only a few isolated and small populations, the presence of nonnative species in most fluvial and lacustrine habitats, complexity of threats for the lacustrine form of Lahontan cutthroat trout, and poor water quality in Walker Lake. While the Eastern Lahontan basin has the largest intact habitat for Lahontan cutthroat trout, populations also suffer from the presence of nonnative species and small isolated populations.

Threats. Lahontan cutthroat trout occupies a wide range of habitat types and conditions. Factors that historically and currently influenced the decline in the species include 1) hybridization, predation, and competition with introduced species; 2) commercial fishing; 3) blockage of migrations and genetic isolation due to diversion dams and other impassable structures; 4) degradation of habitat due to logging, mining, road construction, irrigation practices, recreational use, channelization, and dewatering due to irrigation and urban demands; 5) changes in water quality and water temperature; 6) urbanization; and 7) improper grazing. Other threats include habitat fragmentation and isolation, drought, and fire.

Most Lahontan cutthroat trout populations which co-occur with nonnative species are decreasing and the majority of Lahontan cutthroat trout population extinctions which have occurred since the mid-1990s have been caused by nonnative species. Additionally, nonnative fish occupy habitat in nearly all unoccupied Lahontan cutthroat trout historical stream and lake habitat, making repatriation of Lahontan cutthroat trout extremely difficult. The majority of Lahontan cutthroat trout populations are isolated and confined to narrow and short lengths of stream. These factors reduce gene flow between populations, and reduce the ability of populations to recover from catastrophic events, thus threatening their long-term persistence and viability. Pyramid and Walker lakes are important habitat for the lacustrine form of Lahontan cutthroat trout. Conditions in these lakes have deteriorated over the past 100 years and continue to decline, most dramatically in Walker Lake. The present or threatened destruction, modification, or curtailment of Lahontan cutthroat trout habitat and range continues to be a significant threat and in some instances is increasing in magnitude and severity.

Recreation on federal lands can also adversely impact Lahontan cutthroat trout and their habitats. Recreational use includes hiking and camping, both on foot and on horseback. Popular trails, such as the Pacific Crest Trail along the Upper Truckee Meadows, contribute sediment to the stream system. Campers generally choose stable sites away from creeks, but camping along springs and streams impacts riparian vegetation and streambank stability. Recreationists leaving gates open is a continuing threat because it allows cattle access to riparian areas that are not authorized for grazing.

Grazing by sheep and cattle has occurred throughout Lahontan cutthroat trout range and over time entire plant communities may change as a result of grazing pressure. Improper livestock grazing can affect riparian areas by changing, reducing, or eliminating vegetation, compacting soils, trampling streambanks, and by loss in riparian areas through channel widening, channel degradation, or lowering of the water table. Localized contamination of surface water also can occur from improper grazing due to increased fecal coliform levels.

The impacts to Lahontan cutthroat trout from climate change are not known with certainty. The Service anticipates negative impacts will occur through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events such as drought and fire. These impacts will likely increase the magnitude and severity of other existing threats to Lahontan cutthroat trout. Climate change stressors may exacerbate the current threats to Lahontan cutthroat trout populations throughout its range, many of which already have multiple stressors affecting their persistence.

Survival and Recovery Needs. The Service's 5 year review (2009a) indicated Lahontan cutthroat trout survival and recovery needs include continued efforts and successes in improving riparian habitat through improved management of land use activities (*i.e.*, improved grazing management), protection of quality habitat, and identification of key habitat restoration opportunities. Key to Lahontan cutthroat trout survival, and eventual recovery, is reduction of nonnative species conflicts. The Service (2009a) also recommends continued stakeholder efforts to reconnect Lahontan cutthroat trout metapopulation habitats. Finally, the Service (2009a) recommends a revision of the 1995 Lahontan cutthroat trout Recovery Plan to reprioritize recovery actions to better focus on the above priority Lahontan cutthroat trout survival and recovery needs.

Warner Sucker

Species Description. Two forms of Warner sucker are recognized. One is the lake resident form and the other is the stream resident form, with frequent migration between the two habitat types. The Warner Basin provides both a temporally more stable stream environment and a temporally less stable lake environment (e.g., lakes dried in 1992). Representatives of a species occupying this continuum form a metapopulation. Observations indicate that Warner sucker grow larger in the lakes than they do in streams (White et al. 1990). The smaller stream morph and the larger lake morph are examples of phenotypic plasticity within metapopulations of the Warner sucker. Warner sucker are relatively long-lived. One sampled from Crump Lake was aged at 17 years old at a length of 17.9 inches.

Life History/Habitat. Feeding habits depend on life stage of the sucker. Adults are more generalized, feeding on diatoms, filamentous algae, and detritus. Larvae feed on invertebrates, particularly planktonic crustaceans. Adults feed during the night, foraging over a variety of substrates such as boulders, gravel, and silt (Tait and Mulkey 1993a, 1993b). Larvae typically inhabit shallow backwater pools or stream margins where there is no current, often among or near aquatic plants. Juvenile suckers (1 to 2 years old) are at the bottom of deep, cool pools. Adults inhabit sections of low gradient stream with long pools. Habitat components consist of undercut banks; large beds of aquatic vegetation; root wads or boulders; maximum depth greater than 5 feet; and overhanging vegetation (often *Salix* spp.). Lake resident suckers are generally found in the deepest portion of the lake. Hart, Crump, and Pelican lakes are shallow and uniform in depth (the deepest is Hart Lake at 11.3 feet). The mud bottoms provide the suckers with abundant food in the form of invertebrates, algae, and organic matter.

Warner sucker spawning generally occurs in April and May in sand or gravel substrates (White et al. 1990, 1991; Kennedy and North 1993). Temperature and flow cues appear to trigger spawning, at 57°F to 68°F while stream flows are fairly high. Warner suckers are generally potadromous and spawn in both stream and lake environments. This dual spawning strategy protects the species from drought and flood events.

Allen et al. (1996) surmise that spawning aggregations in Hart Lake are triggered more by rising stream temperatures than by peak discharge events in Honey Creek. In years when access to stream spawning areas is limited by low flow or by physical instream blockages (such as beaver dams or diversion structures), suckers may attempt to spawn on gravel beds along the lake shorelines. In 1990, suckers were observed digging nests in 16+ inches of water on the east shore of Hart Lake at a time when access to Honey Creek was blocked by extremely low flows (White et al. 1990).

Population Dynamics. The BLM, in cooperation with The Nature Conservancy and ODFW, have sampled Hart Lake with varying degrees of intensity since 1990. The number of suckers captured was highly variable depending on the year, ranging from 0 to 835 individuals (White 1990, 1991; Kennedy 1993; Allen 1994, 1995, 1996; Bosse 1997; Munhall 1998, 1999, 2005; Hartzell 2001). In 1992, Hart Lake totally dried and in 1993 refilled again. By 1994 suckers were again documented in Hart Lake.

The only population estimate conducted prior to 2006 was done in 1996 (Allen et al. 1996). The estimated population of Warner suckers in Hart Lake was 493, but the sampling was concentrated at the mouth of Honey Creek which would most likely have resulted in a higher catch per unit of effort than a well distributed sample, therefore the estimate is considered to be high.

In the spring of 2006 ODFW intensively sampled Hart and Crump lakes to obtain a population estimate. As of May 5, 2006, 23 suckers in Hart Lake and 47 suckers in Crump Lake were recorded. The smallest sucker captured was 2.3 inches TL, the largest 17.7 inches, and the average was 12.8 inches. Capture of smaller suckers was consistent with previous high flow years as the high stream flows flush small fish from the streams into the lakes (BLM 2006).

Status and Distribution. The Service listed the Warner sucker as a threatened species and designated critical habitat in 1985 (50 FR 39117, Service 1985a). Warner suckers were listed due to reductions in the range and numbers, reduced survival due to predation by introduced game fishes in lake habitats, and habitat fragmentation and migration corridor blockage due to stream diversions structures and agricultural practices. Warner sucker critical habitat includes Twelvemile Creek from the confluence of Twelvemile and Twentymile Creeks upstream for about 4 stream miles; Twentymile Creek starting about 9 miles upstream of the junction of Twelvemile and Twentymile Creeks and extending downstream for about 9 miles; Spillway Canal north of Hart Lake and continuing about 2 miles downstream; Snyder Creek, from the confluence of Snyder and Honey Creeks upstream for about 3 miles; and Honey Creek from the confluence of Hart Lake upstream for about 16 miles. Warner sucker critical habitat includes 50 feet on either side of these waterways.

The Warner sucker is endemic to the Warner Valley watershed of Oregon, northern Nevada, and northern California, although the Warner sucker is currently found only in Oregon and Nevada. The watershed is approximately 2,648 square miles, about 95 percent of which is in Oregon. The basin is endorheic (closed), containing a dozen or more lakes and many potholes during wet years. The three southernmost lakes (Hart, Crump, and Pelican) are semi-permanent. In addition, three perennial streams flow into the basin: Honey, Deep, and Twentymile creeks.

Between 1977 and 1991, eight studies examined the range and distribution of the Warner sucker throughout the Warner Valley (Kobetich 1977; Swenson 1978; Coombs et al. 1979; Coombs and Bond 1980; Hayes 1980; White et al. 1990; Williams et al. 1990; White et al. 1991). These surveys have shown that when adequate water is present, Warner suckers may inhabit all the lakes, sloughs, and potholes in the Warner Valley. The documented range of the sucker extended as far north into the ephemeral lakes as Flagstaff Lake during high water in the early 1980s, and again in the 1990s (Allen et al. 1996). Stream resident populations are found in Honey, Snyder, Twentymile, and Twelvemile creeks. Intermittent streams in the drainages may support small numbers of migratory suckers in high water years.

Although stream resident Warner suckers are present on BLM lands, they do not currently, nor did they historically, inhabit streams on Forest Service (USFS) lands within the Warner Basin. Upper distribution limits are typically determined by stream gradient and stream volume. Habitat conditions on USFS lands upstream from occupied habitat express effects from past and on-going activities such as roads associated with timber harvest, and from grazing activities.

The Service has consulted on USFS Land and Resource Management Plans as well as programmatic and single action (including grazing activities) consultations to reduce the effects of USFS activities that continue to suppress the degraded baseline of watersheds within the Warner Basin. The USFS, along with the BLM, has been managing and restoring streams and uplands within the Warner Basin since the mid-1980s. Road decommissioning, culvert replacements, changes in grazing management, timber harvest strategies, and instream restoration projects are all contributing to reversing the decline in watershed health that began over a century before.

Recovery objectives and criteria are outlined in the Recovery Plan for the Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin (Service 1998). Among the objectives is objective #1.1.3.1, which states: "Maintain high quality habitats on Federal lands to prevent species declines. Federal agencies should develop goals to maintain high quality habitats. Where current agency land management is deemed inadequate to protect (i.e., maintain or improve upon current conditions) high quality habitat conditions, recommend modifications to agencies to bring about needed changes in land use. Set management recommendations conservatively until such time as watershed analyses are completed, or other long term plans can be developed." Few of the objectives in the recovery plan have been met, in particular those that involve modification (screening and passage) to water delivery systems on private lands in the Warner Valley. The Service, BLM, USFS, and ODFW are initiating research and monitoring to prioritize activities with private land owners to facilitate passage and screening projects.

Critical Habitat. Critical habitat was designated for the Warner sucker on September 27, 1985, for approximately four miles of Twelvemile Creek, 16 miles of Twentymile Creek, three miles of Snyder Creek, 16 miles of Honey Creek, two miles of the "spillway canal", and 50 feet on either side of the stream banks in Lake County, Oregon (50 FR 39117). Warner sucker critical habitat PCEs include streams 15-60 ft wide, with gravel substrate, riffle/shoal/pool habitat, clean, unpolluted, flowing water, invertebrates for food, and stable riparian zone. The recovery function of Warner sucker critical habitat includes providing the species with intact riparian vegetation, habitat free of competition or predation by non-native species, barrier free passage, and good water quality. Essential to the conservation of the Warner sucker is the maintenance of a protected 50-foot riparian zone on each side of the stream to protect the integrity of the stream ecosystem. The riparian vegetation helps prevent siltation and run-off of other pollutants, and shading from small trees and shrubs in the riparian zone helps maintain suitable water temperature and dissolved oxygen levels in the streams. These stream areas include spawning and rearing habitat for the species. The critical habitat is designed to lead to recovery by establishing (1) a self-sustaining metapopulation (a group of populations of one species coexisting in time but not in space) that is distributed throughout the Twentymile, Honey, and Deep Creek (below the falls) drainages, and in Pelican, Crump, and Hart Lakes, (2) restored passage within and among the Twentymile, Honey and Deep Creek (below the falls) drainages so that the individual populations of Warner suckers can function as a metapopulation, and (3) an absence of threats likely hurt the survival of the species over a significant portion of its range (Service 1998).

Threats. Warner suckers were once common throughout the Warner basin but gradually declined from about 1900 to the early 1970s. Historical accounts tell of impressive runs of fish in the Warner Valley. Long-time residents recall during the 1930s large numbers of spawning Warner suckers ascending Honey Creek into upstream canyon areas. The combination of restricted distribution, semi-permanent nature of the lakes, degradation of existing stream habitat, blockage of migration corridors, introduction of exotic fishes into the lakes, and water usage has impacted the existing populations of Warner sucker.

Habitat fragmentation and degradation, due to agricultural development in the last century and the placement of irrigation structures in spawning streams during the last 60 years are, in part, responsible for the decline in abundance and distribution of Warner suckers (Williams et al. 1990). In addition, the introduction of non-native piscivorous fishes such as black (*Pomoxis nigromaculatus*) and white (*P. annularis*) crappie, brown bullhead (*Ameiurus nubulosus*), and largemouth bass (*Micropterus salmoides*) in the 1970s is believed to have inhibited successful recruitment to lake populations (Williams et al. 1990). Stream resident populations have been negatively impacted through effects associated with livestock grazing, water diversions, and roads. Erosion of stream banks and loss of riparian vegetation (effects of overgrazing, timber harvest, and other activities) has increased water temperatures and peak flows, silted spawning beds, and reduced the quality and quantity of pool habitat.

The listing rule did not identify climate change as a threat to the continued existence of the Warner sucker (Service 1985a). However, the northwestern corner of the Great Basin is naturally subject to extended droughts, during which even the larger water bodies have dried up (Laird 1971). Regional droughts have occurred every 10 to 20 years in the last century (Reid 2008b). Human-induced climate change could exacerbate low-flow conditions in Warner sucker habitat during future droughts. A warming trend in the mountains of western North America is expected to decrease snowpack, hasten spring runoff, reduce summer stream flows, and increase summer temperatures (IPCC 2007; PPIC 2008). Lower flows as a result of less snowpack could reduce sucker habitat, which might adversely affect Warner sucker reproduction and survival. Warmer water temperatures could lead to physiological stress and could also benefit non-native fishes that prey on or compete with Warner suckers. While it appears reasonable to assume that the Warner sucker will be adversely affected by climate change, there is a lack of sufficient information to accurately determine to what degree of threat climate change poses and when the changes will occur.

Survival and Recovery Needs. The Service (1998) indicated Warner sucker survival needs include continued access to low energy pool habitat with abundant cover, and abundant algae and small benthic invertebrates. Recovery of the species will require the maintenance of self-sustaining populations comprised of multiple age-classes distributed throughout the species' historic range, with some passage ensured between individual populations and drainages. These populations must be stable or increasing in size with documented reproduction and recruitment, and each must be large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes.

The recovery function of Warner sucker critical habitat includes providing the species with intact riparian vegetation, habitat free of competition or predation by non-native species, barrier free passage, good water quality, and adequate habitat for spawning and rearing. Essential to the conservation of the Warner sucker is the maintenance of a protected 50-foot riparian zone on each side of the stream to protect the integrity of the stream ecosystem. The riparian vegetation helps prevent siltation and run-off of other pollutants, and shading from trees and shrubs in the riparian zone helps maintain suitable water temperature and dissolved oxygen levels in the streams.

Lost River Sucker and Shortnose Sucker

The Lost River sucker and shortnose sucker are discussed together because of their similarities and overlapping ranges.

Species Descriptions. Lost River sucker are large fish (up to 3.3 feet long and 10 pounds in weight) that are distinguished by their elongate body and subterminal mouth with a deeply notched lower lip. They have dark brown to black backs and brassy sides that fade to yellow or white on the belly. Lost River sucker are native to the Lost River and upper Klamath River systems where they have adapted to lake living (Moyle 2002).

Shortnose sucker are distinguished by their large heads with oblique, terminal mouths with thin but fleshy lips. The lower lips are deeply notched. Shortnose sucker are dark on their back and sides and silvery or white on the belly. They can grow to about 2 feet long, but growth is variable among individuals (Moyle 2002).

The endangered Lost River sucker and shortnose sucker are part of a group of suckers that are large, long-lived, late-maturing, and live in lakes and reservoirs but spawn primarily in streams; collectively, they are commonly referred to as lake suckers (National Research Council [NRC] 2004). The lake suckers differ from most other suckers in having terminal or subterminal mouths that open more forward than down, an apparent adaptation for feeding on zooplankton rather than sucking food from the substrate (Scoppettone and Vinyard 1991). Zooplanktivory can also be linked to the affinity of these suckers for lakes, which typically have greater abundance of zooplankton than do flowing waters.

Life History/Habitat. Lost River sucker and shortnose sucker grow rapidly in their first five to six years, reaching sexual maturity sometime between years four and six for shortnose sucker and years four and nine for Lost River sucker (Perkins et al. 2000a). Lost River sucker and shortnose sucker have been aged to 55 and 33 years, respectively. Females produce a large number of eggs, 44,000 to 236,000 eggs for Lost River sucker and 18,000 to 72,000 eggs for shortnose sucker, per year when they spawn. Some females spawn every year, while others spawn every two or three years. Larger, older females produce substantially more eggs and, therefore, can contribute relatively more to recruitment than a recently matured female. However, only a small percentage of the eggs survive to become larvae.

Lost River sucker and shortnose sucker spawn from February through May. River spawning habitat is riffles or runs with gravel and cobble substrate, moderate flows, and depths of less than 4 feet (Buettner and Scoppettone 1990). Females broadcast their eggs and they are buried within the top few inches of the substrate. Some Lost River sucker have been noted to spawn in the Upper Klamath Lake (UKL), particularly at springs occurring along the shorelines. Spawning site fidelity in UKL has been documented suggesting two discrete spawning stocks of Lost River sucker (i.e., those using UKL springs and Williamson/Sprague rivers). Lost River sucker and shortnose sucker do not die after spawning and can spawn many times during their lifetime. Individual males and females of both species commonly spawn in consecutive years.

Soon after hatching, sucker larvae move out of the gravel; they are about 0.3 inch TL and mostly transparent with a small yolk sac (Buettner and Scoppettone 1990). Larvae generally spend relatively little time upriver before drifting downstream to the lakes. However, in 2006, the Service documented a large number of larvae residing in the Sprague River until June when they were 1.0 to 1.4 inches TL, probably related to better flow and stream habitat conditions (Service 2008). In the Williamson River, larval sucker out-migration from spawning sites begins in April and is generally completed by July. Downstream movement takes place mostly at night and near the water surface (Klamath Tribes 1996; Tyler et al. 2004). Once in the lake, larval suckers disperse to near-shore areas (Cooperman 2004; Cooperman and Markle 2004).

In the UKL, larval suckers are first captured in early April during most years, with peak catches occurring in June, and densities dropping to very low levels by mid-July (Cooperman and Markle 2000). Larval habitat is generally along the shoreline, in water 0.3 to 1.6 feet deep and associated with emergent aquatic vegetation, such as bulrush (Buettner and Scoppettone 1990; Cooperman and Markle 2004). Emergent vegetation provides cover from predators, protection from currents and turbulence, and abundant prey (including zooplankton, macroinvertebrates, and periphyton). Larvae transform into juveniles at about 1 inch TL. This generally occurs by mid-July.

Juvenile suckers (age-0) utilize a wide variety of near-shore habitat including emergent wetlands and non-vegetated areas and off-shore habitat (Terwilliger 2006; VanderKooi et al. 2006; Hendrixson 2007a, 2007b). As they grow during the summer, many move offshore. Adult suckers generally use water depths 3 feet or deeper (Peck 2000; Banish et al. 2007). Adult Lost River sucker and shortnose sucker are mainly found at deeper depths. Radio-telemetry studies show that adult Lost River sucker and shortnose sucker primarily use water depths of 6 to 9 feet and strongly avoid depths of less than 4 feet. There are observations of suckers spawning in shallower depths during the night when cover is provided by darkness. Suckers apparently avoid clear water except when showing ill effects of poor water quality (Service 2008). These observations suggest that suckers are strongly associated with cover, primarily depth and turbidity.

Lost River sucker and shortnose sucker are generally limited to lake habitats when not spawning, although small river-resident populations have been documented. The Lost River sucker should be considered an obligate lacustrine (lake-dwelling) fish, as no known population exists in rivers. In contrast, the shortnose sucker is present throughout its life cycle in some riverine habitats (e.g., Lost River, Miller Creek, Willow Creek, and other tributaries of Clear Lake and Gerber Reservoir) and should be considered a lacustrine/riverine facultative species. Perkins and Scoppettone (1996) found adult shortnose sucker in Willow Creek (Clear Lake Basin) resting in the bottom of pools and using undercut banks, overhanging shrubs, and algae as cover.

Population Dynamics. Lost River sucker and shortnose sucker are endemic to the lake and tributary habitats of the Upper Klamath Basin including the Lost River subbasin.

Upper Klamath Lake and Tributary Populations

The primary rearing habitat of Lost River sucker and shortnose sucker is in the UKL. Adult Lost River sucker and shortnose sucker are widely distributed throughout the lake in the fall and winter (Service 2002e; NRC 2004). In the spring months, Lost River sucker and shortnose sucker stage in the north end of the lake near Goose Bay and Modoc Point prior to spawning in tributaries or shoreline spawning areas (Hendrixson et al. 2004). Adult Lost River sucker and shortnose sucker are primarily found in the northern portion of the lake above Bare Island during summer months (Peck 2000; Banish et al. 2007). Reasons for this summer distribution are not clear but may be related to better water quality near spring-fed Pelican Bay and the Williamson River (Reiser et al. 2001; Service 2002e; Banish et al. 2007).

During the summer and early fall, UKL water quality conditions periodically deteriorate to stressful and even lethal levels for suckers as a result of decomposition of massive algae blooms and resultant low levels of dissolved oxygen (Loftus 2001). A multiple-year radio-telemetry study has documented Lost River sucker and shortnose sucker concentrating in or near Pelican Bay during periods of deteriorating water quality, presumably to seek refuge at areas of better water quality (Banish et al. 2007).

The Lost River sucker population in the UKL appears to consist of two distinct stocks: fish that spawn along the eastern shoreline of the UKL; and fish that spawn in the Williamson and Sprague rivers (Perkins et al. 2000). Mark-recapture data show that the two stocks maintain a high degree of fidelity to spawning areas and seldom interbreed (Hayes et al. 2002; Barry et al. 2007a, 2007b). The river spawning stock migrates up the lower Williamson River and lower Sprague River in the spring to spawn. Chiloquin Dam was identified as a partial barrier to upstream passage that may prevent a portion of the sucker spawning run from migrating farther upstream into the Sprague River or may delay the timing of the migration to upstream areas (Scoppettone and Vinyard 1991; NRC 2004), particularly during periods of low discharge. With removal of Chiloquin Dam by USBR and Bureau of Indian Affairs during the summer of 2008, adult sucker migrations in the Sprague River will be unimpeded.

Known areas of concentrated Lost River sucker spawning in the Williamson and Sprague rivers include the lower Williamson River from RM 6 to the confluence of the Sprague River (RM 11), lower Sprague River below Chiloquin Dam, and in the Beatty Gap area of the upper Sprague River (RM 75) (Buettner and Scoppettone 1990; Tyler et al. 2007; Ellsworth et al. 2007). Other areas in the Sprague River watershed where Lost River sucker may spawn include the lower Sycan River and in the Sprague River near the Nine Mile area (Ellsworth et al. 2007).

Shortnose sucker from the UKL currently spawn in the lower Williamson and Sprague rivers (Tyler et al. 2007; Ellsworth et al. 2007). The few adult shortnose sucker captured at shoreline spawning areas in the UKL indicate that some shortnose sucker spawning is likely to still occur at these locations (Hayes et al. 2002; Barry et al. 2007a, 2007b). Although species identification is not clear, a small number of suckers presumed to be shortnose sucker may spawn in the Wood River (USBR 2001a). It is possible that sucker spawning may occur in other tributaries to the UKL; however, investigations have not located suckers in UKL tributaries other than the Williamson, Sprague, and Wood rivers.

Since the early 1980s, information on the relative abundance of adult sucker populations has been obtained from the number of captured suckers migrating up the Williamson River each spring (Service 2002e). The Williamson River spawning abundance index, based on actual and interpolated catch per unit effort data, shows a decline in abundance for both species during the three die-off years in the mid-1990s and a hiatus in recruitment of new individuals in 1998 and 1999 before the population began to increase in 2000 (Cunningham et al. 2002; Tyler et al. 2004). The increase in the spawning abundance index that began in 2000 could represent the recruitment of a single dominant year class over a period of two years or the recruitment of two distinct year classes. If a single year class recruited in over two years during 2000 and 2001, it would likely be the 1991 year class for Lost River sucker and the 1993 year class for shortnose sucker (Service 2002e).

Length frequency data indicated a size shift to smaller male Lost River sucker starting in 1992 and smaller female Lost River sucker in 1995 among Lost River sucker captured in the UKL tributaries (Janney and Shively 2007). The frequency of large male Lost River sucker began decreasing in 1994 for both tributary and shoreline spawning groups, with very few large male Lost River sucker present in survey efforts between 1996 and 1999 (Janney and Shively 2007). Large females began decreasing in numbers in 1995 and by 2000 they were rarely collected at shoreline areas and in the tributaries.

Length frequency data on shortnose sucker from monitoring efforts on the UKL tributaries indicates a shift to smaller male and female adults occurred in 1995 (Janney and Shively 2007). This shift to smaller individuals indicates a recruitment event of smaller individuals presumably from the 1991 year class. The shortnose sucker population in the UKL shows an increasing trend in length frequency beginning in 1996 with the possibility of some recruitment occurring in 1999 (Janney and Shively 2007). Larger and presumably older shortnose sucker began decreasing during the mid-1990s and by 2001 and 2002 there were few larger fish (Janney and Shively 2007).

Between 1995 and 2007, the U.S. Geological Survey (USGS) captured, tagged, and released 3,519 female and 5,680 male Lost River sucker at lakeshore spawning areas in the UKL to analyze survival rates (Janney et al. 2008). Of these, 2,489 females and 3,984 males were recaptured or remotely detected on at least one occasion. Survival estimates were calculated based on the Cormack-Jolly-Seber model (Janney et al. 2008). Mean annual survival probability for lakeshore spawning Lost River sucker from 1995 to 2006 was estimated to be 0.88. Based on this estimate, average life expectancy of Lost River sucker upon reaching maturity was approximately 8 years. Since Lost River sucker can live 50+ years and do not reach sexual maturity until they are 5 to 10 years of age, it would be expected for a viable population to have an annual survival rate of at least 90 percent.

From 1995 to 2005, USGS used trammel nets to monitor adult sucker migrations in the lower Williamson River to obtain annual population indices and to capture, mark, and release suckers (Janney et al. 2008). In 2000, USGS began systematic capture, mark, and release of suckers in the Sprague River fish ladder. A resistance board fish weir was installed in 2005 on the Williamson River (RM 6) to enhance capture-recapture efficiency (Janney et al. 2008). These capture-recapture data were included with data from other sampling efforts and used to estimate vital population parameters.

Between 2000 and 2007, 5,018 female and 1,965 male Lost River sucker were captured, tagged, and released in the Sprague River to analyze survival rates (Janney et al. 2008). Of the tagged suckers, USGS subsequently recaptured or remotely detected 1,247 females and 708 males on at least one occasion. Comparison of survival estimates between lake shoreline and river spawning subpopulations suggest that survival of the Sprague River spawning segment was substantially lower than the lakeshore segment in 2000, 2002, and 2004 (Janney et al. 2008).

Between 1995 and 2004, USGS captured, tagged, and released 8,156 female and 5,286 male shortnose sucker in the Sprague River (Janney et al. 2008). Of the tagged suckers, 3,781 of the females and 2,034 of the males were subsequently recaptured or remotely detected on at least one occasion. Based on the recapture data, the model averaged survival estimates varied considerably by year. Estimate of precision was relatively poor in several years due to sparse recapture data, but it improved substantially in later years as sampling effort and consistency increased and underwater passive integrated transponder (PIT) tag antennas were incorporated into the study design. Shortnose sucker survival was generally lower than Lost River sucker survival and was especially low in 1996, 1997, 2001, and 2004. Shortnose sucker mean annual survival probability over the study period was estimated at 0.76. Based on this estimate, average life expectancy of shortnose sucker upon reaching maturity was only 3.6 years. Therefore, the combination of reduced and variable survival and low and intermittent recruitment could present negative consequences for the viability of shortnose sucker populations in the UKL. Since shortnose sucker can live over 30 years, and do not reach sexual maturity until 4 to 6 years of age, expected natural survival of adults ideally would be greater than 90 percent (0.9) and show little variation over time.

These recent studies of sucker population s corroborate the assessment in Scoppettone and Vinyard (1991) at the time of listing. Both Lost River sucker and shortnose sucker transformed from populations dominated by old fish with little size diversity and consistently poor recruitment in the late 1980s and early 1990s, to populations dominated by smaller recruitment-sized fish and very few remaining large individuals by the late 1990s (Janney and Shively 2007; Janney et al. 2008). This marked shift in size structure to smaller individuals suggests that substantial recruitment in the sucker spawning populations occurred sometime during the mid-1990s. A combination of mortality concurrent with this influx of smaller individuals during the mid-1990s likely explains the rapid decline in relative frequency of large and presumably old individuals. Because large female suckers are disproportionately more fecund than young recruitment-sized females (Perkins et al. 2000), the absence of large females in spawning populations could substantially reduce reproductive output of spawning populations (NRC 2004). In recent years, populations of both species exhibited a slowly increasing trend in size (i.e., 0.4- to 0.6-inch increase in median fork length per year) and have exhibited little size diversity (Janney and Shively 2007; Janney et al. 2008). This homogenous size structure suggests populations are comprised mostly of similarly aged individuals with little evidence of recent substantial recruitment.

A small group of Lost River sucker appears to reside in the Sprague River near Beatty. A few adult Lost River sucker were first encountered during the summer of 2001 during fish survey work in the Sprague River (Service 2008). In 2007, the Service located small groups of adult Lost River sucker above the confluence of the Sycan River and below Beatty Gap and near the town of Sprague River (Service 2008). Although there was a substantial fish survey effort conducted on the Sprague River in 2007 by Oregon State University and the Service, no adult shortnose sucker were collected. The additional subpopulation of Lost River sucker in the Sprague River may help provide species resiliency, genetic diversity, and improve its ability to adapt to changing environmental conditions.

Clear Lake Reservoir Populations

Both Lost River sucker and shortnose sucker reside in Clear Lake Reservoir. Monitoring of fish populations has occurred sporadically over the last 35 years. Data collected by Andreasen (1975) and Koch et al. (1973) suggested these sucker populations were in decline; however, more recent and intensive monitoring from 1989 through 2000 indicated that populations of Lost River sucker and shortnose sucker were abundant and had diverse age structures (Buettner and Scoppettone 1991; USBR 1994; Scoppettone et al. 1995; Service 2002e). Intensive adult population monitoring resumed from 2004 through 2007. Data from 2004 to 2006 indicate that Lost River sucker and shortnose sucker were relatively abundant in Clear Lake, although there was a lower frequency of larger individuals present compared to data from the 1990s (Leeseberg et al. 2007; Barry et al. 2007c). Such a change in length frequency suggests relatively good recruitment but low adult survivorship (Service 2002e).

In 2006, USGS installed a PIT tag detection station in lower Willow Creek, the primary spawning tributary to Clear Lake. Surprisingly, 46 percent of the suckers tagged in the fall of 2005 were detected upstream at lake levels of 4,527 to 4,529 feet and relatively high flows (Barry et al. 2007c). It is likely that the percentage of suckers in the spawning migration was actually higher because high flows caused the width of Willow Creek to surpass that of the antenna array, creating gaps in coverage that migrating suckers could pass through. In 2007, with similar late winter and spring water levels and low spring flows, only 13 percent of suckers tagged in Clear Lake in 2005 to 2006 migrated upstream (Service 2008), suggesting that spawning run size is positively correlated with stream flow. This relationship has also been demonstrated in the Sprague and Williamson rivers (Barry et al. 2007c).

Gerber Reservoir Populations

In Gerber Reservoir, monitoring has documented a substantial shortnose sucker population (or shortnose sucker hybridized with Klamath largescale suckers [*Catostomus snyderi*]), exhibiting multiple size classes and presumably multiple age classes. Data from 2004 to 2006 indicate a lower frequency of larger adults compared to those from 2000 (Piaskowski and Buettner 2003; Leeseberg et al. 2007; Barry et al. 2007c). Such a change in length frequency suggests relatively good recruitment but low adult survivorship (Service 2002e). Lost River sucker have not been reported in Gerber Reservoir (Piaskowski and Buettner 2003; USBR 2001a, 2002; Leeseberg et al. 2007; Barry et al. 2007c). Sucker spawning at Gerber Reservoir occurs primarily in Barnes Valley and Ben Hall creeks (BLM 2000; Piaskowski and Buettner 2003; Service 2002e).

In 2006, USGS installed PIT tag detection stations on lower Ben Hall and Barnes Valley creeks. Of the 2,300 suckers tagged in the fall of 2005, 75 percent were detected at the remote station on Ben Hall or Barnes Valley creeks during spring 2006, a high flow year. While the population of shortnose sucker in Gerber Reservoir appears to have more frequent recruitment than some other populations, the problems of restricted distribution and lack of genetic connectivity with other populations still exist (Service 2002e). A high degree of hybridization between shortnose sucker and Klamath Lake sucker is thought to occur in Gerber Reservoir (Markle et al. 2005). However, until the status of these fish has been resolved, the Service considers the Gerber sucker population to be shortnose sucker.

Lost River Populations

Historically, large runs of Lost River sucker and shortnose sucker from Tule Lake migrated up the Lost River to spawn near Olene and at Big Springs near Bonanza (Howe 1969; Service 2002e). However, there may have been river resident populations similar to those in the Sprague River (Service 2008) and Clear Lake tributaries (Buettner and Scoppettone 1991). As a result of the development of the Klamath Project and other actions to develop water resources, several diversion dams were constructed creating lacustrine habitat in the Lost River more suitable to these fish (USBR 2000a).

Shortnose sucker have been reported throughout the Lost River in past investigations (Koch and Contreras 1973; USBR 2001a; Shively et al. 2000b). Although monitoring has not been conducted for several years, it is presumed that the Lost River currently supports a small population of shortnose sucker and very few Lost River sucker (Service 2002e). The majority of both adults and juveniles are caught above Harpold Dam and to a lesser extent from Wilson Reservoir (Shively et al. 2000b; USBR 2001a). Based on length frequency distributions, it appears that several year classes were represented within the Lost River during the last fish surveys in 1999 and 2000 (Shively et al. 2000b).

Sucker spawning habitat in the Lost River is very limited. Sucker spawning has been documented below Anderson-Rose Dam (USBR 2001a; Hodge 2007, 2008), in Big Springs near Bonanza (USBR 2001a), and at the terminal end of the West Canal as it spills into the Lost River (USBR 2001a). Suspected areas that have suitable spawning habitat (i.e., riffle areas with rocky substrate) include the spillway area below Malone Dam, immediately upstream of Keller Bridge, immediately below Big Springs in the Lost River, immediately below Harpold Dam, and adjacent to Station 48. Sucker spawning has been documented in lower Miller Creek, a tributary to Lost River (USBR 2001a) and is suspected in Buck and Rocky Canyon creeks (Shively et al. 2000b). Sucker spawning was observed in a riffle area above Malone Reservoir in May 2005 (Sutton and Morris 2005).

The Lost River is currently a highly modified water conveyance system used primarily to distribute water stored for irrigation purposes and receive agricultural drainage and surface runoff. The Lost River probably never supported large populations of suckers. However, it was important spawning habitat for Lost River sucker and shortnose sucker migrating upstream from Tule Lake. There are several diversion dams on the Lost River that block or restrict upstream passage including Clear Lake, Malone, Harpold, Lost River Ranch, Wilson, and Anderson-Rose dams. A fish ladder was installed on Big Springs Dam in 2007 (Service 2008). There are dozens of unscreened diversions along the Lost River (USBR 2001b).

Tule Lake Populations

Historically, sucker spawning migrations from Tule Lake into the Lost River were substantial (Service 2002e). The Modoc Indians and Euro-American settlers captured suckers during these migrations for consumption, livestock food, oil, and other uses (Coots 1965; Howe 1969; Andreasen 1975).

At present, populations of Lost River sucker and shortnose sucker in Tule Lake are a remnant of the historical levels. Sampling at Tule Lake in 1973 and 1990 captured no suckers (Koch and Contreras 1973; Buettner and Scoppettone 1991). However, in 1991, individuals of both species were observed spawning below Anderson-Rose Dam, and sampling at Tule Lake in the early 1990s captured and recaptured several adults of each species suggesting a small population of both species was present (Scoppettone et al. 1995; Service 2002e). While accurate estimates of the population size are not possible from the low number of recaptured individuals, available information suggests that sucker population sizes for both species were limited to a few hundred individuals of each species in the early 1990s (Scoppettone et al. 1995). Recent fisheries monitoring in Tule Lake in 2006 and 2007 by the Service suggests that adult Lost River sucker and shortnose sucker populations may be slightly higher than earlier estimates (about 1,000 individuals of each species) (Hodge 2007, 2008).

Sampling in the 1990s and between 2006 and 2007 observed suckers of both species spawning in the Lost River below Anderson-Rose Dam (Hodge 2007, 2008). However, documentation of successful spawning was infrequent and during years when larvae were observed they were generally present in small numbers. It is also possible that larvae observed in the lower Lost River may be vagrants from the UKL because most of the water in the river during the late spring originates from the UKL and is diverted into the Lost River Diversion Channel and then into the Lost River at Station 48. In 2007, an intensive trap-netting effort was made in Tule Lake sumps to assess the presence and relative abundance of juvenile and sub-adult suckers. With over 1,000 hours of effort throughout both Sumps 1A and 1B, only two juvenile suckers were captured suggesting little recent recruitment had occurred and that Tule Lake is primarily a refuge population for adult Lost River sucker and shortnose sucker and unlikely supports self-sustaining sucker populations (Hodge 2008).

Tule Lake is a fraction of its historic size and is primarily managed as a water conveyance reservoir for the Klamath Project and wetland habitat for Tule Lake National Wildlife Refuge. It is very shallow and is highly modified. The lower Lost River below Anderson-Rose Dam is channelized and flows are highly regulated. There are no fish passage facilities at the dam and there are a number of unscreened diversions around Tule Lake sumps (USBR 2001a). Degraded water quality conditions, particularly high pH and low dissolved oxygen (DO), occur during the summer as a result of nutrient loading and associated growth and decay of filamentous green algae and rooted aquatic plants (Buettner 2000; Hicks 2001; Beckstrand et al. 2001; USBR 2001a).

Keno Reservoir and Link River Populations

Keno Reservoir is a long, narrow, and relatively shallow body of water located between the Link River and Keno Dam and incorporates Lake Ewauna and the upper part of the Klamath River. Most of the water in the reservoir comes from the UKL but it also receives winter run-off from the Lost River Diversion Channel, drain water from the Klamath Straits Drain, and local run-off.

Keno Dam is operated by PacifiCorp and was first completed in 1931 and rebuilt in 1966 and allows regulation of water levels in the reservoir. Historically, there were two reefs that acted as sills regulating water levels in the upper Klamath River above Keno. One reef is located about 3 river miles below the Link River forming Lake Ewauna and a second about 15 miles farther downstream (Keno Reef). Keno Reef impounded water in Lower Klamath Lake and the Klamath River between the reef and Lake Ewauna (USBR 200oa).

Water levels in the reservoir are generally maintained at 4,085.4 feet from October 1 to May 15 and at 4,085.5 feet during the rest of the year to allow for efficient operation of irrigation facilities in the reach (FERC 2007). There are occasional short-term draw-downs prior to the irrigation season associated with irrigation maintenance.

Before construction of the Link River Dam, there were apparently large spawning runs of suckers migrating up the Link River in March of each year (Service 2002e). The origin of these runs is not recorded; presumably fish migrated out of Lower Klamath Lake or the Lake Ewauna/Keno reach, as lacustrine habitat was not available below Keno Reef prior to construction of J.C. Boyle Dam. Suckers apparently occupied the Link River even in summer, as evidenced by accounts of stranded suckers when flow to the Link River was cut off by southerly winds producing a seiche (oscillation of the water surface) in the UKL that lowered the level at the outlet to below the sill (Spindor 1996; Service 2002e).

All life stages of listed suckers have been found in Link River in recent years (PacifiCorp 2004; USBR 2000b; Piaskowski 2003). This habitat is primarily a migration corridor for large numbers of larval and juvenile suckers entrained or moving downstream from the UKL (Gutermuth et al. 2000b; Foster and Bennetts 2006; Tyler 2007). From 2002 to 2004, Reclamation conducted radio-telemetry studies of adult suckers from Keno Reservoir (Piaskowski 2003; Piaskowski et al. 2004; Korson et al. 2008). Many of these fish migrated up the Link River during April and May, perhaps attempting to reach tributaries of the UKL for spawning. In 2005, the new Link River fishway became operational. Since then, Reclamation biologists have documented seven PIT-tagged suckers using the fishway. Some of these fish passed through the fishway and into the UKL (Korson et al. 2008). In 2005, six radio-tagged Lost River sucker passed the ladder into the UKL. It is believed that suckers need to be at least 3 years of age so that they are large enough to ascend the cascade reaches in the Link River and use the fishway (Piaskowski 2003).

While low numbers of juvenile suckers occupy habitat throughout the Link River, the lower Link River is an important water quality refuge area for juvenile and adult suckers during periods of poor water quality in Keno Reservoir (Piaskowski et al. 2004). Although water quality in Link River is frequently poor during the summer, and is essentially the same as that in the UKL, it is usually better than Keno Reservoir (Piaskowski 2003; USBR unpublished data). From 2002 to 2004, radio-tagged adult suckers in Keno Reservoir moved into lower Link River during summer when the reservoir had low DO concentrations (Piaskowski 2003; Piaskowski and Simon 2005).

Fisheries surveys in Keno Reservoir have been conducted infrequently and generally have been short in duration (Hummel 1993; Piaskowski 2003; PacifiCorp 2004). The only intensive monitoring effort was conducted by Terwilliger et al. (2004) in 2002 and 2003. A detailed review of the fisheries monitoring information is presented in Service (2007a). Larvae and age-0 suckers were most abundant in the upper part of Keno Reservoir and decreased downstream. Juvenile and sub-adult and adult suckers were rare. It is likely that most of the suckers captured were fish entrained from the UKL according to entrainment studies at Eastside and Westside Diversion canals at Link River Dam in 1998 and 1999 (Gutermuth et al. 2000b) and below Link River Dam in 2005 and 2006 (Foster and Bennetts 2006; Tyler 2007).

During the spring of 2002, Reclamation captured 172 adult suckers in the upper end of Keno Reservoir. Additional suckers were sampled in this area from 2003 to 2006 to assess adult sucker spawning migrations and habitat use in Link River and Keno Reservoir. In 2005 and 2006, catch per unit effort for adult suckers in upper Keno Reservoir was much lower than in 2002 to 2004 (Service 2008). This may indicate that adult suckers that dispersed below Link River Dam were able to migrate back to the UKL through the new fishway at Link River Dam, but the actual reason for the lower trapping success is unknown.

The low numbers of adult suckers in Keno Reservoir appear to be related primarily to poor water quality in the summer (Piaskowski 2003). DO levels reach stressful and lethal levels for suckers during July and August (Piaskowski 2003; Deas and Vaughn 2006; USBR 2007). Fish die-offs including juvenile suckers are a regular occurrence in Keno Reservoir (Tinniswood 2006). Also, there is very little wetland habitat for sucker rearing due to past diking and draining of wetlands along the Klamath River above Keno Dam and water management operations resulting in stable water levels. Larval and juvenile suckers are also lost through entrainment at the Lost River Diversion Channel (Bennetts 2005; Foster and Bennetts 2006; USBR 2007) and presumably other irrigation diversions in Keno Reservoir. The major diversions include the Lost River Diversion Channel, North Canal, and Ady Canal. There are over 50 small irrigation diversions present in the Keno Reservoir (USBR 2001b). The ODFW has fish screens on their diversions at Miller Island Wildlife Area; another fish screen is located at Rocking AC Ranch (Service 2008).

Lower Klamath Lake and Sheepy Lake Populations

Lower Klamath Lake (LKL) was seasonally connected to the Klamath River before 1917 (Weddell 2000; USBR 2000a). The majority of the LKL wetlands were drained by 1924 with construction of a railway dike across the outlet of LKL in 1907 and closing of the diversion gates under the railroad in 1917 (Weddell 2000). LKL's connectivity to the rest of the Klamath Basin is currently limited to water delivered through Sheepy Ridge from Tule Lake and the Klamath Straits Drain and North and Ady canals.

There were approximately 85,000 acres of open water and wetland habitat in the LKL and Klamath River area between Keno Reef and Link River before anthropogenic changes began around 1900 (USBR 2000a). Large areas of emergent marsh along the shoreline likely provided habitat for larval and juvenile suckers (Service 2002e). Water levels in LKL probably fluctuated up to 3.0 feet per year but typically 1.0 to 1.5 feet before construction of Keno Dam (Weddell 2000; Service 2008). Water levels were generally highest during late winter and spring and gradually receded during the summer and fall. This type of hydrograph supported emergent wetland fringe along the shorelines of the Klamath River by dewatering shoreline areas during the late spring and early summer, resulting in good conditions for germination of emergent plant seeds.

Before 1924, suckers migrated up Sheepy Creek (a spring-fed tributary to Lower Klamath Lake) in sufficient numbers that they were harvested (Coots 1965). In 1960, small numbers of adult suckers were observed moving up Sheepy Creek in the springtime (Coots 1965). Since 1960, few surveys have been conducted in the LKL or its tributaries and no suckers were observed (Koch and Contreras 1973; Buettner and Scoppettone 1991; Service 2002e).

At present, there are no known populations of suckers in the LKL subbasin. The occasional sucker may disperse into LKL from Keno Reservoir through irrigation canals (Service 2002e). The LKL National Wildlife Refuge is currently a highly managed agriculture and refuge complex with an extensive network of canals, drains, agricultural fields, and refuge wetland units. There are few permanently flooded refuge units that might support suckers and they are generally very shallow (less than 3 feet deep). Water quality conditions are generally poor during the summer with warm temperatures and low DO (Buettner and Scoppettone 1991; Mayer 2000).

Klamath River Impoundments: J.C. Boyle, Copco, and Iron Gate Populations

Downstream of Keno Dam, the Klamath River consists of three primary reservoirs (J.C. Boyle, Copco No. 1, and Iron Gate) and three riverine reaches (FERC 2007). A more detailed description of the reservoirs and riverine reaches is presented in the biological opinion for the proposed relicensing of the Klamath Hydroelectric Project (Service 2007a). Four species of sucker are present in the Klamath River and its reservoirs: Lost River sucker, shortnose sucker, Klamath Lake sucker, and Klamath smallscale sucker (*Catostomus rimiculus).* The high gradient between reservoirs may exclude the two endangered sucker species except during migrations (Service 2002e, 2007a).

Although previous efforts have been made to survey suckers in the Klamath River reservoirs (Coots 1965; Beak Consultants 1987; Buettner and Scoppettone 1991; PacifiCorp 2004; and others cited in Buettner et al. 2006), the most intensive survey for suckers was performed in 1998 and 1999 (Desjardins and Markle 2000). Shortnose sucker is the only lake sucker that occurs commonly in the reservoirs below Keno Dam. Lost River sucker are rare in all three reservoirs (Buettner et al. 2006; Desjardins and Markle 2000). Although shortnose sucker adults are more abundant in Copco No.1 Reservoir, both Copco No.1 and Iron Gate reservoirs contain primarily larger individuals than J.C. Boyle Reservoir which contains a wide range of size classes including juveniles (Buettner et al. 2006). These fish are probably expatriated from the UKL (Desjardins and Markle 2000).

Unidentified sucker larvae have been caught in all three reservoirs, and shortnose sucker spawn in the Klamath River above Copco No.1 Reservoir; although, there is no evidence that shortnose sucker larvae and juveniles consistently survive in the reservoir (Beak Consultants 1987; Buettner and Scoppettone 1991; Desjardins and Markle 2000). Poor summertime water quality, lack of larval and juvenile rearing habitat, and large populations of non-native fish predators likely limit sucker populations in the Klamath River reservoirs (NRC 2004). The National Research Council (2004) concluded that sucker populations in Klamath River reservoirs below Keno Reservoir do not have a high priority for recovery because they are not part of the original habitat complex of the suckers and probably are inherently unsuitable for completion of life cycles of suckers. However, maintenance of adult suckers in these reservoirs could provide insurance against loss of other subpopulations as long as the reservoirs are present.

Population Summary

The UKL has the largest population of Lost River sucker in the Upper Klamath Basin. The Lost River sucker population there declined substantially in a series of die-offs in 1995 to 1997. Although at a much lower level, the existing population appears to be stable, and the portion of the population that spawns along the lakeshore increased in the late 1990s. The low amount of recruitment remains a substantial concern, as does the apparent moderate rate of adult survival. There is a substantial population in Clear Lake. However, the breeding population is now composed of smaller, younger fish than were present in the late 1990s.

A refuge population of about 1,000 adult Lost River sucker occurs in Tule Lake. A small number of expatriates from the UKL also occur in Keno Reservoir and J.C. Boyle Reservoir. Shortnose sucker populations in Gerber Reservoir and Clear Lake are relatively abundant and showing evidence of frequent recruitment. Sampling in recent years indicates a lower frequency of larger adults compared to the 1990s suggesting the addition of smaller individuals into the population but lower adult survivorship. In the UKL, the shortnose sucker population which had increased substantially in the early 1990s declined sharply between 1995 and 1997 as a result of die-offs. Since 1997 there has been no measurable recruitment, although in 2006 there was substantial production of age 0 shortnose sucker. It will take several years to determine if substantial recruitment from this year class occurs. Small self-sustaining populations occur in the Lost River. Small refuge populations of adult shortnose sucker occur in Tule Lake, Keno, J.C. Boyle, and Copco No.1 reservoirs.

Status and Distribution. Lost River sucker and shortnose sucker were listed as endangered on July 18, 1988. Much of the information presented here was developed as a result of a recent 5-year review of the listing status of the Lost River sucker and shortnose sucker (Service 2007b, 2007c). As a result of these reviews, the Service recommended downlisting the Lost River sucker to threatened and continued endangered status for the shortnose sucker. To date, no formal proposal for downlisting the Lost River sucker has been made.

Shortnose sucker and Lost River sucker were historically present in Lake Modoc, the Pleistocene lake that inundated all of the upper Klamath Basin from Wood River to Tule Lake that was below 4,240 feet (Dicken 1980). The lake outlet near Keno was at a higher elevation, thus blocking flow below 4,240 feet elevation. Lake Modoc had several interconnecting arms and was approximately 1,000 square miles in area and 75 miles in length. The lake began to dry at the end of the Pleistocene about 10,000 to 12,000 years ago. The UKL, Agency, Tule, Swan, and Lower Klamath lakes are the major remaining parts of Lake Modoc.

Historically, shortnose sucker and Lost River sucker were abundant and widespread in the UKL and its lower tributaries, probably including the Lost River system, Clear Lake, Tule Lake, and Lower Klamath Lake (Cope 1879; Gilbert 1898; Service 1993). The Klamath largescale sucker was also widespread in the Upper Klamath Basin, and probably occurred in the Lost River system as well (Andreasen 1975; Buettner and Scoppettone 1990). Lost River sucker historically occurred in the UKL and its tributaries, including the Williamson, Sprague, and Wood rivers; Crooked, Crystal, Sevenmile, and Odessa creeks, and Fourmile Creek and Slough (Stine 1982); and the Lost River system, including Tule Lake, Lower Klamath Lake, and Sheepy Lake (Andreasen 1975; Moyle 1976; Williams et al. 1985). The distribution of the shortnose sucker is not as well understood because of its similarity to the Klamath largescale sucker, especially juveniles. Shortnose sucker historically occurred in the UKL and its tributaries (Andreasen 1975; Miller and Smith 1981; Williams et al. 1985); although Moyle (1976) also includes Lake of the Woods and the Lost River system as part of the species' historic distribution (Sonnevil 1972; Buettner and Scoppettone 1991; Scoppettone and Vinyard 1991; Scoppettone and Buettner 1995; Perkins and Scoppettone 1996). Andreasen (1975) believed that the Lake of the Woods sucker was a distinct species, *Chasmistes stomias*, which became extinct in 1952 as a result of fish control operations.

The Lost River subbasin, about 2,000 square miles in size, contains major sucker populations in Clear Lake and Gerber reservoirs. Smaller numbers of suckers occur in the Lost River, Miller Creek, and Tule Lake sumps. Most of these are shortnose sucker; however, a significant population of Lost River sucker is present in Clear Lake.

Critical Habitat – Proposed. Critical habitat for the suckers was proposed in 1994, but has not been finalized (Service 1994). Refer to Appendix A for more information.

Threats. The factors affecting the species environment in the action area include degradation and loss of habitat as a result of Klamath Project facilities and operations; non-Project agricultural and livestock grazing activities; Klamath Hydroelectric Project facilities and operations; non-native fish interactions; and poor water quality (i.e., high pH, high ammonia, low DO) resulting from watershed alterations associated with agriculture, livestock grazing, and forest practices (Eilers et al. 2004; Bradbury et al. 2004; Service 2002e).

Aquatic habitats throughout the upper Klamath Basin are highly modified, but the Lost River has perhaps been the most severely affected. As mentioned above, the Lost River was once a major spawning site for suckers. Modoc and Klamath Indians gathered along the Lost River during the spring spawning runs to harvest suckers. Later it was the site for several canneries. However, today the Lost River supports few suckers, and furthermore, can perhaps be best characterized as an irrigation water conveyance, rather than a river. For nearly its entire 75-mile length, from Clear Lake Reservoir to Tule Lake Sump, the Lost River is highly modified to meet agricultural demands. Flows are completely regulated, it has been channelized in one 6-mile reach, its riparian habitats and adjacent wetlands are highly modified, and it receives significant discharges from agricultural drains and sewage effluent. Likely the active floodplain is no longer functioning except in very high water conditions. This has likely affected wetlands and wet meadows and may have resulted in lowered water tables, increasing the need for irrigation.

Although the impacts to Lost River sucker and shortnose sucker from climate change are not known with certainty, predicted outcomes of climate change imply that negative impacts will occur through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events such as drought and fire. These impacts will likely increase the magnitude and severity of other existing threats to these species.

Survival and Recovery Needs. According to Service (1994), the survival of Lost River sucker and shortnose sucker relies upon the availability of habitat with good water quality, unrestricted flows, and little competition or predation. These species need habitat protected from the negative impacts of agricultural practices and grazing, and relatively free of non-native aquatic fish species. Recovery of these suckers will rely on an increase in spawning, larval and juvenile rearing habitat to enhance sucker survival and recruitment, increased access to high quality habitat, reduced entrainment into unscreened diversions, and protection from threats to water quality.

Modoc Sucker

Species Description. The Modoc sucker is a relatively small member of the sucker family (Catostomidae), generally maturing around 3 to 4 inches, and usually reaching only 7 inches in length but with a maximum size near 11 inches Standard Length (SL) (Boccone and Mills 1979; Martin 1972; Moyle and Marchiochi 1975; Rutter 1908). Its original description was based on three specimens collected from Rush Creek in 1898 (Rutter 1908). Non-breeding coloration is similar to Pit River Sacramento suckers of similar size: the back varies from greenish-brown through bluish to deep gray and olive; the sides are lighter with light yellowish coloring below; the caudal and paired fins are light yellow-orangish; and the belly is cream to white (Martin 1972). Breeding coloration in the Modoc sucker is particularly marked in males, which develop a generally reddish-orange body coloration, a strong reddish-orange lateral stripe and similar coloration on the central caudal fin rays and paired fins, as well as exhibiting extensive tuberculation on various parts of the body and fins (Boccone and Mills 1979; Martin 1972). Females occasionally exhibit a weak, dull lateral stripe and very reduced tuberculation on the fins (Boccone and Mills 1979; Martin 1972). Rutter differentiated the Modoc sucker from the sympatric Sacramento sucker by its smaller eye, small conical head, smaller scales, and a nearly closed frontoparietal fontanelle (Rutter 1908). Martin further characterized the morphometric and meristic characters based on eleven specimens and elucidated osteological differences in the jaw bones of the two species (Martin 1972).

Subsequent authors have differentiated the two species primarily by lateral line scale and dorsal fin ray counts, or by locality (Martin 1967, 1972; Moyle 1976; Ford 1977; Cooper et al.1978). Although some authors have used intermediate lateral line counts and dorsal ray numbers to characterize "hybrids" between the two species (Cooper et al.1978; Mills 1980; Cooper 1983), a recent meristic analysis of a more extensive data set with additional characters (Kettratad 2001), suggests that the presumed hybrid characteristics are within the natural range for the Modoc sucker. Nevertheless, the similarity in coloration and external morphology between Modoc and Sacramento suckers have made it difficult to field identify specimens visually without the excessive handling necessary for meristic counts.

Life History/Habitat. The known range of the Modoc sucker includes elevations of 4,260 to 5,040 feet. However, most known populations are constrained by the effective upstream limit of the permanent stream. In the upper reaches, gradient and shading increase, while temperature and available low-energy, sedimented habitats decrease. Trout dominate the upper reaches of the creek. The low-elevation ecological constraints on distribution are not fully understood.

Modoc suckers typically occupy low-energy pool habitat with abundant cover in the intermediate and upper reaches of small tributaries; they are generally absent from the cool, swift, high-gradient upper stream reaches occupied by trout (Martin 1967; Moyle and Marciochi 1975; Moyle 1976; Ford 1977; Moyle and Daniels 1982). The pool habitat occupied by Modoc suckers generally includes soft bottoms, substantial detritus, and abundant cover. Cover can be provided by overhanging banks, larger rocks, woody debris, aquatic rooted vegetation, or filamentous algae. Moyle and Daniels (1982) report that the streams inhabited by Modoc suckers (Turner and Rush creek drainages) were all 2nd to 4th degree streams with moderate gradients, low summer flows (0.9 to 4.4 cfs), and cool summer temperatures (59°F to 72°F).

Modoc suckers concentrate in areas containing large pools and avoid extensive riffles, especially channelized areas. They are most abundant in pools, especially those deeper than 1 foot, where they graze on algae and small benthic invertebrates (Reid 2007a). Modoc suckers often segregate themselves along the length of a stream by size with larger individuals being more common in lower reaches of streams. This may indicate a temperature-growth relationship or it may indicate that larger Modoc suckers move downstream into larger, deeper, warmer pool habitats as they outgrow the relatively limited habitat in upper stream reaches. Spawning often occurs in the lower end of the pools over gravel-dominated substrates containing gravels, sand, silt, and detritus. Intermittent tributaries are apparently also used for spawning, when these habitats are available. The limited number of observations and the diversity of the observation sites limit the extent to which specific spawning habitat requirements can be characterized, other than to reinforce the overall importance of gravel substrates and relatively low energy habitat. Because spawning and rearing habitats are relatively non-specific and common, suitable habitat is not considered limiting except during severe droughts. There are approximately 40 miles of suitable habitat within their range and most of that is occupied.

Modoc suckers appear to be opportunistic feeders, similar to other catostomids, feeding primarily on algae and detritus (Moyle 1976), as well as diatoms, chironomid larvae, crustaceans (mostly amphipods and chydorid cladocerans), and aquatic insect larvae (Moyle and Marciochi 1975; Li and Moyle 1976).

Population Dynamics. Modoc suckers apparently mature in their second year and as small as 2.8 and 3.3 inches SL for males and females, respectively, and spawn in the spring from early April through early June, with localized spawning activity restricted to 3 to 4 weeks (Martin 1967; Moyle and Marciochi 1975; Boccone and Mills 1979). Spawning occurs in the lower end of pools or other environments with gravel substrates and moderate flow, such as behind rocks in low gradient stream reaches (Boccone and Mills 1979). The only information available on fecundity in Modoc suckers is derived from two females (6.4 to 6.5 inches SL) collected by Moyle and Marciochi (1975) which contained 6,395 to 12,590 eggs. The authors considered this to be high, given the small size of the specimens.

Modoc sucker population estimates from the 1970s ranged from 2,600 to 5,000 total individuals, of which 100 to 200 fish were estimated to be reproductive adults (Moyle 1974; Ford 1977). These estimates were based on limited sampling and visual surveys, with general qualitative estimates of unsurveyed stream reaches or populations (Moyle 1974; Ford 1977; White 1989, Scoppetone et al. 1992). At the time of listing, the population estimate for Modoc suckers was thought to be somewhere under 5,000 individuals, of which only about 1,300 fish were thought to be "pure," with the remainder considered to be introgressed hybrids with Sacramento suckers (50 FR 24526). At this time, there is no substantial evidence supporting the hypothesis of introgressive hybridization, and all known Modoc sucker populations should be treated as pure.

Status and Distribution. The Modoc sucker was listed as endangered on June 11, 1985 (50 FR 24526; Service 1985b) and critical habitat was designated in 1985 for the Modoc sucker in Modoc County, California. No critical habitat is designated in Oregon. No recovery plan was produced at the time of listing as it was determined to be unnecessary given the existence of the "Action Plan for Recovery of the Modoc Sucker," signed in 1984 by California Department of Fish and Game, USFS, and the Service (Service 1984). The Service recently completed a 5-year status review for the Modoc sucker (Service 2009b).

The current known distribution of the Modoc sucker includes ten stream populations of Modoc suckers in three subdrainages. At the time of listing, the historic range of the Modoc sucker was thought to have been limited to Modoc and Lassen counties, California, in the Turner and Ash Creek subdrainages of the Pit River (i.e., Turner, Hulbert, and Washington creeks [all tributaries to Turner Creek], and Johnson Creek [a tributary of Rush Creek]). The original listing also recognized four additional creeks (Ash, Dutch Flat, Rush, and Willow creeks) as having been occupied historically. However, these populations were presumed lost due to hybridization with Sacramento suckers, although there was no genetic corroboration of hybridization available at that time (Ford 1977; Mills 1980; Service 1985b).

The Service is currently aware of three additional populations not considered in the original listing (i.e., Coffee Mill and Garden Gulch creeks in the Turner subdrainage and Thomas Creek in the Goose Lake subbasin). The Thomas Creek population is in the Goose Lake subbasin of

Oregon and is isolated from the other populations in the Pit River subbasin in California. The Thomas Creek population is not within designated critical habitat.

At the time of listing in 1985, it was thought there were less than 5,000 Modoc suckers, of which only an estimated 1,300 were considered genetically "pure," the remainder being treated as hybrids with Sacramento suckers (Service 1985b). These estimates were based on limited sampling and visual surveys along with qualitative estimates of unsurveyed stream reaches or populations (Moyle 1974; Ford 1977).

Recent survey efforts within the Pit River drainage of California (White 1989; Scoppettone et al. 1992; Reid 2008a) suggest that the populations have been relatively stable over the 35 years that the species has been monitored. Additionally, as discussed below, the species has occupied most of the available habitat. These data suggest that the populations are resilient to threats such as drought and exotic predators that affect survival and reproduction. No population size estimates are currently available from the Oregon portion of the range.

At the time of proposed listing in 1984, the Service, California Department of Fish and Game, and USFS had been developing an "Action Plan for the Recovery of the Modoc Sucker" through a number of drafts and years. The signed 1984 Action Plan was understood to preclude the need for a formal recovery plan at the time of listing (Service 1984, 1985b). The stated purpose of the 1984 Action Plan was to provide direction and assign responsibilities for the recovery of the Modoc sucker; it also provided action (recovery) tasks and reclassification (downlisting/delisting) criteria.

Recovery tasks identified in the 1984 recovery action plan can be divided into five categories: 1) improve and secure habitat; 2) reduce threats from hybridization and perform genetic studies to assess degree of introgression; 3) expand range; 4) monitor populations; and 5) perform recovery-related administrative tasks. All recovery tasks from the signed 1984 recovery action plan and subsequent draft action plans are generally completed, ongoing, or have been deemed inappropriate, based on current information or policy (Reid 2008b). Implementation of these recovery tasks has contributed significantly to the conservation and recovery of the Modoc sucker.

Habitat improvement projects completed in the 1980s and 1990s and USFS management policies continue to provide habitat benefits with upward trending conditions. Recent habitat improvement projects include: 1) fencing to exclude grazing from newly recognized occupied habitat in upper Turner Creek (USFS in progress); 2) channel improvements in lower Dutch Flat Creek (Pit Resource Conservation District); 3) extensive channel stabilization and pool development as part of the Thomas Creek Restoration Project (USFS 1986–2002); 4) exclusion of grazing from Garden Gulch (USFS 2004) and stabilization of stream channel on private lands with increased flow duration due to hayfield irrigation subflow (private landowner 2002); fencing to exclude cattle along privately owned reaches of designated Critical Habitat in California on Rush Creek (Service and private landowner 2002) and Johnson Creek below barrier (private landowner 2002); and 5) screening of reservoir outflows in the upper Washington creek (USFS completed 2006). Also, there is continued outreach and collaboration with landowners on Modoc Sucker streams and throughout the Pit River watershed (Clark 2004).

Threats. The 1985 listing rule identified threats to the Modoc sucker which include habitat modification, range reduction, presence of movement barriers, predation, and hybridization. Actions that might adversely modify critical habitat for the Modoc sucker were considered at the time of listing and remain valid today (50 FR 24526). They include the following activities: overgrazing by livestock in areas adjacent to streams, which causes compacting and denuding of soils, leading to erosion and stream incision (this is presently occurring and poses a serious threat); channelization, impoundment, and water diversion activities along streams which would reduce available habitat allowing Sacramento suckers access to headwater areas; introduction of additional exotic species which would compete with or prey on Modoc suckers; application of herbicides or insecticides toxic to Modoc suckers or their food sources along stream courses; pollution of streams by silt or other pollutants which would reduce the suitability of the stream environment for Modoc suckers; removal of trees or bushes along streams which would reduce cover and shade, thereby reducing the suitability of the stream environment for the species.

According to the 5-year status review (Service 2009b:26–27):

> Most threats to the Modoc sucker that were considered in the 1985 listing rule (e.g., habitat modification, range reduction, and hybridization) have undergone substantial improvements or been ameliorated by new information and improved technology such that they no longer threaten the continued existence of the species. Habitat conditions on both public and private lands have shown substantial improvement, with continuing upward trends and a reasonable expectation that similar land management practices will continue. The distribution of known populations has remained stable or expanded slightly over the last 20 years, through a number of regional droughts. In addition, the range of the Modoc sucker has been expanded with the discovery of additional populations and documentation of genetic integrity in populations originally considered lost through hybridization. A greater understanding of the genetic relationships and natural gene flow between the Modoc and Sacramento sucker has reduced concerns over hybridization between the two naturally sympatric species.
>
> The principal remaining threat to the Modoc sucker is predation by non-native fishes, in particular brown trout in the Ash Creek subdrainage and largemouth bass in the Turner subdrainage. While the Modoc sucker has survived for decades in the presence of non-native fish, if left unchecked introduced fish predators have the potential to threaten the Modoc sucker with the effects of non-native fish to the survivability of Modoc suckers and to develop a long-term management plan to address these effects.

Each of the threats identified in the 1985 listing rule are discussed in more detail below, as well as a discussion on climate change and drought.

Habitat Modification

The 1985 listing rule stated that land management activities had: 1) dramatically degraded Modoc sucker habitat, 2) removed natural passage barriers allowing hybridization with Sacramento suckers and providing exposure to predaceous fishes, and 3) decreased the distribution of the Modoc sucker to only four streams (Service 1985b). Since listing, the majority of Modoc sucker streams on public land have been fenced to exclude or actively manage cattle grazing (Reid 2008b). In 2001, California Department of Fish and Game, in cooperation with the Modoc National Forest and the Service, conducted extensive habitat surveys of all known occupied stream reaches on public land and all private lands in the Turner Creek drainage and lower Johnson Creek to determine Proper Functioning Condition. Proper Functioning Condition is a method of assessing the physical functioning of riparian and wetland areas. The team found that all stream reaches of designated Critical Habitat on public lands were in "proper functioning condition" (i.e., Turner, Coffee Mill, Hulbert, Washington, Johnson creeks) and that Dutch Flat and Garden Gulch, two occupied streams not originally listed as Critical Habitat, were "functional-at risk" with "upward trends," which is a positive condition just below proper functioning condition. On private lands surveyed in Critical Habitat, most habitat was assessed to be "functional-at risk;" however, all habitat also showed upward trends.

Extensive landowner outreach and improved land stewardship in Modoc and Lassen counties in California have also resulted in improved protection of riparian corridors on private lands. Cattle are currently excluded from all private land Critical Habitat on Rush Creek and Johnson Creek below Higgins Flat (Modoc National Forest), allowing continued upward trends in habitat condition (Reid 2008b).

Movement Barriers

The 1985 listing rule assumed that natural passage barriers in streams occupied by Modoc suckers had been eliminated by human activities, allowing hybridization between the Modoc and Sacramento suckers, as well as providing access to Modoc sucker streams by non-native predatory fishes. However, review of all streams where Modoc suckers occur indicates no evidence for historical natural barriers that would have physically separated the two species in the past, particularly during higher springtime flows when Sacramento suckers make their upstream spawning migrations (Reid 2008b). In addition, there is no evidence showing the historical range of the Modoc sucker, or its distribution within that range, has been substantially reduced in the recent past. To the contrary, continued field surveys have resulted in recent expansions of our understanding of the species' range and distribution. Furthermore, the distribution of Modoc suckers within the stream populations recognized in 1985 has either remained stable over the past 22 years, or slightly expanded, and the ten populations appear to occupy all available and suitable habitat.

Predation

The listing rule identifies the presence of introduced and highly piscivorous brown trout as an adverse element that reduced sucker numbers through predation (Service 1985b). Although non-native predatory fish are a problem in parts of the range in California (Reid 2008b), no non-native fishes have been found (Reid 2007a; Heck et al. 2008) in Thomas Creek in Oregon.

Predation on Modoc suckers by brown trout is of particular concern in the Ash Creek subdrainage and largemouth bass in the Turner Creek subdrainage. The Modoc sucker, which rarely exceeds 7 inches standard length in small streams, typically occupies habitat where the only native predatory fish is the native redband trout. Stream-resident redband trout, which are not substantially larger than the Modoc sucker, is a primarily insectivorous species that occasionally feeds on small fishes (Moyle 2002). Because stream-resident redband trout are small and primarily feed on insects, they do not pose a threat to the Modoc sucker.

Hybridization

The 1985 listing rule identified hybridization with the Sacramento sucker, also native to the Pit River drainage, as a principal threat to the Modoc sucker. Hybridization can be cause for concern in a species with restricted distribution, particularly when a closely related non-native species is introduced into its range, and can lead to loss of genetic integrity or even extinction (Rhymer and Simberloff 1996). In 1985, it was assumed that hybridization between Modoc and Sacramento suckers had been prevented in the past by natural physical barriers, which had been recently eliminated by human activities, allowing contact between the two species. Modoc sucker populations from streams in which both species were present were considered hybrid populations and were excluded when evaluating the Modoc sucker's distribution in 1985. The assumption that extensive hybridization was occurring was based solely on the opportunity presented by co-occurrence and the identification of a few specimens exhibiting what were thought to be intermediate morphological characters. At that time, genetic information to assess this assumption was not available.

Modoc and Sacramento suckers are naturally sympatric (occurring in the same streams) in the Pit drainage. There is no indication that Sacramento suckers are recent invaders to the Pit River or its tributaries. Both morphological and preliminary genetic data suggest that the upper Pit River population of Sacramento suckers is distinct from other Sacramento River drainage populations (Ward and Fritsche 1987; Dowling, unpub. data. 2005). There is also no available information suggesting Modoc and Sacramento suckers were geographically isolated from each other in the recent past by barriers within the Pit River drainage. Separation of the two species appears to be primarily ecological, with Modoc suckers occupying smaller, headwater streams typically associated with trout and speckled dace, and Sacramento suckers primarily occupying the larger, warmer downstream reaches of tributaries and main-stem rivers with continuous flow (Moyle and Marciochi 1975; Moyle and Daniels 1982). Further reproductive isolation is probably reinforced by different spawning times in the two species and their size differences at maturity (Reid 2008b).

The morphological evidence for hybridization in 1985 listing was based on a limited understanding of morphological variation in the Modoc and Sacramento suckers, derived from the small number of specimens available at that time. Subsequent evaluation of variability in the two species, based on a larger number of specimens, shows that the overlapping character states (primarily lateral line and dorsal ray counts), interpreted by earlier authors as evidence of hybridization, are actually part of the natural meristic (involving counts of body parts such as fins and scales) range for the two species and are not associated with genetic evidence of introgression (Kettratad 2001; Reid 2008b). Furthermore, the actual number of specimens identified as apparent hybrids by earlier authors was very small and in great part came from streams without established Modoc sucker populations.

In 1999, the Service initiated a program to examine the genetics of suckers in the Pit River drainage and determine the extent and role of hybridization between the Modoc and Sacramento suckers using both nuclear and mitochondrial genes (Palmerston et al. 2001; Wagman and

Markle 2000; Dowling 2005a; Topinka 2006). The two species are genetically similar, suggesting that they are relatively recently differentiated and/or have a history of introgression throughout their range that has obscured their differences (Wagman and Markle 2000; Dowling 2005; Topinka 2006). Although the available evidence cannot differentiate between the two hypotheses, the genetic similarity in all three subdrainages, including those populations shown to be free of introgression based on species-specific genetic markers (Topinka 2006), suggests that introgression has occurred on a broad temporal and geographic scale and is not a localized or recent phenomenon. Consequently the evidence indicates that introgression is natural and is not caused or measurably affected by human activities.

There is no evidence that the observed hybridization has been affected by human modification of habitat, and genetic exchange between the two species under such conditions may be a natural phenomenon and a part of their evolutionary legacy. Despite any hybridization that has occurred in the past, the Modoc sucker maintains its morphological and ecological distinctiveness, even in populations showing low levels of introgression, and is clearly distinguishable from the Sacramento sucker using morphological characteristics (Kettratad 2001). Therefore, given the observed low-levels of observed introgression in nine known streams dominated by Modoc suckers, the absence of evidence for extensive ongoing hybridization in the form of first generation hybrids, the fact that Modoc and Sacramento suckers are naturally sympatric, and the continued ecological and morphological integrity of Modoc sucker populations, hybridization is not considered a threat to Modoc sucker populations.

Drought and Climate Change. The listing rule did not identify drought or climate change as threats to the continued existence of the Modoc sucker (Service 1985b). However, the northwestern corner of the Great Basin is naturally subject to extended droughts, during which even the larger water bodies such as Goose Lake have dried up (Laird 1971). Regional droughts have occurred every 10 to 20 years in the last century (Reid 2008b). There is no record of how frequently Modoc sucker streams went dry except for occasional pools. However, reaches of these streams likely did stop flowing in the past because some reaches dry up (or flow goes through the gravel instead of over the surface) nearly every summer under current climatic conditions (Reid 2008b). Collections of Modoc sucker from Rush Creek and Thomas Creek near the end of that drought (Hubbs and Miller 1934; Merriman and Soutter 1933), and the continued persistence of Modoc sucker throughout its known range through substantial local drought years since 1985 without active management, demonstrate the resiliency of the population given availability of suitable refuge habitat. Based on this, drought does not pose a substantial threat to the species.

Human-induced climate change could exacerbate low-flow conditions in Modoc sucker habitat during future droughts. A warming trend in the mountains of western North America is expected to decrease snowpack, hasten spring runoff, reduce summer stream flows, and increase summer temperatures (IPCC 2007; PPIC 2008). Lower flows as a result of less snowpack could reduce sucker habitat, which might adversely affect Modoc sucker reproduction and survival. Warmer water temperatures could lead to physiological stress and could also benefit non-native fishes that prey on or compete with Modoc suckers. Increases in the numbers and size of forest fires could also result from climate change (Westerling et al. 2006) and could adversely affect watershed function resulting in faster runoff, lower base flows during the summer and fall, and increased sedimentation rates. While it appears reasonable to assume that the Modoc sucker will be adversely affected by climate change, there is a lack of sufficient information to accurately determine to what degree of threat climate change poses and when the changes will occur.

Survival and Recovery Needs. According to Service (1984), the principal remaining threat to the Modoc sucker is predation by non-native fishes, as most threats to the Modoc sucker that were considered in the 1985 listing rule have undergone substantial improvements or been ameliorated by new information and improved technology. Therefore the survival of the species relies upon the availability of habitat either free of non-native predators or where these predators are controlled and their effects are managed. Recovery needs include the establishment and protection of populations (for 3 to 5 years) throughout Rush and Turner Creeks watersheds, and in two additional streams within historic range.

Colorado River Fishes

Four federally endangered fish species occur within the upper Colorado River system: the Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub. All four species have been negatively impacted by dam construction, water withdrawal, and introduction of non-native fish into the Colorado River system.

Colorado Pikeminnow

Species Description. The Colorado pikeminnow is the largest cyprinid fish (minnow family) native to North America and evolved as the main predator in the Colorado River system. It is an elongated pike-like fish that during predevelopment times may have grown as large as 6 feet in length and weighed nearly 100 pounds (Behnke and Benson 1983). Today, Colorado pikeminnow rarely exceed 3 feet in length or weigh more than 18 pounds; fish of this size are estimated to be 45 to 55 years old (Osmundson et al. 1997). The mouth of this species is large and nearly horizontal with long slender pharyngeal teeth (located in the throat), adapted for grasping and holding prey. The diet of Colorado pikeminnow consists almost entirely of other fishes longer than 3 or 4 inches (Vanicek and Kramer 1969). Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 20 inches in length (Vanicek and Kramer 1969; Seethaler 1978; Hamman 1981). Adults are strongly countershaded with a dark olive back, and a white belly. Young are silvery and usually have a dark, wedge-shaped spot at the base of the caudal fin.

Life History/Habitat. The following excerpt from the Colorado pikeminnow Recovery Goals (Service 2002a) summarizes the life history of Colorado pikeminnow.

Adult Colorado pikeminnow move hundreds of miles to and from spawning areas. 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. Spawning occurs after spring runoff at water temperatures typically between 64 to 73 degrees Fahrenheit (°F). 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. Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by Colorado pikeminnow in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes.

Colorado pikeminnow live in warm-water reaches of the Colorado River mainstem and larger tributaries, and require uninterrupted stream passage for spawning migrations and dispersal of young. The species is adapted to a hydrologic cycle characterized by large spring peaks of snow-melt runoff and low, relatively stable base flows. High spring flows create and maintain in-channel habitats, and reconnect floodplain and riverine habitats, a phenomenon described as the spring flood-pulse (Junk et al. 1989; Johnson et al. 1995). Throughout most of the year, juvenile, subadult, and adult Colorado pikeminnow use relatively deep, low-velocity eddies, pools, and runs that occur in near-shore areas of main river channels (Tyus and McAda 1984; Valdez and Masslich 1989; Tyus 1990, 1991; Osmundson et al. 1995). In spring, however, Colorado pikeminnow adults use floodplain habitats, flooded tributary mouths, flooded side canyons, and eddies that are available only during high flows (Tyus 1990, 1991; Osmundson et al. 1995). Such environments may be particularly beneficial for Colorado pikeminnow because other riverine fishes gather in floodplain habitats to exploit food and temperature resources, and may serve as prey. Such low-velocity environments also may serve as resting areas for Colorado pikeminnow. Colorado pikeminnow appear to prefer river reaches containing high habitat complexity.

Because of their mobility and environmental tolerances, adult Colorado pikeminnow are more widely distributed than other life stages. Distribution patterns of adults are stable during most of the year (Tyus 1990, 1991; Irving and Modde 2000), but distribution of adults changes in late spring and early summer, when most mature fish migrate to spawning areas (Tyus and McAda 1984; Tyus 1985, 1990, 1991; Irving and Modde 2000). High spring flows provide an important cue to prepare adults for migration and also ensure that conditions at spawning areas are suitable for reproduction once adults arrive. Specifically, bankfull or much larger floods mobilize coarse sediment to build or reshape cobble bars, and they create side channels that Colorado pikeminnow sometimes use for spawning (Harvey et al. 1993).

Colorado pikeminnow spawning sites in the Green River subbasin have been well documented. The two principal locations are in Yampa Canyon on the lower Yampa River and in Gray Canyon on the lower Green River (Tyus 1990, 1991). These reaches are 26 and 45 miles long, respectively, but most spawning is believed to occur at one or two short segments within each of the two reaches. Another spawning area may occur in Desolation Canyon on the lower Green River (Irving and Modde 2000), but the location and importance of this area has not been verified. Radio telemetry surveys indicate spawning occurs over cobble-bottomed riffles (Tyus 1990). High spring flows and subsequent post-peak summer flows are important for construction and maintenance of spawning substrates (Harvey et al. 1993). In contrast with the Green River subbasin, where known spawning sites are in canyon-bound reaches, currently suspected spawning sites in the upper Colorado River subbasin are at six locations in meandering, alluvial reaches (McAda 2000).

After hatching and emerging from the spawning substrate, Colorado pikeminnow larvae drift downstream to backwaters in sandy, alluvial regions, where they remain through most of their first year of life (Holden 1977; Tyus and Haines 1991; Muth and Snyder 1995). Backwaters and the physical factors that create them are vital to successful recruitment of early life stages of Colorado pikeminnow, and age-0 Colorado pikeminnow in backwaters have been the subject of extensive research (e.g., Tyus and Karp 1989; Haines and Tyus 1990; Tyus 1991; Tyus and Haines 1991; Bestgen et al. 1997). It is important to note that these backwaters are formed after cessation of spring runoff within the active channel and are not floodplain features. Colorado pikeminnow larvae occupy these in-channel backwaters soon after hatching. They tend to occur in backwaters that are large, warm, deep (averaging approximately 0.3 meter [m] in the Green River), and turbid (Tyus and Haines 1991). Research by Day et al. (1999a, 1999b) and Trammell and Chart (1999) has confirmed these preferences and suggested that a particular type of backwater is preferred by Colorado pikeminnow larvae and juveniles. Such backwaters are created when a secondary channel is cut off at the upper end, but remains connected to the river at the downstream end. These chute channels are deep and may persist even when discharge levels change dramatically. An optimal river-reach environment for growth and survival of early life stages of Colorado pikeminnow has warm, relatively stable backwaters; warm river channels; and abundant food (Muth et al. 2000).

Population Dynamics. Preliminary population estimates presented in the Recovery Goals (Service 2002a) for the three Colorado pikeminnow populations (Green River, Upper Colorado River, and San Juan River subbasins) ranged from 6,600 to 8,900 wild adults. These numbers provided a general indication of the total wild adult population size at the time the Recovery Goals were developed, however, it was also recognized that the accuracy of the estimates varies among populations. Monitoring of Colorado pikeminnow populations is ongoing, and sampling protocols and the reliability of the population estimates are being assessed by the Service and cooperating entities. A recent report on the status of Colorado pikeminnow in the Green River Basin (Bestgen et al. 2007) presented population estimates for adult (≥18 inches total length [TL]) Colorado pikeminnow. The report suggests that over the study period (2001 to 2003) there was a decline in abundance of Colorado pikeminnow in the Green River Basin. Reductions were most severe in the middle Green River (59 percent) and White River (63 percent), which are the two largest population segments. In 2001, the first year the entire subbasin was sampled, adult Colorado pikeminnow abundance was estimated at 3,304 fish (95 percent confidence interval, 2,900–3,707) but declined to 2,142 fish (1,686–2,598) by 2003, a 35 percent reduction. However, accounting for a reach not sampled in 2000 makes it likely that the reduction was 48 percent over the 2000–2003 period.

In the Yampa River, estimates of adult abundance declined from 322 fish in 2000 to 250 fish in 2003. Adult abundance estimates in the White River declined from 1,115 fish in 2000 to 465 fish in 2003 and recruit-sized estimates declined from 44 fish in 2000 to zero in 2003. In the middle Green River (Yampa River confluence to Desolation Canyon) abundance estimates for adults ranged from 1,629 fish in 2000 to 747 fish in 2003 and estimates of abundance of recruit-sized fish ranged from 103 fish in 2000 to 50 fish in 2003. Estimates for the Desolation-Gray Canyon reach of the Green River ranged from 681 adults in 2001 to 585 adults in 2003 and recruit-sized estimates ranged from 162 fish in 2001 to 64 fish in 2003. In the lower Green River (Green River, Utah to the confluence of the Colorado River) abundance estimates were 366 adults in 2001 and 273 adults in 2003 and recruit-sized estimates ranged from 70 fish in 2001 to 104 fish in 2003. Studies indicate that significant recruitment of Colorado pikeminnow may not occur every year, but occurs in episodic intervals of several years (Osmundson and Burnham 1998).

The demographic criteria for the Green River subbasin presented in the Recovery Goals for removing Colorado pikeminnow from the endangered species list is a self-sustaining, reproducing population of more than 2,600 adults. The estimated minimum viable population needed to ensure long-term genetic and demographic viability is 2,600 self-sustaining, reproducing adults (Service 2002a).

The estimate of adult Colorado pikeminnow associated with the spawning site in Yampa Canyon in the lower 20 miles of the Yampa River is approximately 1,400 fish. The estimate for the Three Fords spawning site in Gray Canyon in the lower Green River is approximately 1,000 adults (Crowl and Bouwes 1998). Because some Colorado pikeminnow from the Green River migrate into the Yampa River to spawn, the Colorado pikeminnow in the Yampa River are considered part of the Green River subbasin population.

All life stages of Colorado pikeminnow in the Green River demonstrate wide variations in abundance at seasonal, annual, or longer time scales, but reasons for shifts in abundance are poorly understood. Bestgen et al. (1998) captured drifting larvae produced from the two main spawning areas in the Green River system and found order-of-magnitude differences in abundance from year to year. They reported that low- or high-discharge years were often associated with poor reproduction but could not ascribe a specific cause-effect mechanism (Bestgen et al. 1998). In general, similar numbers of age-0 fish were found in autumn in the middle Green River, in spite of different-sized cohorts of larvae produced each summer in the Yampa River. Conversely, numbers of Colorado pikeminnow larvae produced in the lower Green River were similar among years but resulted in variable age-0 fish abundance in autumn.

Status and Distribution. Based on early fish collection records, archaeological finds, and other observations, the Colorado pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin down to the Gulf of California, and including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, and the Gila River system in Arizona (Seethaler 1978). Colorado pikeminnow apparently were never found in colder, headwater areas. The species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850s (Seethaler 1978). By the 1970s they were extirpated from the entire lower basin (downstream of Glen Canyon Dam) and portions of the upper basin as a result of major alterations to the riverine environment. Having lost some 75 to 80 percent of its former range due to habitat loss, the Colorado pikeminnow was federally listed as an endangered species in 1967 (Miller 1961; Moyle 1976; Tyus 1991; Osmundson and Burnham 1998); full protection under the ESA occurred on January 4, 1974.

Colorado pikeminnow critical habitat was designated on March 21, 1994 (59 FR 13374) including the Green and Colorado Rivers. The Green River critical habitat designation is in the Project's action area, and includes the Green River and its 100-year floodplain from the confluence with the Yampa River to the confluence with the Colorado River. The Colorado

River critical habitat designation also is in the Project's action area, and includes the Colorado River and its 100-year floodplain from the confluence with the Green River to Lake Powell.

The Service has identified water, physical habitat, and the biological environment as the PCEs of critical habitat (59 FR 13374). Water includes a quantity of water of sufficient quality delivered to a specific location in accordance with a hydrologic regime required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. Food supply, predation, and competition are important elements of the biological environment.

Colorado pikeminnow are presently restricted to the Upper Colorado River Basin and inhabit warm water reaches of the Colorado, Green, and San Juan rivers and associated tributaries. The Colorado pikeminnow Recovery Goals (Service 2002a) identify occupied habitat of wild Colorado pikeminnow as follows: the Green River from Lodore Canyon to the confluence of the Colorado River; the Yampa River downstream of Craig, Colorado; the Little Snake River from its confluence with the Yampa River upstream into Wyoming; the White River downstream of Taylor Draw Dam; the lower 89 miles of the Price River; the lower Duchesne River; the upper Colorado River from Palisade, Colorado, to Lake Powell; the lower 34 miles of the Gunnison River; the lower 1 mile of the Dolores River; and 150 miles of the San Juan River downstream from Shiprock, New Mexico, to Lake Powell.

Major declines in Colorado pikeminnow populations occurred during the dam-building era of the 1930s through the 1960s. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water use practices drastically modified the river's natural hydrology and channel characteristics throughout the Colorado River Basin. Dams on the mainstem broke the natural continuum of the river ecosystem into a series of disjunctive segments, blocking native fish migrations, reducing temperatures downstream of dams, creating lacustrine habitat, and providing conditions that allowed competitive and predatory nonnative fishes to thrive both within the impounded reservoirs and in the modified river segments that connect them. The highly modified flow regime in the lower basin coupled with the introduction of nonnative fishes decimated populations of native fish.

Major declines of native fishes first occurred in the lower basin where large dams were constructed from the 1930s through the 1960s. In the upper basin, the following major dams were not constructed until the 1960s: Glen Canyon Dam on the mainstem Colorado River, Flaming Gorge Dam on the Green River, Navajo Dam on the San Juan River, and the Aspinall Unit Dams on the Gunnison River. To date, some native fish populations in the upper basin have managed to persist, while others have become nearly extirpated. River segments where native fish have declined more slowly than in other areas are those where the hydrologic regime most closely resembles the natural condition, such as the Yampa River, where adequate habitat for important life phases still exists, and where migration corridors are unblocked and allow connectivity among life phases.

Threats. The primary threats to Colorado pikeminnow are stream flow regulation and habitat modification, competition with and predation by nonnative fishes, and pesticides and pollutants (Service 2002a). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. Stream flow regulation includes mainstem dams that cause adverse effects to Colorado pikeminnow and its habitat, including 1) blocking migration corridors; 2) changes in flow patterns, reduced peak flows, and increased base flows; 3) releasing cold water, making temperature regimes less than optimal; 4) changing river habitat into lake habitat; and 5) retaining sediment that is important for forming and maintaining backwater habitats.

In the upper basin, 435 miles of Colorado pikeminnow habitat has been lost by reservoir inundation from Flaming Forge Reservoir on the Green River, Lake Powell on the Colorado River, and Navajo Reservoir on the San Juan River. Cold water releases from these dams have eliminated suitable habitat for native fishes, including Colorado pikeminnow, from river reaches downstream for approximately 50 miles below Flaming Gorge Dam and Navajo Dam. In addition to mainstem dams, many dams and water diversion structures occur in and upstream from critical habitat that reduce flows and alter flow patterns, which adversely affect critical habitat. Diversion structures in critical habitat divert fish into canals and pipes where the fish are permanently lost to the river system. It is unknown how many endangered fish are lost in irrigation systems, but in some years, in some river reaches, the majority of the river flow is diverted into unscreened canals. High spring flows maintain habitat diversity, flush sediments from spawning habitat, increase invertebrate food production, form gravel and cobble deposits important for spawning, and maintain backwater nursery habitats (McAda 2000; Muth et al. 2000). Peak spring flows in the Green River at Jensen, Utah, have decreased 13 to 35 percent and base flows have increased 10 to 140 percent due to regulation by Flaming Gorge Dam (Muth et al. 2000).

Predation and competition from nonnative fishes have been clearly implicated in the population reductions or elimination of native fishes in the Colorado River Basin (Dill 1944; Osmundson and Kaeding 1989; Behnke 1980; Joseph et al. 1977; Lanigan and Berry 1979; Minckley and Deacon 1968; Meffe 1985; Propst and Bestgen 1991; Rinne 1991). Data collected by Osmundson and Kaeding (1991) indicated that during low-water years, nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers.

More than 50 nonnative fish species were intentionally introduced in the Colorado River Basin prior to 1980 for sport fishing, forage fish, biological control, and ornamental purposes (Minckley 1982; Tyus et al. 1982; Carlson and Muth 1989). Nonnative fishes compete with native fishes in several ways. The capacity of a particular area to support aquatic life is limited by physical habitat conditions. Increasing the number of species in an area usually results in a smaller population of most species. The size of each species' population is controlled by the ability of each life stage to compete for space and food resources and to avoid predation. Some life stages of nonnative fishes appear to have a greater ability to compete for space and food and to avoid predation in the existing altered habitat than do some life stages of native fishes.

Climate change could negatively impact Colorado pikeminnow through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events such as drought and fire. These impacts will likely increase the magnitude and severity of the other existing threats discussed above for Colorado pikeminnow.

Threats from pesticides and pollutants include accidental spills of petroleum products and hazardous materials, discharge of pollutants from uranium mill tailings, and high selenium concentration in the water and food chain (Service 2002a). Accidental spills of hazardous material into critical habitat can cause immediate mortality when lethal toxicity levels are exceeded. Pollutants from uranium mill tailings cause high levels of ammonia that exceed water quality standards. High selenium levels may adversely affect reproduction and recruitment (Hamilton and Wiedmeyer 1990; Stephens et al. 1992; Hamilton and Waddell 1994; Hamilton et al. 1996; Stephens and Waddell 1998; Osmundson et al. 2000).

Humpback Chub

Species Description. The humpback chub is a medium-sized freshwater fish (less than 20 inches in length) of the minnow family. The adults have a pronounced dorsal hump, a narrow flattened head, a fleshy snout with an inferior-subterminal mouth, and small eyes. The humpback chub has silvery sides with a brown or olive colored back.

Life History/Habitat. Humpback chubs in the Green River do not appear to make extensive migrations (Karp and Tyus 1990). Radio-telemetry and tagging studies on other humpback chub populations have revealed strong fidelity by adults for specific locations with little movement to areas outside of home canyon regions. Humpback chubs in Black Rocks (Valdez and Clemmer 1982), Westwater Canyon (Chart and Lentsch 1999a), and Desolation and Gray canyons (Chart and Lentsch 1999b) do not migrate to spawn.

In the Green River and upper Colorado River, humpback chubs spawned in spring and summer as flows declined shortly after the spring peak (Valdez and Clemmer 1982; Valdez et al. 1982a; Kaeding and Zimmerman 1983; Tyus and Karp 1989; Karp and Tyus 1990; Chart and Lentsch 1999a, 1999b). Similar spawning patterns were reported from Grand Canyon (Kaeding and Zimmerman 1983; Valdez and Ryel 1995, 1997). Little is known about spawning habitats and behavior of humpback chub. Although humpback chub are believed to broadcast eggs over midchannel cobble and gravel bars, spawning in the wild has not been observed for this species. Gorman and Stone (1999) reported that ripe male humpback chubs in the Little Colorado River aggregated in areas of complex habitat structure (i.e., matrix of large boulders and travertine masses combined with chutes, runs, and eddies, 1.6 to 6.6 feet deep) and were associated with deposits of clean gravel.

Chart and Lentsch (1999b) estimated hatching dates for young *Gila* collected from Desolation and Gray canyons between 1992 and 1995. They determined that hatching occurred on the descending limb of the hydrograph as early as 9 June 1992 at a flow of 4,909 cubic feet per second (cfs) and as late as 1 July 1995 at a flow of 25,815 cfs. Instantaneous daily river temperatures on hatching dates over all years ranged from 68 to 72°F.

Newly hatched larvae average 0.3 inch TL (Holden 1973; Suttkus and Clemmer 1977; Minckley 1973; Snyder 1981; Hamman 1982; Behnke and Benson 1983; Muth 1990), and 1-month-old fish are approximately 0.8 inch TL (Hamman 1982). No evidence exists of long-distance humpback chub larval drift (Miller and Hubert 1990; Robinson et al. 1998). Upon emergence from spawning gravels, humpback chub larvae remain in the vicinity of bottom surfaces (Marsh 1985) near spawning areas (Chart and Lentsch 1999a).

Backwaters, eddies, and runs have been reported as common capture locations for young-of-year humpback chub (Valdez and Clemmer 1982). These data indicate that in Black Rocks and Westwater Canyon, young utilize shallow areas. Habitat suitability index curves developed by Valdez et al. (1990) indicate young-of-year prefer average depths of 2.1 feet with a maximum of 5.1 feet. Average velocities were reported at 0.2 foot per second. Valdez et al. (1982a), Wick et al. (1979), and Wick et al. (1981) found adult humpback chub in Black Rocks and Westwater Canyon in water averaging 50 feet in depth with a maximum depth of 92 feet. In these localities, humpback chub were associated with large boulders and steep cliffs.

Population Dynamics. There are six populations of humpback chub in the Colorado River Basin: five in the upper basin and one in the lower basin. Population estimates for humpback chub using mark-recapture estimators began in 1998 with the Black Rocks and Westwater Canyon populations, and were conducted between 1998 and 2000 and 2003 and 2005. These estimates show the Black Rocks population between about 1,000 and 2,000 adults (age 4+) and the Westwater Canyon population between about 1,700 and 5,100 adults (McAda 2004, 2006, 2007; Hudson and Jackson 2003). Population estimates for Desolation/Gray Canyon in 2001 through 2003 show the population between about 1,000 and 2,600 adults (Jackson and Hudson 2005). The Cataract Canyon population was recently estimated at about 100 adults. In Yampa Canyon, too few adults were captured to estimate population size (Finney 2006; Badame 2008).

Mark-recapture methods have been used since the late 1980s to assess trend in adult abundance and recruitment of the Little Colorado River aggregation of humpback chub, the primary aggregation constituting the Grand Canyon population and the only humpback chub population in the lower Colorado River Basin. These estimates indicate that the adult population declined through the 1980s and early 1990s but has been increasing for the past decade (Coggins et al. 2006a; Coggins 2008a; Coggins and Walters 2009). Coggins (2008a) summarized information on abundance and analyzed monitoring data collected since the late 1980s and found that the adult population had declined from about 8,900 to 9,800 adults in 1989 to a low of about 4,500 to 5,700 adults in 2001.

Current methods for assessment of humpback chub abundance rely on the Age-Structured Mark-Recapture model (ASMR) (Coggins et al. 2006b; Coggins and Walters 2009). Although Coggins and Walters (2009) caution that the ASMR has limited capability to provide abundance estimates, and that the most important finding in their report is that the population trend in humpback chub is increasing, they conclude that "considering a range of assumed natural mortality-rates and magnitude of ageing error, it is unlikely that there are currently less than 6,000 adults or more than 10,000 adults" and estimate that the current adult (age 4 years or more) population is approximately 7,650 fish. This is an increase from the 2006 estimate of 5,300 to 6,700 fish (Coggins 2008a).

Status and Distribution. The humpback chub is endemic to the Colorado River Basin and is part of a native fish fauna traced to the Miocene epoch in fossil records (Miller 1946; Minckley et al. 1986). Humpback chub remains have been dated to about 4000 B.C. The fish was not described as a species until the 1940s (Miller 1946), presumably because of its restricted distribution in remote white water canyons (Service 1990). Because of this, its original distribution is not known. The humpback chub was listed as endangered on March 11, 1967.

Until the 1950s, the humpback chub was known only from Grand Canyon. During surveys in the 1950s and 1960s, humpback chub were found in the upper Green River including specimens from Echo Park, Island Park, and Swallow Canyon (Smith 1960; Vanicek et al. 1970). Individuals were also reported from the lower Yampa River (Holden and Stalnaker 1975b), the White River in Utah (Sigler and Miller 1963), Desolation Canyon of the Green River (Holden and Stalnaker 1970), and the Colorado River near Moab (Sigler and Miller 1963).

Humpback chub critical habitat was designated in 1994 within the humpback chub's historical range in the upper Colorado River (59 FR 13374). The PCEs are the same as those described for the Colorado pikeminnow, above. Seven reaches of the Colorado River system were designated for a total river length of 379 miles within the Yampa, Green, Colorado, and Little Colorado rivers in Arizona, Colorado, and Utah. Humpback chub critical habitat in the Project's action area occurs in the Green River from the confluence with the Yampa River downstream to the southern boundary of Dinosaur National Monument, and further downstream in Desolation and Gray canyons, as well as in the Colorado River from its confluence with the Green River downstream to Lake Powell.

Although historic data are limited, the apparent range-wide decline in humpback chubs is likely due to a combination of factors including alteration of river habitats by reservoir inundation, changes in stream discharge and temperature, competition with and predation by introduced fish species, and other factors such as changes in food resources resulting from stream alterations (Service 1990).

Failure to recognize humpback chub as a species until 1946 complicated interpretation of historic distribution of humpback chubs in the Green River (Douglas et al. 1989, 1998). Best available information suggests that before Flaming Gorge Dam, humpback chubs were distributed in canyon regions throughout much of the Green River, from the present site of Flaming Gorge Reservoir downstream through Desolation and Gray canyons (Vanicek 1967; Holden and Stalnaker 1975a; Holden 1991). In addition, the species occurred in the Yampa and White rivers. Pre-impoundment surveys of the Flaming Gorge Reservoir basin (Bosley 1960; Gaufin et al. 1960; McDonald and Dotson 1960; Smith 1960) reported both humpback chubs and bonytail chubs from the Green River near Hideout Canyon, now inundated by Flaming Gorge Reservoir.

Historic collection records of humpback chub exist from the Yampa and White rivers, both tributaries to the Green River. Tyus (1998) verified the presence of seven humpback chubs in collections of the University of Colorado Museum, collected from the Yampa River in Castle Park between 19 June and 11 July 1948. A single humpback chub was found in the White River near Bonanza, Utah, in June 1981 (Miller et al. 1982), and a possible bonytail-humpback chub intergrade was also captured in July 1978 (Lanigan and Berry 1981).

Present concentrations of humpback chub in the upper basin occur in canyon-bound river reaches ranging in length from 2 miles (Black Rocks) to 25 miles (Desolation and Gray canyons). Humpback chubs are distributed throughout most of Black Rocks and Westwater Canyon (8 miles), and in or near whitewater reaches of Cataract Canyon (13 miles), Desolation and Gray canyons (40.5 miles), and Yampa Canyon (27.5 miles), with populations in the separate canyon reaches ranging from 400 to 5,000 adults (see Population Dynamics, above). The Utah Division of Wildlife Resources has monitored the fish community in Desolation and Gray canyons since 1989 and has consistently reported captures of age-0, juvenile, and adult *Gila,* including humpback chub, indicating a reproducing population (Chart and Lentsch 1999b). Distribution of humpback chubs within Whirlpool and Split Mountain canyons is not presently known, but it is believed that numbers of humpback chub in these sections of the Green River are low.

The Yampa River is the only tributary to the Green River presently known to support a reproducing humpback chub population. Between 1986 and 1989, Karp and Tyus (1990) collected 130 humpback chubs from Yampa Canyon and indicated that a small but reproducing population was present. Continuing captures of juveniles and adults within Dinosaur National Monument indicate that a population persists in Yampa Canyon (Service 2005). Small numbers of humpback chub also have been reported in Cross Mountain Canyon on the Yampa River and in the Little Snake River about 6 miles upstream of its confluence with the Yampa River (Wick et al. 1981; Hawkins et al. 1996).

Threats. The primary threats to humpback chub are stream flow regulation and habitat modification; competition with and predation by nonnative fishes; parasitism; hybridization with other native *Gila* species; and pesticides and pollutants (Service 2002c). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to humpback chub in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow, above.

The humpback chub population in the Grand Canyon is threatened by predation from nonnative trout in the Colorado River below Glen Canyon Dam. This population is also threatened by the Asian tapeworm reported in humpback chub in the Little Colorado River (Service 2002c). No Asian tapeworms have been reported in the upper basin populations.

Hybridization with roundtail chub (*Gila robusta*) and bonytail chub, where they occur with humpback chub, is recognized as a threat to humpback chub. A larger proportion of roundtail chub has been found in Black Rocks and Westwater Canyon during low flow years (Kaeding et al. 1990; Chart and Lentsch 2000), which increases the chances for hybridization.

Additional impacts to humpback chub from climate change may occur through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events such as drought and fire. These impacts will likely increase the magnitude and severity of other existing threats to humpback chub.

Razorback Sucker

Species Description. Like all suckers (Family Catostomidae, meaning "down mouth"), the razorback sucker has a ventral mouth with thick lips covered with papillae and no scales on its head. In general, suckers are bottom browsers, sucking up or scraping off small invertebrates, algae, and organic matter with their fleshy, protrusible lips (Moyle 1976). The razorback sucker is the only sucker with an abrupt sharp-edged dorsal keel behind its head. The keel becomes more massive with age. The head and keel are dark, the back is olive-colored, the sides are brownish or reddish, and the abdomen is yellowish-white (Sublette et al. 1990). Adults often exceed 6 pounds in weight and 2 feet in length. Like pikeminnow, razorback suckers are long-lived, living 40^+ years.

Life History/Habitat. McAda and Wydoski (1980) and Tyus (1987) reported springtime aggregations of razorback suckers in off-channel habitats and tributaries; such aggregations are believed to be associated with reproductive activities. Tyus and Karp (1990) and Osmundson and Kaeding (1991) reported off-channel habitats to be much warmer than the mainstem river and that razorback suckers presumably moved to these areas for feeding, resting, sexual maturation, spawning, and other activities associated with their reproductive cycle. Prior to construction of large mainstem dams and the suppression of spring peak flows, low velocity, off-channel habitats (seasonally flooded bottomlands and shorelines) were commonly available throughout the upper basin (Tyus and Karp 1989; Osmundson and Kaeding 1991). Dams changed riverine ecosystems into lakes by impounding water, which eliminated these off-channel habitats in reservoirs. Reduction in spring peak flows eliminates or reduces the frequency of inundation of off-channel habitats.

The absence of these seasonally flooded riverine habitats is believed to be a limiting factor in the successful recruitment of razorback suckers in their native environment (Tyus and Karp 1989; Osmundson and Kaeding 1991). Wydoski and Wick (1998) identified starvation of larval razorback suckers due to low zooplankton densities in the main channel and loss of floodplain habitats which provide adequate zooplankton densities for larval food as two of the most important factors limiting recruitment.

While razorback suckers have never been directly observed spawning in turbid riverine environments within the upper basin, captures of ripe specimens (in spawning condition), both males and females, have been recorded (Valdez et al. 1982a; McAda and Wydoski 1980; Tyus 1987; Osmundson and Kaeding 1989; Tyus and Karp 1989; Tyus and Karp 1990; Osmundson and Kaeding 1991; Platania 1990) in the Yampa, Green, Colorado, and San Juan rivers. Sexually mature razorback suckers are generally collected on the ascending limb of the hydrograph from mid-April through June and are associated with coarse gravel substrates (depending on the specific location). Outside of the spawning season, adult razorback suckers occupy a variety of shoreline and main channel habitats including slow runs, shallow to deep pools, backwaters, eddies, and other relatively slow velocity areas associated with sand substrates (Tyus 1987; Tyus and Karp 1989; Osmundson and Kaeding 1989; Valdez and Masslich 1989; Osmundson and Kaeding 1991; Tyus and Karp 1990).

Habitat requirements of young and juvenile razorback suckers in the wild are not well known, particularly in native riverine environments. Prior to 1991, the last confirmed documentation of a razorback sucker juvenile in the Upper Basin was a capture in the Colorado River near Moab, Utah (Taba et al. 1965). In 1991, two early juvenile (1.4 and 1.6 inches TL) razorback suckers were collected in the lower Green River near Hell Roaring Canyon (Gutermuth et al. 1994). Juvenile razorback suckers have been collected in recent years from Old Charley Wash, a wetland adjacent to the Green River (Modde 1996). Between 1992 and 1995 larval razorback suckers were collected in the middle and lower Green River and within the Colorado River inflow to Lake Powell (Muth 1995). In 2002, eight larval razorback suckers were collected in the Gunnison River (Osmundson 2002). No young razorback suckers have been collected in recent times in the Colorado River.

Population Dynamics. The largest concentration of razorback suckers in the upper basin exists in low-gradient flatwater reaches of the middle Green River between and including the lower few miles of the Duchesne River and the Yampa River (Tyus 1987; Tyus and Karp 1990; Muth 1995; Modde and Wick 1997; Muth et al. 2000). This area includes the greatest expanse of floodplain habitat in the Upper Colorado River Basin, between Pariette Draw at river mile (RM) 238 and the Escalante Ranch at RM 310 (Irving and Burdick 1995).

Lanigan and Tyus (1989) used a demographically closed model with capture-recapture data collected from 1980 to 1988 and estimated that the middle Green River population consisted of about 1,000 adults (mean, 948; 95 percent confidence interval, 758–1,138). Based on a demographically open model and capture-recapture data collected from 1980 to 1992, Modde et al. (1996) estimated the number of adults in the middle Green River population at about 500 fish (mean, 524; 95 percent confidence interval, 351–696). That population had a relatively constant length frequency distribution among years (most frequent modes were in the 19.9 to 20.3-inches-TL interval) and an estimated annual survival rate of 71 percent. Bestgen et al. (2002) estimated the current population of wild razorback sucker in the middle Green River to be about 100 fish based on data collected in 1998 and 1999.

There are no current population estimates of razorback sucker in the Yampa River due to low numbers captured in recent years.

Status and Distribution. On March 14, 1989, the Service was petitioned to conduct a status review of the razorback sucker. Subsequently, the razorback sucker was designated as endangered under a final rule published on October 23, 1991 (56 FR 13374). The final rule stated that "little evidence of natural recruitment has been found in the past 30 years, and numbers of adult fish captured in the last 10 years demonstrate a downward trend relative to historic abundance. Significant changes have occurred in razorback sucker habitat through diversion and depletion of water, introduction of nonnative fishes, and construction and operation of dams." Recruitment of razorback suckers to the population continues to be a problem.

Critical habitat was designated in 1994 within the 100-year floodplain of the razorback sucker's historical range in the upper Colorado River (59 FR 13374). The PCEs are the same as critical habitat for Colorado pikeminnow described above. Razorback sucker critical habitat in the

Project's action area includes the Green River from its confluence with the Yampa River downstream to its confluence with the Colorado River, and in the Colorado River from its confluence with the Green River downstream to Lake Powell.

Historically, razorback suckers were found in the mainstem Colorado River and major tributaries in Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming, and in Mexico (Ellis 1914; Minckley 1983). Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and, further, that commercially marketable quantities were caught in Arizona as recently as 1949. In the upper basin, razorback suckers in the Green River were reported to be very abundant near Green River, Utah, in the late 1800s (Jordan 1891). An account in Osmundson and Kaeding (1989) reported that residents living along the Colorado River near Clifton, Colorado, observed several thousand razorback suckers during spring runoff in the 1930s and early 1940s. In the San Juan River drainage, Platania and Young (1989) relayed historical accounts of razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century.

A marked decline in populations of razorback suckers can be attributed to construction of dams and reservoirs, introduction of nonnative fishes, and removal of large quantities of water from the Colorado River system. Dams on the mainstem Colorado River and its major tributaries have segmented the river system, blocked migration routes, and changed river habitat into lake habitat. Dams also have drastically altered flows, temperatures, and channel geomorphology. These changes have modified habitats in many areas so that they are no longer suitable for breeding, feeding, or sheltering. Major changes in species composition have occurred due to the introduction of numerous nonnative fishes, many of which have thrived due to human-induced changes to the natural riverine system. These nonnative fishes prey upon and compete with razorback suckers.

Currently, the largest concentration of razorback sucker remaining in the Colorado River Basin is in Lake Mohave on the border of Arizona and California. Estimates of the wild stock in Lake Mohave have fallen precipitously in recent years from 60,000 fish as late as 1991, to 25,000 fish in 1993 (Marsh 1993; Holden 1994), to about 9,000 fish in 2000 (Service 2002b). Until recently, efforts to introduce young razorback sucker into Lake Mohave have failed because of predation by nonnative species (Minckley et al. 1991; Clarkson et al. 1993; Burke 1994). While limited numbers of razorback suckers persist in other locations in the Lower Colorado River, they are considered rare or incidental and may be continuing to decline.

In the Upper Colorado River Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic (lake-like) and riverine environments. The largest populations of razorback suckers in the upper basin are found in the upper Green and lower Yampa rivers (Tyus 1987). In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. Osmundson and Kaeding (1991) reported that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974. Between 1984 and 1990, intensive collecting effort captured only 12 individuals in the Grand Valley (Osmundson and Kaeding 1991). The wild population of razorback sucker is considered extirpated from the Gunnison River (Burdick and Bonar 1997).

Razorback suckers are in imminent danger of extirpation in the wild. The virtual absence of any recruitment suggests a combination of biological, physical, and/or chemical factors that may be affecting the survival and recruitment of early life stages of razorback suckers. Within the upper basin, recovery efforts endorsed by the Recovery Program include the capture and removal of razorback suckers from all known locations for genetic analyses and development of discrete brood stocks. These measures have been undertaken to develop refugia populations of the razorback sucker from the same genetic parentage as their wild counterparts such that, if these fish are genetically unique by subbasin or individual population, then separate stocks will be available for future augmentation. Such augmentation may be a necessary step to prevent the extinction of razorback suckers in the upper basin.

Threats. The primary threats to razorback sucker are stream flow regulation and habitat modification; competition with and predation by nonnative fishes; and pesticides and pollutants (Service 2002b). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to razorback sucker are essentially the same threats identified for Colorado pikeminnow, above.

Climate change could negatively impact razorback sucker through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events such as drought and fire. These impacts will likely increase the magnitude and severity of the other existing threats to razorback sucker.

Bonytail Chub

Species Description. Bonytail chub are medium-sized (less than 24 inches long) fish in the minnow family. Adult bonytail chub are gray or olive colored on the back with silvery sides and a white belly. The adult bonytail chub has an elongated body with a long, thin caudal peduncle. The head is small and compressed compared to the rest of the body. The mouth is slightly overhung by the snout and there is a smooth low hump behind the head that is not as pronounced as the hump on a humpback chub.

Life History/Habitat. The bonytail chub is considered a species that is adapted to mainstem rivers where it has been observed in pools and eddies (Vanicek 1967; Minckley 1973). Spawning of bonytail chub has never been observed in a river, but ripe fish were collected in Dinosaur National Monument during late June and early July suggesting that spawning occurred at water temperatures of about 64°F (Vanicek and Kramer 1969). Similar to other closely related *Gila* species, bonytail chub probably spawn in rivers in spring over rocky substrates; spawning has been observed in reservoirs over rocky shoals and shorelines.

Population Dynamics. Bonytail chub are so rare that currently it is not possible to conduct population estimates. A stocking program is being implemented to reestablish populations in the upper Colorado River Basin. The Recovery Goals (Service 2002d) call for reestablished populations in the Green River and upper Colorado River subbasins, each with >4,400 adults that are self-sustaining with recruitment.

Status and Distribution. The bonytail chub is the rarest native fish in the Colorado River. Little is known about its specific habitat requirements or cause of decline, because the bonytail chub was extirpated from most of its historic range prior to extensive fishery surveys. Bonytail chub was listed as endangered on April 23, 1980.

Critical habitat was designated in 1994 within the species' historical range in sections of the upper Colorado River (59 FR 13374). The PCEs are the same as those described for the Colorado pikeminnow, above. Bonytail chub critical habitat in the Project's action area includes the Green River from the confluence with the Yampa River to the boundary of Dinosaur National Monument, as well as in Desolation and Gray canyons, and in the Colorado River from below the confluence with the Green River to Lake Powell.

Currently, no documented self-sustaining populations of bonytail chub exist in the wild. Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), bonytail chub populations have been greatly reduced. Remnant populations presently occur in the wild in low numbers in Lake Mohave and several fish have been captured in Lake Powell and Lake Havasu (Service 2002d). The last known riverine area where bonytail were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens from 1962 to 1966. From 1977 to 1983, no bonytail chub were collected from the Colorado or Gunnison rivers in Colorado or Utah (Wick et al. 1979, 1981; Valdez et al. 1982b; Miller et al. 1984). However, in 1984, a single bonytail chub was collected from Black Rocks on the Colorado River (Kaeding et al. 1986). Several suspected bonytail chub were captured in Cataract Canyon between 1985 and 1987 (Valdez 1990). Current stocking plans for bonytail chub identify the middle Green and Yampa rivers in Dinosaur National Monument as the highest priority for stocking in Colorado and the plan calls for 2,665 fish to be stocked per year over six years (Nesler et al. 2003).

Threats. The primary threats to bonytail chub are stream flow regulation and habitat modification; competition with and predation by nonnative fishes; hybridization with other native *Gila* species; and pesticides and pollutants (Service 2002d). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to bonytail chub in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow, above. Threats to bonytail chub in relation to hybridization are essentially the same threats identified for humpback chub, above.

Climate change could negatively impact bonytail chub through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events such as drought and fire. These impacts will likely increase the magnitude and severity of the other existing threats to bonytail chub.

Environmental Baseline

The environmental baseline is the past and present effects of all federal, state, or private actions and other human activity in the action area (see Action Area description above), but does not include the effects of federal actions that have not yet undergone Section 7 consultation. Thus, the environmental baseline does not include the effects of the proposed action addressed by this BO.

Lahontan cutthroat trout

Status within the Action Area. The Project will be constructed within broad areas of the Northwest and Eastern GMU for Lahontan cutthroat trout, but only streams within the Eastern GMU will be impacted by waterbody crossing activities. No stream segments currently known to be occupied by Lahontan cutthroat trout would be crossed by the pipeline. However, the pipeline will impact habitat at multiple stream crossings that occur both downstream and upstream of known occupied habitat. These multiple stream crossings, impacted by the pipeline, contain habitat that provides connectivity between populations and may be seasonally occupied by Lahontan cutthroat trout. These specific areas are shown in Table 4. Tributaries to occupied streams or areas upstream or downstream of occupied streams may provide seasonal Lahontan cutthroat trout habitat, provide other supporting role towards habitat functionality that helps sustain Lahontan cutthroat trout in occupied habitat, or are connected via potential propagation of adverse geomorphic effects into occupied habitats. These waterbodies are located in the Marys River, the North Fork Humboldt River, the Maggie Creek, and Rock Creek subbasins in Nevada. Existing conditions in these subbasins are discussed below.

Much effort has been expended by land management agencies to improve riparian habitat through improved management of land use activities (*i.e.*, improved grazing management), most notably in the Marys River, Maggie Creek, and Rock Creek watersheds. In addition, recent fisheries management actions in the action area to reduce or eliminate nonnatives and to focus on large, connected habitat have been a positive step forward towards Lahontan cutthroat trout recovery.

The Lahontan cutthroat trout 5-year review recommends a revision of the 1995 Lahontan cutthroat trout Recovery Plan. A revised recovery plan should re-prioritize recovery actions and provide for reduction of nonnative (stocked) species conflicts, ensurance of recreational opportunities, protection of quality habitat, and identification of key habitat restoration opportunities. The creation of interagency recovery implementation teams in the major Lahontan Basins has allowed for the planning and implementation of watershed specific recovery efforts.

Factors affecting the species environment within the Action Area. The primary threats to Lahontan cutthroat trout include isolation of populations, loss and alteration of spawning habitat, competition with non-native fish, and hybridization with non-native trout species, as discussed in the Status of Species section. A database search and consultation with state resource agencies found that none of the Lahontan cutthroat trout waterbody crossings contain pathogens or non-native aquatic species (Elliot and Layton 2004).

Habitat condition on BLM-administered portions of streams in the Marys River Subbasin have primarily been rated fair to good, with an upward trend (Elliot and Layton 2004). The primary limiting factor in most of these streams is a lack of over-summer and over-winter habitat in the form of high-quality pools. Management activities aimed at formation of high-quality pools through beaver activity, changes in channel morphology, or from large woody debris can be a long-term undertaking. In 1998 and 2002, habitat surveys on potential Lahontan cutthroat trout recovery streams in the subbasin found that aquatic habitat conditions ranged from good to excellent, with the primary limiting factors being a poor pool:riffle ratio, and a lack of quality pools and desirable substrate.

Angling pressure in the Marys River Subbasin is generally low. The Marys River proper has reportedly had the highest angler use at an average of 148 angler days/year (Elliot and Layton 2004). Surveys have shown stable to declining Lahontan cutthroat trout populations in many of the tributaries to the Marys River. BLM and USFS assessments of riparian habitat in Marys River showed an upward trend and good to excellent conditions in relation to the Lahontan cutthroat trout management objectives.

In 1991, habitat conditions on the BLM-administered portions of the North Fork Humboldt River were found to be variable (Elliot and Layton 2004). Riparian conditions were rated as fair to good with an upward trend in exclosures and riparian pastures, but were found to be poor with a downward trend in unfenced areas. The riparian habitat of the USFS portion was found to be in good condition. Pie Creek had an overall upward habitat trend, but was variable due to grazing in the upper portion of the creek. Surveys in 1998-1999 found no Lahontan cutthroat trout in Pie Creek. Lahontan cutthroat trout were found in Gance Creek during 1997-2000 surveys. Gance Creek is the second heaviest fished stream in this subbasin (52 angler days/year) and has an abundant population of Lahontan cutthroat trout. Riparian conditions were considered fair during 1995 assessment of Gance Creek, but had an upward trend (in relation to Lahontan cutthroat trout management objectives) on USFS portions in 1997.

In Maggie Creek, cooperative efforts involving BLM, mining, and ranching interests have led to improved habitat (Elliot and Layton 2004). Projects to improve the connectivity of Maggie Creek with its tributaries, including modifying a diversion structure and removing road culverts, have been implemented in order to establish the Maggie Creek Subbasin as a functioning metapopulation. The potential for dewatering from mining activities also exists in the Maggie Creek Subbasin. Portions of Lahontan cutthroat trout streams within the Maggie Creek Subbasin may lose baseflows as a result of future mine-related dewatering activities. The potential exists for further isolation of tributary streams as a result of dewatering in Maggie Creek.

Maggie Creek has shown a Lahontan cutthroat trout population with decreasing range and numbers (Elliot and Layton 2004). A 1997 survey of Maggie Creek from the narrows to the headwaters failed to produce any Lahontan cutthroat trout within the survey stations, but three trout (presumably Lahontan cutthroat trout) were observed in very large pools outside of one survey station. In the spring of 2000, a new Lahontan cutthroat trout population was discovered in Lone Mountain Creek, a headwater tributary to Maggie Creek. This population occupies approximately 0.5 mile of habitat on private and BLM land. Maggie Creek proper sustains the highest fishing rate in the subbasin at 27 angler days/year. The 1998 assessment showed that riparian habitat along Maggie Creek had an upward trend (in relation to Lahontan cutthroat trout management objectives) due in part to the Maggie Creek Watershed Restoration Project, which included stream restoration, riparian enhancement, and livestock management.

The Rock Creek Subbasin has six Lahontan cutthroat trout populations occupying approximately 20.5 miles of habitat. This subbasin is unique in that it contains the only reservoir (Willow Creek Reservoir) identified as a potential Lahontan cutthroat trout recovery site in the Upper Humboldt Basin. During normal water years, some metapopulation potential exists in the upper Rock Creek area and the streams above Willow Creek Reservoir. Population surveys (2001-2002) found Toe Jam Creek and Frazier Creek to have the only stable/increasing Lahontan cutthroat trout populations in the subbasin (Elliot and Layton 2004). Upper Rock Creek, Lewis Creek, and Nelson Creek all exhibited decreasing populations and a slight decrease in occupied range. More recent Lahontan cutthroat trout population surveys in Lewis and Nelson Creeks document steadily increasing Lahontan cutthroat trout numbers as upper elevation habitat has been improving (Neville and DeGraff 2006). Notably, between 2005 and 2006, multiple age classes of Lahontan cutthroat trout were present, suggesting a natural reproducing population exists. Age class structure in Lewis and Nelson Creeks is slowly mirroring that in Frazer Creek, suggesting that habitat improvements are positively affecting recruitment (Neville and DeGraff 2006).

Habitat condition data collected in 2002 and 2003 in the Rock Creek Subbasin show all streams except Upper Willow Creek to be in fair to good condition with primarily a static-downward trend (Elliot and Layton 2004). Nelson and Frazier Creeks were found to be the only streams within the subbasin that were exhibiting an upward trend in habitat condition. A majority of the streams in the subbasin will be grazed under a riparian-friendly grazing system beginning in 2004 (Elliot and Layton 2004).

In the past, brook and rainbow trout were stocked in Willow Creek, Rock Creek, Nelson Creek, and Willow Creek Reservoir, but none have been found in recent surveys. A warmwater recreational fishery has been established at Willow Creek Reservoir through the stocking of white crappie (*Pomoxis annularis*), largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), and white catfish (*Ictalurus catus*) (Elliot and Layton 2004).

All recovery streams in the Rock Creek Subbasin, except upper and lower Willow Creek, had angling pressure reported over the 1989-1998 period. Again, pressure was very light with Nelson Creek (37 angler days/year), Rock Creek (18 angler days/year), and Toe Jam Creek (8 angler days/year) having the majority of angling pressure. The recreational warmwater fishery at Willow Creek Reservoir, a potential recovery water, sustained the heaviest pressure at 3,211 angler days/year (Elliot and Layton 2004).

Role of the Action Area in Lahontan Cutthroat Trout Survival and Recovery. The 75 waterbody crossings in ephemeral, intermittent, and perennial waters within the Eastern GMU are not known to be currently occupied by Lahontan cutthroat trout. However, the pipeline crossings will impact aquatic and riparian habitat at multiple stream crossings that occur both downstream and upstream of known Lahontan cutthroat trout occupied habitat. These occupied habitats outside of the action area are important for the survival and recovery of Lahontan cutthroat trout in the Eastern GMU as well as rangewide, and the 75 Project waterbodies may provide a supportive role towards well distributed and connected Lahontan cutthroat trout metapopulations in the Marys River, the North Fork Humboldt River, the Maggie Creek, and Rock Creek subbasins in Nevada.

Warner Sucker

Status within the Action Area. The action area crosses designated critical habitat for Warner sucker mapped within Twelvemile Creek and Twentymile Creek in the Warner Basin. A 50-foot riparian zone on each side of these creeks is also designated as critical habitat. The Service has determined that the maintenance of this riparian zone is essential to protect the integrity of the stream ecosystem and to the conservation of the Warner sucker. Surveys have documented Warner sucker in Twelvemile Creek in an area less than 1 mile upstream and downstream of the proposed pipeline crossing (Scheerer et al. 2008). ODFW sampling conducted in 1994 documented 18 adult Warner sucker and 158 juvenile Warner sucker were observed within 1 mile upstream of the proposed crossing and an additional 51 adults and 16 juvenile Warner sucker were documented downstream of the proposed crossing (Service 2009). The Twelvemile Creek waterbody crossing will occur on BLM-managed lands, while the Twentymile Creek waterbody crossing is privately owned. Stream structure at these two crossings consists of small riffles, and large pools influenced by large boulder substrate. Vegetation characteristics at the Twelvemile Creek waterbody crossing include an over story of several larger diameter (> 18 inches) ponderosa pine. Warner sucker has variable distribution and, under certain water conditions and seasons, individuals may exist farther downstream into historic "migratory" habitats in the action area. Similar to other fishes discussed in this BO, other tributaries to these streams or areas downstream of these occupied streams may provide seasonal fish habitat, provide other supporting role towards habitat functionality that helps sustain Warner sucker in occupied habitat and critical habitat, or are connected via potential propagation of adverse geomorphic effects into occupied habitats or critical habitat. The action area also crosses Deep Creek, which contains occupied Warner sucker habitat from Crump Lake up to a waterfall near Adel, Oregon. The Project's Deep Creek waterbody crossing is 12 miles upstream of the waterfall.

Factors affecting the species environment within the Action Area. Habitat conditions upstream from occupied habitat are generally in lower quality condition from past and on-going effects from roads associated with timber harvest and from grazing activities. Habitat fragmentation and degradation due to agricultural development, including the placement of irrigation structures in spawning streams, have negatively influenced the abundance and distribution of Warner suckers. Twelvemile Creek and Twentymile Creek are identified on the State of Oregon's Clean Water Act section 303(d) list of impaired waters and could have the potential to contain contaminated sediments (i.e., arsenic).

Role of the Action Area in Warner Sucker Survival and Recovery. The action area includes several streams occupied by Warner sucker or connected to Warner sucker habitat. The action area also includes designated critical habitat for Warner sucker within Twelvemile Creek and Twentymile Creek. The limited number of habitats impacted by Project waterbody crossings do provide some low energy pool habitat, cover, and food items for a limited number of Warner sucker, and support the maintenance of multiple age-classes of Warner sucker. However, the limited aquatic and riparian habitat in the action area used by Warner sucker or designated as

Warner sucker critical habitat have a minor role in the overall survival and recovery of Warner sucker.

Lost River Sucker and Shortnose Sucker

Status within the Action Area. Occupied Lost River sucker and shortnose sucker habitat would be directly crossed where the proposed Project crosses the South Arm of East Willow Creek (MP 642) and the North Fork Willow Creek (MP 645)The proposed Project also crosses occupied Lost River sucker and shortnose sucker habitat within the Lost River (MP667). This section of the Lost River is operated as a reservoir during irrigation periods, which increases the width of the river to 360 feet, but during the inwater timing period required for this waterbody crossing (October 15-January 31) the Lost River functions as a river and is only 15-20 ft wide. Additionally, similar to other fishes discussed in this BO, other tributaries to these occupied streams or areas downstream of or connected to these occupied streams may provide seasonal fish habitat, provide other supporting role towards habitat functionality that helps sustain Lost River sucker and shortnose sucker in occupied habitat and proposed critical habitat, or are connected via potential propagation of adverse geomorphic effects into occupied habitats or proposed critical habitat.

Factors affecting the species environment within the Action Area. The proposed Project crosses two tributaries of Willow Creek upstream of Clear Lake. Reduced water quality, primarily low dissolved oxygen, occurs when Clear Lake recedes to a small size with low lake levels. Under these stressful conditions, Lost River sucker and shortnose sucker are at greater risk of disease, parasitism, and fish die-offs. Competition and predation by non-native fish species, including Sacramento perch and brown bullhead, likely impact sucker populations particularly at low lake levels. A migration barrier at Clear Lake Dam isolates Lost River sucker and shortnose sucker populations and prevents genetic exchange with other populations in the Upper Klamath Basin.

The proposed Project also crosses the Lost River below Clear Lake Dam. The Lost River is a highly modified water conveyance system used primarily to distribute water stored for irrigation purposes and receive agricultural drainage and surface runoff. As previously discussed, there are several diversion dams on the Lost River that block or restrict upstream passage, and fish ladders have only been installed on a few of the dams. There are dozens of unscreened diversions along the Lost River.

Role of the Action Area in Lost River Sucker and Shortnose Sucker Survival and Recovery. The proposed Project will cross two streams and one river occupied by the Lost River sucker and the shortnose sucker, and two additional streams with connection to occupied habitat. These action area streams provide Lost River sucker and shortnose sucker with acceptable water quality conditions, unrestricted flows, and limited competition or predation from other fish species. Based on the small amount of occupied habitat that these four waterbodies represent to these two species, the action area provides only a minor, but supportive role towards the survival and recovery of Lost River sucker and shortnose sucker. However, the Lost River waterbody crossing location is highly modified, and provides relatively poor water quality conditions, restricted flows, and competition and predation from other fish species. Based on the small amount of occupied habitat that this waterbody represents to these two species, this portion of the action area provides a minor role towards the survival and recovery of Lost River sucker and shortnose sucker.

Modoc Sucker

Status within the Action Area. Modoc sucker are known to occur in Thomas Creek, which will be crossed by the proposed Project. In 2007, surveys confirmed that Modoc suckers were present throughout at least 14 miles of upper Thomas Creek (Reid 2007; Heck et al. 2008) located roughly 15 miles upstream of the action area. Surveys focused on all principal Oregon streams in the Goose Lake Basin within the known elevational range (4,900 to 5,700 feet) of the Modoc sucker population in Thomas Creek to determine the distribution of the Modoc and Sacramento suckers. Modoc sucker has variable distribution and, under certain water conditions and seasons, individuals may exist farther downstream in the action area. Similar to other fishes discussed in this BO, other tributaries to Thomas Creek or areas downstream of or connected to occupied stream habitat may provide seasonal fish habitat, provide other supporting role towards habitat functionality that helps sustain Modoc sucker, or are connected via potential propagation of adverse geomorphic effects into occupied habitats.

The results of these surveys indicate that Thomas Creek holds the only substantial population of Modoc suckers occupying higher elevation streams (>4,900 feet) outside the distribution of the Goose Lake sucker (*Catostomus occidentalis lacusanserinus*), a sub-species of the Sacramento sucker found in the Goose Lake drainage. Modoc suckers were found only in Thomas Creek, where they were continuously distributed and relatively common, from 4,900 feet (lower survey limit) up to 5,840 feet above Cox Flat, a distance of 14.2 miles. Modoc suckers may extend farther upstream at lower densities or during other seasons. Goose Lake suckers were found in the lower reaches of nine streams, with an elevational upper limit ranging from 4,880 to 5,265 feet. No Goose Lake suckers were collected from the surveyed reach of Thomas Creek above the waterfall, however, there is evidence that the distribution of Modoc suckers extends farther downstream onto the valley floor in Thomas Creek and its tributaries.

Factors affecting the species environment within the Action Area. Thomas Creek is identified on the Oregon 303(d) list of impaired waters and could have the potential to contain contaminated sediments (i.e., iron). Non-native predatory fish have not been found in Thomas Creek (Reid 2007a; Heck et al. 2008).

The majority of the upper Thomas Creek watershed and the stream reaches generally occupied by Modoc sucker are managed by Fremont-Winema National Forests. In 1986, prior to the recognition that there were Modoc suckers in the drainage, the USFS established the Thomas Creek Riparian Recovery Project with the objective to halt erosion, stabilize stream banks, and reduce water temperatures for the benefit of native fishes. As part of this project, there have been numerous riparian restoration and channel improvement projects to promote deeper pool development and water retention, as well as improved grazing management.

There are two privately owned meadow reaches of Thomas Creek above the lower USFS boundary that are characterized by low-gradient and large open pools. Both are managed for grazing by the USFS permittee. The lower parcel, which is unfenced and grazed with neighboring USFS allotments, contains substantial populations of Modoc sucker (Reid 2007). The upper parcel is fenced and has not been surveyed, although Modoc suckers are abundant in pools at its boundaries and therefore the suckers are likely to occur in the unsurveyed stream reach. Current land management practices on public and private lands on Thomas Creek are compatible with the conservation of the species and, at this time, the Service has no indication that these practices will not continue. Therefore, upward habitat trends are expected to continue.

Role of the Action Area in Modoc Sucker Survival and Recovery. The action area contains one waterbody crossing in Modoc sucker habitat. Thomas Creek is the only Modoc sucker habitat in the Goose Lake basin of Oregon, but Thomas Creek does not contain designated critical habitat. Regardless, this stream provides an important role in the survival and recovery of Modoc sucker. The Project's waterbody crossing is approximately 15 miles below the main Thomas Creek habitats occupied by Modoc sucker, limiting the importance of the action area to the survival and recovery of Modoc sucker. The waterbody crossing also is downstream of an impassible fish migration barrier, so the action area cannot provide significant benefit to the upstream Modoc sucker population.

Colorado River Fishes

Status Within the Action Area. The Project will not be constructed in any waterbody occupied by the four Colorado River fish species of concern (Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub). There is no critical habitat in Wyoming where proposed water extraction would occur (Hams Fork River, near MP 0.8). However, adverse effects from the 49.5 acre-foot water depletion will be transmitted downstream into occupied habitat and designated critical habitat for these four species in the middle Green River and the Colorado River. Therefore, downstream occupied habitat and critical habitat for the four Colorado River fish species are within the Project's action area.

Critical habitat in the action area includes the Green River and its 100-year floodplain from the confluence with the Yampa River downstream to the Green River's confluence with the Colorado River, as well as downstream in the Colorado River to Lake Powell. As part of the Recovery Program, floodplain/wetland habitat has been improved to benefit endangered fish at five BLM sites on the Green River. The Recovery Program has acquired easements on eleven properties along the Green and Colorado rivers for a total of 630 acres of protected habitat. Non-native smallmouth bass have been removed from the Green River. In the most intensely sampled reach in the Green River, a collaborative effort of the Service and Utah Division of Wildlife Resources exceeded the numerical goal for smallmouth bass reduction. The recovery programs provide ESA compliance for water development and has provided ESA compliance for more than 1,600 water projects depleting more than 3 million acre-feet per year.

Colorado Pikeminnow

The Colorado pikeminnow population has been augmented by stocking both in the Colorado and Gunnison Rivers, as part of the integrated stocking plan. In the Green River, Colorado pikeminnow were only stocked in 1999 when 36 were released. Estimates of wild adult Colorado pikeminnow in the middle and lower Green River were approximately 2,300 in 2003

(Bestgen et al. 2004). Colorado pikeminnow are distributed in the Colorado River below the Green River confluence in low numbers.

Humpback Chub

As of 2008, about 1,000 adults occur in the Desolation/Gray Canyon core population on the Green River (Upper Colorado River Endangered Fish Recovery Program 2008). Between 2003 and 2005 approximately 200-400 humpback chub were estimated to occur in Cataract Canyon, in the Colorado River below the Green River confluence (Bedame 2008). The integrated stocking plan (Nesler et al. 2003) does not call for any captive rearing or stocking of humpback chub in Utah or Colorado.

Razorback Sucker

The action area includes the largest concentration of razorback suckers in the Upper Colorado River Basin, found in low-gradient flat-water reaches of the middle Green River between and including the lower few miles of the Duchesne River and the Yampa River. Most recent estimates approximate the population to be 100 adults, based on data collected in 1998 and 1999 (Bestgen et al. 2002). The lower Yampa River provides adult habitat, spawning habitat, and potential nursery areas occur downstream in the Green River (Service 1998). Between 1992 and 1995 larval razorback suckers were collected in the middle and lower Green River (Muth 1995). The integrated stocking plan (Nesler et al. 2003) calls for stocking 19,860 razorback suckers into the Green River each year, split between the middle and lower reaches. The actual number of razorback suckers stocked into the Green River has been relatively high, although the stocking targets have not always been met. Combining all years from 1995 through 2007, the total number of razorback suckers stocked into the Green River totaled 75,300 fish. Recapture rates of these stocked fish are typically quite low. River-wide and localized sampling efforts from 2000 to 2004 recaptured approximately 8% of the razorback suckers stocked into the Green River prior to sampling. Some of these razorbacks, however, have persisted and have been captured four years after stocking and fish from earlier stocking efforts have been recaptured up to nine years after stocking (Upper Colorado River Endangered Fish Recovery Program 2006). Additionally, some of these stocked fish have moved long distances; razorbacks stocked in the Green River have been captured in the Colorado River and some stocked in the Gunnison River have been captured in the Green River (Upper Colorado River Endangered Fish Recovery Program 2006). Stocked razorback suckers have also been recaptured or observed in reproductive condition at spawning sites in the Green and San Juan rivers, larval razorbacks have been captured in the Green, Gunnison, Colorado, and San Juan rivers, and razorback larvae are surviving through the first year based on the capture of juveniles in the Green and San Juan rivers (Upper Colorado River Endangered Fish Recovery Program 2007).

Bonytail Chub

Bonytail chub are so rare that it is currently not possible to conduct population estimates. Surveys from 1964 to 1966 found large numbers of bonytail in the Green River downstream of the Yampa River confluence (Vanicek and Kramer 1969). Surveys from 1967 to 1973 found far fewer bonytail (Holden and Stalnaker 1975). Few bonytail chub have been captured after this period, and the last recorded capture in the Green River was in 1985 (Service 2002d). Several suspected bonytail chub were captured in Cataract Canyon in 1985-1987 (Valdez 1990). Experimental stocking of bonytail chub began in the Green River in 1998 and approximately 47,700 bonytail chub were stocked into the Green River through 2007. Also, in 2000 approximately 5,000 juveniles (5 to 10 cm) were stocked in the Yampa River at Echo Park, near the confluence with the Green River. The integrated stocking plan (Nesler et al. 2003) calls for 2,665 age 2+ fish to be stocked per year from 2005 to 2011 into the Middle Green River (RM 302-249). Bonytail chub stocking has occurred close to or at these levels since that time; however, despite thousands of released fish, through 2004 only about two dozen bonytail chub were recaptured from the Green River.

Factors Affecting the Species Environment and Critical Habitat Within the Action Area. Stream regulation, habitat modification, competition with and predation by nonnative fish, and pesticides and pollutants are primary factors negatively affecting Colorado River fishes and critical habitat in the action area (Service 2002a, 2002b, 2002c, 2002d).

Stream regulation, including water depletions, have changed timing and quality of flows in the action area by reducing peak flows and increasing base flows. Stream regulation also has modified sediment transport and deposition, which are important mechanisms for habitat creation. Between Flaming Gorge Dam and Lake Powell in the action area, numerous small diversion structures occur that may entrain larval and juvenile endangered fishes and some may affect adult fish migration. Tyus et al. (1982) reported that 42 nonnative fish species have become established in the upper basin, including the action area. Approximately 20 of these nonnative fish species that occur in the action area are potential and documented predators of Colorado River fishes (Tyus et al. 1982), and many are direct competitors with larval and juvenile Colorado River fishes for food and space resources that exist in the action area. Studies have documented that, during low water years, nonnative fish greatly expand their population numbers (Osmundson and Kaeding 1991), indicating greater competition and predation risk from nonnative fishes to larval and juvenile Colorado River fishes in the action area from water depletions which create and exacerbate low water year conditions. All these above factors also negatively impact the recovery function of critical habitat in the action area, including impacts to water, physical habitat, and the biological environment PCEs.

Role of the Action Area in Colorado River Fishes Survival and Recovery. The action area provides important survival and recovery function for the four Colorado River fishes, especially for adult razorback sucker and larval and juvenile forms of Colorado pikeminnow. The Service has a Recovery Program for Colorado River fishes with established conservation measures to minimize adverse effects to the endangered fish species and their critical habitat caused by water depletions. Under the program, depletion impacts are offset by the accomplishment of activities necessary to recover the endangered Colorado River Basin fish species. Ongoing recovery activities in the action area, that serve to improve the conservation status of listed Colorado River fishes and the recovery function of critical habitat, include stocking of Colorado River fishes, continued implementation of nonnative fish management actions, modified flows and water temperatures below Flaming Gorge Dam (Service 2009c).

Recently, the Service re-initiated intra-Service Section 7 consultation for small water depletions of 100 acre-feet or less from the Upper Colorado River Basin. As a result, the Service determined that even though the cumulative impact of small water depletions causes an adverse impact to the Colorado River fishes, the experience of the Service since the implementation of the Recovery Program has shown that the individual depletions in and of themselves are minimal because of their size and scattered locations. Consequently, the Service has determined that it would be more efficient and economical to exempt depletions of 100 acre-foot or less from the depletion fee.

Effects of the Action

"Effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Direct effects result directly or immediately from the proposed action. Indirect effects are caused by, or result from, the proposed action and occur later in time. Indirect effects may occur outside the area directly affected by the action. "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification; "interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

The Project's adverse effects to nine listed fish species and their designated critical habitats are reviewed in two separate subsections, below. The first subsection includes analysis of the Project's adverse effects to Lahontan cutthroat trout, Warner sucker and critical habitat, Modoc sucker, shortnose sucker, and Lost River sucker. These adverse effects are associated with the Project's construction and restoration of waterbody crossings and maintenance activities at waterbody crossings. The second subsection includes analysis of the Project's water depletion-related adverse effects to endangered Colorado River fishes and their critical habitats. Separately, the Service provides a conference report addressing Project effects to shortnose sucker and Lost River sucker proposed critical habitat (Appendix A).

Lahontan Cutthroat Trout, Warner Sucker, Modoc Sucker, Shortnose Sucker, and Lost River Sucker

The Project will construct a pipeline through subbasins where Lahontan cutthroat trout, Warner sucker and critical habitat, Modoc sucker, shortnose sucker, and Lost River sucker are known to occur. Project waterbody crossing activities in these listed fish occupied or critical habitat subbasins will cause adverse effects to these listed fish and critical habitat. The BA indicates pipeline construction could adversely affect these listed fishes and critical habitat through sedimentation and turbidity, habitat alteration, stream bank erosion, fuel and chemical spills, entrainment or entrapment due to water withdrawals or construction crossing operations, blasting, and unsuccessful habitat restoration or pipeline exposure. These Project waterbody crossing-related direct and indirect adverse effects to listed fishes are reviewed below. Project waterbody crossing-related adverse effects to Warner sucker critical habitat are addressed in a separate subsection, below.

Due to similarity of Project waterbody crossing-related direct and indirect adverse effects to these listed stream-resident fishes, analysis of Project adverse effects to Lahontan cutthroat trout, Warner sucker, Modoc sucker, shortnose sucker, and Lost River sucker are combined in the following subsection, unless a unique difference between species or their habitats is specifically identified.

Direct Effects to Listed Fishes During Construction. Direct effects are the immediate effects of a project on species or its habitat. A total of six streams were determined in the BA to contain listed fish at Project waterbody crossings (Warner sucker: Twelvemile Creek and Twentymile Creek; Modoc sucker: Thomas Creek; Lost River sucker and shortnose sucker: South Arm East Willow Creek, North Fork Willow Creek, and Lost River). In these known occupied streams where listed fish are present during construction of a trenched waterbody crossing, the Project's waterbody crossings could cause direct effects to listed fish during work site isolation, fish salvage, and blasting activities.

Additionally, as noted above in the Status of Species and Environmental Baseline sections, these Listed fishes exhibit migratory life stages as well as migratory life forms and, depending upon water year and other local conditions which influence an individual fish's movement and migration behavior, these listed fish may volitionally move into additional locations than the six known occupied Project waterbody crossings. It is therefore likely that additional waterbody crossings may be occupied by listed fish during Project construction. Tables 1, 2, 3, and 4 include additional streams where listed fish may occur at Project waterbody crossings, and be exposed to the following direct effects. The Service anticipates only streams with perennial or intermittent flow at time of construction, that also exhibit migratory connectivity (i.e., no physical passage barriers) to known listed fishes' occupied habitats, would have an additional possibility of being occupied by listed fishes during waterbody crossing construction.

The Project proposes numerous conservation measures to minimize direct effects to listed fish during waterbody crossing and access road activities. The Project would only construct waterbody crossings at the known occupied and connected streams within respective listed fish-specific inwater work timing windows. Allowable inwater work periods are provided in Table 5, and include July 1-Dec 31 (Lahontan cutthroat trout); July 15-September 30 (Warner sucker and Modoc sucker); and July 1-January 31 (Lost River sucker and shortnose sucker). The inwater work period for the Lost River crossing is October 15-January 31 (Lost River sucker and shortnose sucker).

Work Site Isolation and Fish Salvage

Waterbody crossings identified in tables 1, 2, 3, and 4 will employ work area isolation via a dry-ditch construction method, if water occurs at the waterbody crossing at the time of construction. The Service anticipates all perennial and intermittent streams will have water at time of construction, but that no ephemeral streams would have water at the waterbody crossing at the time of construction. Either a dam-and-pump or flume method would be used at these intermittent and perennial waterbody crossings. If a flume is installed at a dry-ditch waterbody crossing, the flume will serve to maintain some volitional fish movement (mainly downstream) through the construction area. Each waterbody crossing would be completed as quickly as possible (generally within 2 to 3 days). Fish salvage methods are proposed, where work site isolation methods are used, prior to dewatering of the waterbody crossing work area. Fish screening on pumps is proposed, prior to final fish salvage efforts, to ensure any fish that were not initially salvaged would not be entrained during construction site dewatering. Finally, any blasting of stream bed and banks in listed fish streams will be conducted "in the dry" and in locations isolated from adjacent, occupied water. If construction took place in listed fishes habitats without work area isolation, construction timing windows, and these other Project measures, it is likely more listed fish would be injured or killed. However, even with these protective conservation measures, some direct effects to listed fishes will still occur, and are discussed below.

While work site isolation and fish salvage are designed to avoid certain direct impacts (e.g., fish mortality due to crushing by construction equipment) and minimize other direct and indirect effects of the waterbody construction activities, these protective actions can still have adverse effects to listed fishes. Adverse, direct effects from fish salvage activities, including capture, handling, and relocation, include physical injury, death, and physiological stress during capture, holding, or release; predation and cannibalism when relocated fish are released; and potential horizontal transmission of disease and pathogens and stress-related phenomena. Some fish salvage methods are less effective at removing individual fish, but may be less impactful on an individual fish (e.g., seining). While electrofishing is generally more effective in salvaging individual fish, it will increase fish stress and injury or mortality levels over other fish salvage methods.

The Service (2004b) estimated shortnose sucker mortality and injury rates due to inwater project work site isolation and fish salvage activities. In this source document the Service anticipated 25 fish per construction activity site, and that efforts to salvage and dewater an inwater activity site would successfully result in almost all shortnose sucker present being adequately protected from injury or mortality. However, in these conservative analyses, the Service still anticipated that even the best implemented salvage and dewatering efforts would result in one shortnose sucker being killed during fish handling and one shortnose sucker being killed during dewatering activities per each inwater construction activity. The Project's proposed work site isolation and fish salvage activities are similar to those reviewed in Service (2004b) for inwater construction activities, including similar fish protective measures such as inwater work timing windows.

The Service anticipates the Project's salvage and dewatering activities will result in similar successful protection of shortnose sucker during waterbody crossing activities, but that a limited number of shortnose sucker will still be killed during salvage and dewatering activities at each waterbody crossing with perennial or intermittent flow at time of construction. The Service anticipates Lost River sucker, Modoc sucker, Warner sucker, and Lahontan cutthroat trout occurring in similar, low flow, high desert habitats as shortnose sucker will respond similarly to fish salvage and dewatering activities and exhibit similar salvage and dewatering mortality rates as for shortnose sucker identified in Service 2004b). Therefore, for the following analysis of shortnose sucker, Lost River sucker, Modoc sucker, Warner sucker, and Lahontan cutthroat trout, the Service will use the same conservative mortality rates from fish salvage (one fish per activity) and dewatering (one fish per activity) in intermittent or perennial streams as that used in the Service 2004b source document for shortnose sucker.

Based on the number of waterbody crossings in intermittent and perennial streams identified in Tables 1, 2, 3, and 4, the Service therefore anticipates a combined total of 16 Warner sucker will be killed during work site isolation and fish salvage activities at eight waterbody crossings, a total of two Modoc sucker will be killed during work site isolation and fish salvage activities at one waterbody crossing, a combined total of 10 shortnose sucker will be killed during five separate work site isolation and fish salvage activities at five waterbody crossings, a combined total of 10 Lost River sucker will be killed during five separate work site isolation and fish salvage activities at five waterbody crossings, and 150 Lahontan cutthroat trout will be killed during separate work site isolation and fish salvage activities in75 waterbody crossings (Table 6).

Table 6. Summary of direct effects to listed fishes during waterbody crossings activities.

Species	Isolation/Salvage	Blasting	Total
Warner sucker	16	9	25
Modoc sucker	2	2	4
Lost River sucker	10	9	19
shortnose sucker	10	9	19
Lahontan cutthroat trout	150 adult fish and all eggs and fry within 10 higher-elevation waterbody crossings	80 adult fish and all eggs and fry within 200 feet upstream and downstream adjacent to eight higher-elevation waterbody crossings	230 adult fish plus all eggs and fry within and/or adjacent to the higher-elevation waterbody crossings

Lahontan cutthroat trout may spawn between April to as late as July (in colder, higher elevation waters). The Lahontan cutthroat trout inwater work timing window (July 1-December 31) would protect earlier-spawning adults and their eggs and fry. The Service has reviewed the Project's waterbody crossing locations within subbasins containing Lahontan cutthroat trout or connected to known occupied habitat and has determined that Lahontan cutthroat trout are likely to spawn earlier (April or May) at the generally-lower-end-of-watershed locations of the Project's waterbody crossings. Young-of-year Lahontan cutthroat trout emerge from spawning gravels after 4-6 weeks of egg incubation and fry maturation, therefore most fish would emerge from spawning gravels before the start of the July 1 inwater work timing window. However, a limited number of Lahontan cutthroat trout produced in late May in a limited number of higher elevation streams would potentially still occur within spawning gravels at a waterbody crossing if construction commenced at that site in early July.

The Service determined that, due to potential connectivity between known occupied Lahontan cutthroat trout populations both upstream and downstream of proposed waterbody crossings, Lahontan cutthroat trout are likely to be affected at 47 Project waterbody crossings with intermittent flow and 28 Project waterbody crossings with perennial flows (Table 4). Lahontan cutthroat trout eggs or fry may still occur in the gravel at a limited number of higher elevation, connected waterbody crossings until mid-July and an unknown number of Lahontan cutthroat trout eggs and fry at these limited number of sites will therefore be exposed to direct mortality during work site isolation activities, if these activities occur between July 1 and mid-July (Table 6). Based on the generally-lower elevation waterbody crossing locations in Lahontan cutthroat trout habitat, the Service anticipates no more than 10 of the 75 connected waterbody crossings are at higher elevations, and only within these limited number of higher-elevation streams is there likelihood that Lahontan cutthroat trout eggs and fry may still be in the gravel between July 1 and mid-July. Since work site isolation activities will be restricted to a 115 foot wide construction area at each waterbody crossing, any direct mortality of Lahontan cutthroat trout eggs or fry due to work site isolation activities at these 10 streams between July 1 and mid-July would be limited to this relatively narrow impact area.

Blasting

When pipelines crossings are trenched in areas of bedrock, rock or other strongly consolidated sediments, explosives may be required during the construction process. Blasting is proposed for pipeline installation in two occupied Warner sucker and Warner sucker critical habitat streams (Table 1) and is possible or proposed in three known occupied Lost River and shortnose sucker streams and is possible in one known occupied Modoc sucker stream (Tables 2 and 3). In addition, blasting is possible at three connected Warner sucker streams where intermittent flows occur (Table 1), and blasting is proposed at one Lost River sucker and shortnose sucker perennial stream and possible at one Lost River sucker and shortnose sucker intermittent stream (Table 2). There are no Modoc sucker streams crossed by the Project that exhibit migratory connectivity and where intermittent or perennial flows exist, therefore blasting effects will not occur to Modoc sucker in connected habitats. Finally, 38 intermittent streams and 21 perennial streams connected to Lahontan cutthroat trout habitat will require blasting (Table 4). The Service will analyze blasting effects for known occupied and connected habitat with the assumption that any stream with a potential for blasting will require blasting.

When explosives are detonated, compression shock waves are produced that are characterized by a rapid rise to a high peak pressure followed by a rapid decay to below ambient hydrostatic pressure (Wright and Hopky 1998). Exposure to shock waves has been shown to adversely affect all life stages of fish, especially in species with gas filled organs such as these five ESA-listed fishes. In general, earlier life stages are most vulnerable to the adverse effects of shock waves (Govoni et al. 2008). Adverse effects can include direct mortality, structural and cellular damage to auditory and non-auditory tissues, and behavioral changes (Popper and Hastings 2009). Guidelines for the use of explosives in or near Canadian fisheries waters require explosive-caused shock waves, measured as peak particle velocity, to be less than 13 mm/s in spawning beds to avoid impacts to eggs (Wright & Hopky 1998).

The BA and supplemental information from Ruby indicate that, prior to blasting, waterbodies containing water at time of construction will be isolated using a dry-ditch waterbody crossing method, subsequent blasting activities would occur “in the dry”, and all blasting activities would occur within the local inwater work period for the respective listed fishes. When explosives are used in dewatered stream beds and detonated from stemmed boreholes, the explosive is not in direct contact with water. The shockwave is displaced by the surrounding substrate and the rise of the peak shock wave can be reduced (Rickman 2000). The Service therefore assumes that, since all known listed fishes’ waterbodies where blasting will occur and that contain water at the time of construction will be blasted “in the dry”, that direct blasting-related effects from shock waves to listed fishes will be reduced. The BA indicates fish salvage is required prior to construction at known listed fishes’ waterbody crossings, therefore the Service assumes that if fish salvage and relocation occurs prior to construction site dewatering and blasting at a known listed fish location, all fish within the work site isolation area and blasting location will be removed from the most harmful blast impacts. Strict compliance with inwater work windows will additionally minimize likelihood of listed fish being in and adjacent to the construction area in these known listed fish locations.

There is a likelihood that listed fishes will be present outside of, but adjacent to, the isolated work space at locations where blasting "in the dry" will occur. These fishes could be adversely affected by blasting-induced shock waves. If present adjacent to the isolated work space, younger age-classes of listed fishes will be more vulnerable than older life stages to these Project blasting shock waves.

Mortality rates for each ESA-listed species due to worksite isolation and fish salvage activities, that will be associated with a known listed fish waterbody crossing where explosives are necessary, has already been analyzed and accounted for, above. The Service anticipates, based on the blasting effects review above, that fish occurring outside of a work space isolation area would be less vulnerable to blasting-induced shock waves. However, some adverse impacts would still occur to listed fishes that occur outside of the isolated work space but still in the immediate upstream and downstream vicinity of the waterbody crossing. For the analysis below, the Service will assume low fish population densities will occur adjacent to blasting sites, and, based on the above analysis that indicates reduced impacts in areas outside of the isolated blasting location, will assume only one or two fish will be killed by each blasting event. The Service further assumes that slightly higher densities of listed fish will occur at the five known occupied sites with blasting than at connected waterbody crossing sites that require blasting. Also, for both known occupied and connected listed fish sites, the Service will assume that there will be a slightly higher number of fish adjacent to the isolated blasting area in perennially-flowing streams than at sites with intermittent flow, therefore slightly higher levels of impact will occur to listed fish from blasting in streams with perennial flow than in intermittent streams. This assumption is based on more continuous and extensive habitat occurring at sites with perennial flow, where blast-related pressure waves could travel further.

Based on the above assumptions, the Service anticipates that four Warner sucker will be killed (two upstream of the work site and two downstream of the work site) during blasting activities at the perennially-flowing Twelvemile Creek crossing, but, due to Twentymile Creek's intermittent flow and more limited habitat that occurs in this reach during the inwater work period, that only two Warner sucker will be killed (one upstream of the work site and one downstream of the work site) during blasting activities at the intermittent Twentymile Creek crossing (Table 6). The Service also estimates one Warner sucker will be killed during Project blasting at each of three intermittent, connected streams.

Due to the downstream location of the Thomas Creek waterbody crossing, the Service anticipates only two Modoc sucker will be killed (one upstream of the work site and one downstream of the work site) during blasting activities at the perennially-flowing Thomas Creek crossing (Table 6). There are no Modoc sucker streams crossed by the Project that exhibit migratory connectivity and where intermittent or perennial flows exist, therefore blasting effects will not occur to Modoc sucker in connected habitats.

Due to limited habitat availability and/or intermittent flow conditions, the Service anticipates that two Lost River sucker will be killed (one upstream of each work site and one downstream of each work site) and two shortnose sucker will be killed (one upstream of each work site and one downstream of each work site) during blasting activities at the South Fork East Willow Creek crossing, the North Fork Willow Creek crossing, and Lost River crossing, respectively (Table 6). Based on relatively higher densities for Lost River sucker and shortnose sucker at perennial than for ephemeral connected waterbodies, the Service anticipates two Lost River sucker and two shortnose sucker will be killed during Project blasting at one perennial, connected stream. The Service anticipates one Lost River sucker and one shortnose sucker will be killed during Project blasting at one perennially-flowing, connected stream.

Finally, blasting is proposed or possible in 38 intermittent streams and 21 perennial streams connected to Lahontan cutthroat trout habitat (Table 4). The Service anticipates two adult Lahontan cutthroat trout will be killed during Project blasting activities in each perennially-flowing, connected stream, and one adult Lahontan cutthroat trout will be killed during Project blasting activities in each intermittent-flowing, connected stream, for a total of 80 adult Lahontan cutthroat trout (Table 6).

Based on the above worksite isolation-related Lahontan cutthroat trout egg and fry analysis that is applicable for blasting, the Service also anticipates an unknown number of Lahontan cutthroat trout eggs and fry that occur in areas adjacent to the waterbody crossing will be killed during blasting in intermittent and perennially-flowing, connected, higher-elevation streams if the blasting occurs between July 1 and mid-July. Based on the Service's above estimate that 10 higher-elevation streams out of 75 connected streams would still contain Lahontan cutthroat trout eggs and fry if construction occurred before mid-July, and approximately 75 percent of those 75 streams (59 connected streams total) are likely to have blasting activities, the Service estimates eight higher-elevation streams with blasting will be occupied by Lahontan cutthroat trout eggs and fry if blasting activities occur before mid-July. Direct mortality will occur in these eight streams to an unknown number of Lahontan cutthroat trout eggs and fry that occur in areas adjacent to the waterbody crossing where the blast shock waves occur. Due to some of these higher-elevation streams being intermittent (and therefore limiting the distance shock waves travel via water) or having meandering, gradient, or other attenuating features that reduce the distance that blasting-induced shock waves will impact adjacent waters, as well as all these blasting activities occurring in isolated, dewatered locations away from adjacent habitats, the Service anticipates direct mortality from blasting to Lahontan cutthroat trout eggs and fry in adjacent waters will be limited. Therefore the Service anticipates direct mortality of an unknown number of Lahontan cutthroat trout eggs and fry that is limited to the waterbody crossing and, due to aforementioned limited distance the already-minimized shock wave may travel and adversely impact eggs and fry, no more than 200 ft upstream as well as downstream from the edge of each higher-elevation waterbody crossing (total blasting impact area per stream equals 400 ft).

Therefore, in addition to those listed fishes adversely affected at each blasting site by work site isolation and fish salvage activities that proceed blasting activities, the following is a summarized estimate of direct effects to listed fishes, immediately upstream and downstream from each isolated work site, where each Project blasting event is possible or will occur: a total of nine Warner sucker, two Modoc sucker, nine Lost River sucker, nine shortnose sucker, and 80 Lahontan cutthroat trout are anticipated to be killed from blasting-induced shock waves that occur outside of work site isolation barriers during waterbody crossings in these known occupied listed fishes habitats, as well as all Lahontan cutthroat trout eggs and fry within 400 feet of adjacent habitat at each of eight higher elevation waterbody crossings (Table 6).

Indirect Effects to Listed fishes. Indirect effects are caused or result from the proposed action, are later in time, and are reasonably certain to occur. The Project's waterbody crossings will cause indirect effects to listed fish in occupied and connected habitats. The Project proposes numerous conservation measures to minimize indirect effects to listed fish in occupied habitat during waterbody crossing activities, and has clarified that in connected habitat the Project will implement either dry-ditch waterbody crossing techniques or only construct later in the period when the waterbody is naturally dry (F. Robertson, 2010b, pers. comm.). However, few other protective measures are clearly proposed in the BA for waterbody crossings in connected habitats, such as measures to minimize impacts to stream beds and banks, to limit impacts on riparian vegetation, or to protect fish from chemical spills. Since it is not clear if these protective measures will also be applied for waterbody crossings in connected habitats, relatively greater indirect adverse effects are anticipated in connected habitats. However, even with all these Project conservation measures implemented in occupied and connected habitats, there is potential for additional indirect effects to occur to listed fishes, and are discussed below. Additionally, other post-construction activities will occur near listed fish streams, and will cause indirect effects. These indirect effects of post-construction activities also are discussed below.

Geomorphological Impacts to Listed Fish Habitat

As noted in the Consultation History section (above), the Service remains concerned that current waterbody crossing guidance from FERC (2003), and as incorporated into the BA, does not provide sufficiently detailed and specific information to ensure protection, restoration, and monitoring of geomorphological attributes of listed species streams that occur across the Project's complex geographic and ecological settings. Also as noted in the Consultation History section (above), FERC continues to maintain that its waterbody crossing procedures, as well as additional site-specific measures for select waterbodies, does provide for adequate waterbody protection and restoration. Unfortunately, while the Project has committed to undertake additional waterbody crossing procedures and protections (as indentified in the Proposed Action section), the BA proposes no additional waterbody crossing conservation measures to address these Service geomorphological concerns and recommendations. Therefore, as directed by FERC in their January 7, 2010 response to Service draft BA comments and as confirmed in the Service's January 8, 2010 response to FERC's January 7 response, the following analysis of geomorphic impacts uses a very conservative approach, and provides a "worst-case" scenario of Project effects to occupied and connected waterbodies.

The Service has provided the Project and FERC and other federal agencies associated with this BO with numerous comments, recommendations, and tools addressing geomorphological risk from the Project's high number of waterbody crossings (e.g., Service's October 30, 2008 comments on FERC's Notice of Intent; Service's April 8, 2010 recommendations on waterbody crossings to Corps). These comments are pertinent to the Project's proposed waterbody crossings, regardless if the stream is perennial, intermittent, or (for those streams that can transport sediment) ephemeral, regardless of stream size, and regardless if the stream is flowing at time of construction. Additionally, these Service comments include reference to concerns with temporary construction crossings (a.k.a. "temporary bridge") at the pipeline crossing site and any other modifications to or new road crossings to create access to (via a culvert, bridge or other method) a pipeline waterbody crossing site. The Service notes that, to the extent Ruby can use existing bridges and other existing waterbody crossing features for access to the pipeline construction area, the following effects at certain "access road" waterbody crossing locations will be greatly reduced.

The Service has concerns about the Project's impacts on stream geomorphology with associated adverse effects to listed fishes in occupied and connected streams (herein defined to include perennial, intermittent, and ephemeral waterbodies). Streams are dynamic systems where localized disturbances (such as a pipeline waterbody crossing) can be propagated over time upstream, downstream, and laterally. Geomorphic effects that result from a new pipeline crossing will be indeterminant until flows of sufficient magnitude have adjusted the channel shape (i.e. width, depth, planform, and slope). Related channel modifications, such as artificial bank stabilization, will also be undetectable until the channel experiences a series of high flows that may not occur for months or years after construction. Addition of artificial constraints, such as bank stabilization structures or grade control, will cause an exaggerated morphological response in another dimension. For example, if a streambank is stabilized with rock, it will likely result in increased erosion of the channel bed, thus increasing the risk of pipe exposure. This natural geomorphic connectivity of streams and the inherent lag time between channel modification and channel adjustment indicates that the Project's waterbody crossing geomorphological and associated environmental impacts cannot readily be confined to each waterbody crossing location.

The above geomorphic review assumes no change in baseline habitat or flow conditions. However, based on the 50+ year design life of the Project, climate change impacts must also be considered in waterbody crossing analysis. Depending upon location, it is reasonable to expect increases in peak flow, decreases in base flow, and potential changes in hydrologic regime (i.e. snow dominated to rain-on-snow dominated). The geomorphologic implications of predicted climate change include increased variability in both flow and sediment, and hence an increase in stream dynamism. This will result in the stream occupying more and more space over time until the systems regains some level of dynamic equilibrium.

Developing appropriate minimization, reclamation, and mitigation plans for such dynamic systems is very difficult, and for some systems, may not be possible. The Service has therefore recommended to FERC, other associated federal agencies, and the Project that Project waterbody crossings should be evaluated and addressed via a standardized set of sequential steps, including: 1) development of basic site data; 2) risk assessment; 3) design of waterbody crossing appropriate to stream risk; 4) implementation of risk-specific Best Management Practices; 5) site restoration; and 6) implementation and effectiveness monitoring; and 7) as necessary, remediation. These sequential waterbody crossing steps are displayed within Appendix B.

Based on a Service analysis of Project waterbody crossings that occur in the same 10[th] hydrologic unit code (HUC) watershed as listed fish and their habitat, the Service has identified additional waterbodies apart from those listed in the BA where the Project's pipeline construction activities are likely to result in an adverse effect to listed fish (Tables 1, 2, 3, and 4). These additional waterbodies are characterized by their geomorphic and/or biological connectivity to occupied listed fishes' habitat. Examples include an upstream tributary to occupied habitat; a stream reach downstream of occupied habitat; or a tributary to a stream reach downstream of occupied habitat. Pipeline construction activities in these unoccupied but geomorphically connected waterbodies can create adverse conditions that propagate into currently occupied fish habitat. Adverse geomorphic impacts at a waterbody crossing can propagate through channel re-grading, which is the process of erosion of the channel bed and lowering of the stream base level followed by channel widening through bank erosion. This channel incision process is associated with broad-scale loss of instream and floodplain habitats, due to the loss of shallow aquifers, hyporheic flow, and disconnection of the stream from its floodplain. As a connected channel re-grades, listed fishes and their habitat are adversely affected in similar, but in greater magnitude, to the impacts identified below.

Additionally, and especially pertinent to the Service's assessment of Project impacts in connected streams, is the fact that these ESA-listed desert fish species undertake different movements and migrations over their lifetimes and even express additional migratory life forms. Over the 50+ year life of the Project, these listed fish species may temporarily or permanently occupy additional locations than currently identified in the BA, that coincide with a Project waterbody crossing location where adverse conditions occur.

Finally, the Service believes inclusion of these additional ESA waterbodies in the action area, and this BO's analysis of effects to listed fishes and their critical habitats, addresses many listed fishes-related comments and concerns provided by affected Tribes to FERC, other federal action agencies, and the Project during the Project's prefiling and NEPA analysis periods. The Service therefore anticipates the expanded ESA action area and extended analysis of adverse Project effects within additional waterbodies likely to contain listed fishes, contained in this BO, helps to address the Service's Executive Order 13175 consultation and coordination obligations to Tribes affected by this FERC action.

Significant discussion regarding geomorphological and environmental impacts of waterbody crossings has occurred between the Service and the Project during formal consultation, and responsive information and new conservation measures are currently being developed by the Project to address the above Service concerns and recommendations. However, these new Project waterbody conservation measures are not comprehensively and site-specifically available for incorporation and evaluation in this BO. Therefore the following analysis will only address the general waterbody crossing actions described in the BA.

The BA's proposed waterbody crossing actions will likely cause adverse effects to listed fish species in occupied and connected habitats including floodplain disturbance, channel disturbance, water quality and quantity effects, and instream fish habitat effects.

Floodplain disturbance impacts include:

- Direct loss of riparian habitat and indirectly the loss of various functions that riparian habitat serves for listed fishes; and

- Reduction in floodplain resiliency because of decreased floodplain roughness and hence higher flow velocities during flood events.

Removal of riparian vegetation will reduce stream shade, increase solar radiation, and result in increased water temperature. Lahontan cutthroat trout and Modoc sucker, which occupy cooler water habitats than the other three listed sucker species, are most sensitive to increased temperature. Additionally, increased solar radiation leads to increased primary productivity, and fluctuating stream dissolved oxygen and pH levels, which can be physiologically stressful for listed fish. Removal of riparian vegetation decreases both overhead and future instream cover for listed fish, and, since many aquatic and terrestrial insects rely on riparian vegetation at various stages of their life history, reduces an important contributor of food for listed fish. Removal of riparian vegetation also decreases allochthonous inputs thus altering nutrient cycling within the stream.

Herbaceous and woody riparian plants are very important to streambank stability, especially in alluvial streams with fine soil banks. Riparian habitat removal will result in decreased bank stability, increased lateral bank erosion, and other instream geomorphological effects propagating from the waterbody crossing site into upstream and downstream locations, with adverse affects to listed fish habitat, as discussed below.

Removal of floodplain vegetation and modification of a floodplain's integrity increases likelihood that, upon higher flow events that access floodplain areas, adverse habitat changes will occur to listed fish habitat. Pipeline crossings that are not perpendicular to the stream channel will generally remove more riparian habitat and adversely impact more floodplain habitat; pipeline crossings that are paralleling a stream, with multiple waterbody crossings in a short reach of stream, will have significantly higher adverse effects to floodplain and riparian habitats.

Channel disturbance impacts include:

- Simplification of channel geometry and reduction of hydraulic roughness due to open trench excavation and subsequent fill, thus resulting in reduced habitat diversity;
- Changes in channel cross-sectional shape due to a decrease in natural bank stability or from permanent, rigid stabilization measures (e.g., rip rap, gabion baskets) used to reestablish channel banks;
- Increased lateral channel migration resulting from decreased bank stability and loss of riparian vegetation, which may result in proposals for future streambank stabilization projects;
- Increased vertical streambed variability due to localized scour and fill in the area of disturbed streambed material, potentially resulting in disconnection with the floodplain and possibly exposure of the pipeline, thus resulting in additional, future in-channel work;
- Downstream deposition of high volumes of sediment from bed and/or bank erosion that cause additional lateral scour events.

As a stream's sediment load increases from a project's inwater and upslope activities, the stream compensates by undergoing geomorphic changes, including increased slope, increased channel width, and decreased depths (Castro and Reckendorf 1995). Each of these stream habitat responses leads to significant adverse effects to all life history stages of listed fish, including loss of cover and food items, reduction in amount and quality of habitat, modifications in flow timing and magnitude, and blockage of fishes' migratory corridors. These geomorphic changes subsequently contribute to increased bank erosion and sediment deposition, further degrading remaining fish habitat. Ultimately, the loss of fish habitat, as well as associated decreased connectivity among habitats, reduces the carrying capacity of streams for fish (Bash et al. 2001).

Additional physical and biological implications of increased sediment in streams include degradation of spawning and rearing habitat, simplification and damage to habitat structure and complexity, loss of habitat, and decreased connectivity among habitats (Bash et al. 2001). Deposition of fine sediments can influence egg incubation survival and fry emergence success (Weaver and White 1985) and may also limit access to substrate interstices that are important cover during rearing and overwintering (Goetz 1994, Jakober 1995). Implications to listed fish from sediment-related habitat damage include underutilization of stream habitat, abandonment of traditional spawning habitat, displacement of fish from their habitat, and avoidance of habitat (Newcombe and Jensen 1996), and negative impacts on food web and water quality conditions, such as water temperature and dissolved oxygen (Rhodes et al. 1994).

Effects to water quality and quantity include:

- Increased downstream suspended sediment due to streambed disturbance;
- Increased water turbidity due to destabilized banks and inundation of recently disturbed areas in the channel and on the floodplain; and
- Reductions in local and downstream stream flow due to modification of impervious bed materials, channel widening, reduction in habitat, or disruption of longitudinal connectivity resulting from excavation (including use of explosives) of the trench and filling with non-site materials, particularly in channels that are formed in other less-porous material types (e.g., clay, bedrock).

Increased sediment contributions, and associated increases in turbidity, suspended sediment, and bedload, will be caused during dry- and wet-ditch construction activities in listed fishes habitat. Increased sediment contributions in the local waterbody crossing area will occur during installation and removal of the upstream and downstream coffer dams and flume, water leaking through the upstream dam and collecting sediment as it flows across the work area and continues through the downstream dam, when streamflow is returned to the construction work area after the crossing is complete and the dams and flume are removed, and during the first natural flow events which can occur days, months, or years after project construction. Increased sediment contributions, and associated increases in turbidity, suspended sediment, and bedload in listed fishes habitat, could also be caused by upslope pipeline construction activities.

Increased sediment loads and water turbidity can adversely affect fish behavior, such as feeding and migration, and physiological processes, such as blood chemistry, gill trauma, and immune system resistance, all of which can result in injury or even mortality if sediment is introduced into occupied listed fishes habitat at high enough levels. Construction-related suspended sediment, turbidity, and bedload can be redeposited on downstream substrates and could bury aquatic macro-invertebrates and other fish food sources. Additionally, construction-related downstream sedimentation could affect spawning habitat, spawning activities, eggs, larvae, and juvenile fish survival, as well as benthic community diversity and health. Individual fish may be displaced to other, less suitable habitats during turbidity events. A relatively short period of increased sedimentation and turbidity is expected during the period of instream work. However, specific site characteristics including flow, substrate composition, relative disturbance, and other broadscale geomorphological factors previously discussed could make the duration of construction effects last longer, more intense, and broader-ranging.

Most functioning stream channels have inherent capacity to retain surface flows. Some streambeds have exceptionally low porosity (i.e., channels in bedrock or clay substrates), and hence modification of a stream's native bed materials, via a waterbody crossing, to retain its surface water and flow connectivity can reduce the amount, timing, and duration of flows. Water quality is impacted via reduction or loss of flow, including increases in water temperature, and increased diel fluctuations in dissolved oxygen and pH. Loss or reduction of flow also leads to reductions in flow-dependant riparian vegetation, with decreases in riparian habitat benefits including shading, food production, and streambed and bank stability.

Effects to instream fish habitat include:

- Reduction in fish habitat and blockage of fish access due to physical changes of the stream channel, including channel widening and subsequent subsurface flow;
- Replacement of stream substrate with non-native materials; and
- Direct removal of spawning gravel from the streambed, and modified spawning substrate following site reclamation.
- Reduction of habitat complexity due to the removal of organic material, overhanging vegetation, and undercut banks.

Modification of a stream's native bed material, via a waterbody crossing, that results in increased porosity can reduce the flow-related connectivity between listed fishes habitats. Reductions in flow availability leads to significant impacts to listed fishes and their habitats, including loss of habitat, dewatering during important life history events (e.g., dewatering of eggs), and disconnection of habitats that are important to support all life stages and life histories of listed fishes. The Project is proposed in habitats that are already flow-limited, due to the high desert environment. Any additional reduction of flows caused by waterbody crossings in or connected to listed fishes habitats will have significant, adverse effects to listed fishes.

The Project will modify stream substrate materials, and, in some locations, completely replace native materials with non-native gravels. Effects of modification of stream bed materials on listed fishes have been discussed in several sections, above.

The number of fish adversely affected by modification of stream bed materials cannot be reasonably quantified because sediment deposits into different habitats at different rates; listed fish occupy these different habitats at different rates and during different seasons; and changes in listed fish occurrence and behavior (especially eggs and smaller life forms) is difficult to recognize, especially during inwater project-related sediment transport and deposition events. The Service (2007c, 2009d) estimated linear feet of instream listed fishes' habitat impacted by sediment immediately after instream construction activities. These inwater construction activities are generally similar to those reviewed in this BO, therefore the Service will use these ecological surrogates to quantify levels of adverse effects to listed fishes due to sediment released during and immediately after the Project's instream construction at waterbody crossings with perennial or intermittent flow at the time of construction.

Instream construction will cause increased transport of suspended sediment, with associated turbidity, at and below a project site (Service 2007c, 2009d). These project-related sediment plumes will be of short duration (less than three hours per sediment plume) but may occur more than once per project. While a project-related suspended sediment/turbidity plume may remain above-ambient levels for up to ¼ mile (below project sites where fine sediments comprise a low percentage of stream bed and banks) to ½ mile (below project sites where fine sediments comprise a high percentage of stream bed and banks) at and below a project site, most of the larger suspended sediments will be deposited at and up to 600 feet below an individual project, and any additional, larger sediment will deposit within and immediately below the construction site.

Therefore, the Service anticipates adverse effects to listed fishes related to sediment, as described above, will occur at each perennial and intermittent waterbody crossing in listed fishes occupied as well as connected habitat. These adverse effects to listed fishes will occur during and immediately after inwater activities in streams with perennial or intermittent flow, and within the work site and up to 600 feet of the downstream edge of each waterbody crossing. Combining the 600 feet of adverse sediment-related impact per waterbody crossing with the approximately 115 foot wide construction area proposed for most Project waterbody crossings equates to 715 linear feet of sediment-related adverse effect to listed fishes for each waterbody crossing in occupied and connected habitats that have perennial or intermittent flow. The Service (2007c, 2009d) determined that these levels of sediment impacts, due to instream construction activities that are similar to those review in this BO, were well below lethal levels for these same listed fishes.

Based on Tables 1, 2, 3, and 4, and estimating 715 linear feet of adverse sediment-related impact per waterbody crossing, the Service anticipates a combined total of 53,625 linear feet of sediment-related adverse effect will occur to Lahontan cutthroat trout in connected habitats from waterbody crossing construction activities in 47 Project waterbody crossings with intermittent flow and 28 Project waterbody crossings with perennial flows (Table 7). The Service anticipates 1,430 feet of sediment-related adverse effect to Warner sucker will occur from two waterbody crossings in occupied habitats and 4,290 feet of sediment-related adverse effect to Warner sucker will occur from six waterbody crossings in connected habitats. The Service anticipates 715 feet of sediment-related adverse effect to Modoc sucker will occur from one waterbody crossing in occupied habitat. Finally, the Service anticipates an overlapping 2,145 feet of sediment-related adverse effect to Lost River sucker and shortnose sucker will occur from three waterbody crossings in occupied habitats, and an overlapping 1,430 feet of sediment-related adverse effect to Lost River sucker and shortnose sucker will occur from two waterbody crossings in connected habitats.

Table 7. Summary of indirect effects to listed fishes from waterbody crossings in occupied and connected habitats.

Species	Occupied	Connected	Total
Warner sucker	1,430 ft	4,290 ft	5,720 ft
Modoc sucker	715 ft		715 ft
Lost River sucker and shortnose sucker	2,145 ft	1,430 ft	3,575 ft
Lahontan cutthroat trout	n/a	53,625 ft	53,625 ft

Other Indirect Effects to Listed Fishes

Inwater construction may result in fluid or lubricant leakages or spills, which may have adverse effects on listed fish species. The Project proposes preventive measures such as personnel training, equipment inspection, and refueling procedures to reduce the likelihood of spills, as well as mitigation measures such as containment and cleanup to minimize potential impacts should a spill occur. Construction equipment fueling and hazardous material storage would be prohibited within 100 feet of waterbodies, with a 500-foot hazardous materials setback on BLM-managed lands, where appropriate. Additionally, all heavy equipment construction work will be conducted in dry conditions, with full isolation of the work area from adjacent water. The Project will implement a spill containment plan in the unlikely event a spill occurs into a listed fish-occupied waterbody. These spill prevention measures ensure most spills into listed fish waters are completely avoided, and proposed containment measures ensure any adverse effects on listed fishes from any construction-related chemical spills further minimized.

Twelvemile Creek, Twentymile Creek, and Thomas Creek are identified on Oregon 303(d) list of impaired waters and could have the potential to contain contaminated sediments (arsenic in Twelvemile and Twentymile Creeks and iron in Thomas Creek). Release of these contaminants during inwater construction could have acute, direct effects to Warner sucker or Modoc sucker, or could have indirect effects to these listed fishes such as altered behavior, changes in physiological processes, or changes in food sources. The BA proposes to use a dry-ditch crossing method in these three waterbodies to limit instream activity and therefore greatly minimize resuspension of any potentially contaminated sediment. As noted above, dry-ditch construction methods are more than seven times more effective than wet crossings at reducing construction-related suspended sediment. Additionally, the BA lists several additional measures that will ensure any contaminated soils are not released into these listed fish-occupied waters during Project waterbody crossings. Finally, the Service notes that Twelvemile Creek and Twentymile Creek waterbody crossings are within bedrock areas, not areas that would normally contain contaminated sediments. Additionally, the Service notes the Thomas Creek waterbody crossing is below occupied Modoc sucker habitat, so any contaminated sediments released during this waterbody crossing would not adversely affect Modoc sucker. Based on these protective construction measures, the Service does not anticipate any adverse effects to either Warner sucker or Modoc sucker from release of contaminated sediments.

The Project will control noxious weeds at listed fishes waterbody crossings using chemical, manual or mechanical weed removal methods. Herbicides and associated compounds may enter a stream through a variety of means, and, depending upon the chemical and other exposure factors, cause acute and/or chronic adverse effects to listed fish and adverse effects to food items and habitat features. No specific herbicides or application methods, including equipment and timing restrictions and application buffers, were identified in the BA for noxious weed treatments at listed fishes waterbody crossings.

The BA indicates the pipeline would be designed, installed, tested, and maintained such that the chance of a pipeline rupture, and associated impacts if it were to occur at a listed fishes waterbody crossing, would not be reasonably likely to occur. Based on these FERC commitments in the BA, and because the Service has no information contrary to FERC's information associated with the likelihood of a pipeline rupture at a waterbody crossing, the Service will not address pipeline ruptures in this BO.

Warner Sucker Critical Habitat

Warner sucker critical habitat PCEs include streams 15-60 foot wide, with gravel substrate, riffle/shoal/pool habitat, clean, unpolluted, flowing water, invertebrates for food, and stable riparian zone. Riparian vegetation will be removed from Twelvemile and Twentymile creeks during waterbody crossing activities, and other elements of critical habitat will be impacted during construction activities at these two waterbody crossings within designated Warner sucker critical habitat. A limited amount of riparian vegetation currently occurs at these two sites, and therefore serves a small, incremental benefit to the recovery function of Warner sucker critical habitat. Additionally, since both of these crossings are dominated by bedrock and large boulder substrates, any gravel substrates that do occur at these two critical habitat waterbody crossings do not provide significant recovery function for Warner sucker. Modification of PCEs including riffle/shoal/pool habitat, clean, unpolluted, flowing water, and invertebrates for food will occur to varying degrees (see sediment-related impacts to Warner sucker, above), but due to the short section of disturbed habitat at these two waterbody crossings, the adverse effects will not have a significant, adverse effect on the recovery function of these PCEs.

The Project proposes to minimize impacts to Warner sucker critical habitat by restricting temporary extra workspaces outside of the 50 foot critical habitat zone and limiting the construction right-of-way width to 115 feet. This will reduce the amount of riparian vegetation that must be removed before pipeline construction. Woody riparian vegetation will replanted after construction, and monitoring and remedial actions will ensure riparian vegetation is rapidly restored to these locations.

Removal of this limited amount of riparian vegetation, and the long-term loss of these limited riparian vegetation services until restoration was successful, would adversely affect Warner sucker critical habitat. However, these adverse effects will be minimized by the currently-limited amount of riparian vegetation at these waterbody crossings and other Project-proposed conservation measures.

Summary of Direct and Indirect Effects to Lahontan Cutthroat Trout, Warner Sucker, Modoc Sucker, Shortnose Sucker, and Lost River Sucker and Warner Sucker Critical Habitat

The Project will result in adverse effects to Lahontan cutthroat trout, Warner sucker, Modoc sucker, shortnose sucker, and Lost River sucker and Warner sucker critical habitat during and immediately following waterbody crossing activities in the action area.

The Service anticipates up to 230 adult Lahontan cutthroat trout will be killed during work site isolation, salvage, and blasting activities, an unknown number of Lahontan cutthroat trout eggs and fry will be killed within or adjacent to eight higher elevation waterbody crossings during dewatering and blasting activities, and 53,625 linear feet of Lahontan cutthroat trout habitat impacted during and immediately following construction of a total of 75 waterbody crossings connected to Lahontan cutthroat trout habitats.

The Service anticipates 25 Warner sucker will be killed during work site isolation, salvage, and blasting activities, and 5,720 linear feet of Warner sucker habitat will be impacted during and immediately after construction of a total of eight waterbody crossing in occupied and connected Warner sucker habitat.

The Service anticipates four Modoc sucker will be killed during work site isolation, salvage, and blasting activities, and 715 linear feet of Modoc sucker habitat impacted during and immediately after construction of a total of one waterbody crossing in occupied Modoc sucker habitat.

The Service anticipates 19 shortnose sucker and 19 Lost River sucker will be killed during work site isolation, salvage, and blasting activities, and 3,575 linear feet of combined shortnose sucker and Lost River sucker habitat impacted during and immediately after construction of a combined total of five waterbody crossing in overlapping occupied and connected shortnose sucker and Lost River sucker habitat.

Due to the lack of protective waterbody crossing measures identified in the BA, the Service anticipates waterbody crossings constructed in the action area will result in additional, post-construction indirect adverse effects to Lahontan cutthroat trout, Warner sucker, Modoc sucker, shortnose sucker, and Lost River sucker at each waterbody crossing, and additional, greater indirect effects propagated upstream and downstream of each waterbody crossing. These waterbody crossing-related geomorphic indirect effects are unquantifiable, but effects are anticipated to include adverse floodplain disturbance, adverse channel disturbance, adverse effects to water quality and quantity, and adverse effects to instream fish habitat.

The Project proposes to construct two waterbody crossings within designated Warner sucker critical habitat. These activities will adversely affect Warner sucker critical habitat PCEs at these two locations, but, due to the limited amounts of PCEs that will be disturbed at these two waterbody crossings, the adverse effects will not have a significant, adverse effect on the recovery function of Warner sucker critical habitat.

Loss of individual fish during work area isolation, fish salvage, and dewatering activities, as well as Project-related loss or degradation of aquatic and riparian habitat, with associated adverse effects on listed fishes, are important considerations in the range-wide survival and recovery needs of Lahontan cutthroat trout, Warner sucker, Modoc sucker, shortnose sucker, and Lost River sucker. However, while the above Project-related adverse impacts to listed fishes from waterbody crossings are significant to these listed fishes on a local scale, most of these waterbodies in the Project's action area serve only a limited role in the range-wide survival and recovery of Lahontan cutthroat trout in the Eastern GMU as well as rangewide, Warner sucker, Modoc sucker, shortnose sucker, and Lost River sucker. Additionally, at the limited number of waterbody crossings which contribute more significantly to the survival and recovery of these listed fishes (e.g., Twelvemile and Twentymile Creeks for Warner sucker and their critical habitat), existing geomorphological conditions and other Project protective measures will greatly protect and maintain these habitats' role in the range-wide survival and recovery of these ESA species.

Colorado River Fishes

The Project proposes an Upper Colorado River Basin water depletion of approximately 49.5 acre-feet of water, at pipeline MP 0.8, Hams Fork River. The Project's depletion would likely occur between August 1, 2010 and March 31, 2011. A small amount of the diverted water would evaporate; however, the majority of the water withdrawn would permeate into the local groundwater system. Endangered Colorado River fishes occupy habitats downstream of the Hams Fork River water depletion location, including sections of the Green River and Colorado River (from Ladore Canyon above the confluence with Yampa River downstream in the Green River to Colorado River above Lake Powell), and designated critical habitat reaches occur below the Project along the Green River (from the confluence with Yampa River downstream to confluence with Colorado River), and in the Colorado River (from the confluence with Green River downstream to Lake Powell).

Water depletions in the Upper Basin have been recognized as a major source of impact to endangered fish species. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required by various life stages of the endangered Colorado River fishes and to support the PCEs of these endangered fishes' designated critical habitat.

On January 21-22, 1988, the Secretary of the Department of the Interior, the Governors of Wyoming, Colorado, and Utah, and the Administrator of the Western Area Power Administration signed a Cooperative Agreement to implement the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (USFWS 1987). In 2001, the Recovery Program was extended until September 30, 2013. The objective of the Recovery Program is to recover the listed Colorado River fish species while water development continues in accordance with Federal and State laws and interstate compacts.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the Recovery Program, a section 7 Agreement (Agreement) and a Recovery Implementation Program Recovery Action Plan (RIPRAP) was developed (USFWS 1993). The Agreement establishes a framework for conducting all future section 7 consultations on depletion impacts related to new projects and all impacts associated with historic projects in the Upper Basin.

Procedures outlined in the Agreement are used to determine if sufficient progress is being accomplished in the recovery of the endangered fishes to enable the Recovery Program to serve as a reasonable and prudent alternative (RPA) to avoid jeopardy. The RIPRAP was finalized on October 15, 1993, and has been reviewed and updated annually.

On July 5, 1994, and amended on December 6, 1994, we completed an intra-Service biological opinion that exempted the depletion fee for projects depleting 100 acre-feet or less (small water depletions). We amended or revised the small water depletion biological opinion in 1995, 1997, 2000, 2002, and 2010. As of March 31, 2010, 719 small water depletion projects have depleted a cumulative total of 9,731 acre-feet. The 2010 biological opinion increased the cap to 12,000 acre-feet and allowed us to continue to exempt small depletions of 100 acre-feet or less up to a cumulative total of an additional 4,500 acre-feet.

The Service annually assesses progress of the implementation of recovery actions to determine if progress toward recovery has been sufficient for the Recovery Program to serve as Conservation Measures (formally the Reasonable and Prudent Alternative) for projects that deplete water from the Upper Colorado River Basin. In the last review, the Service determined that the Program has made sufficient progress to offset the adverse effects that occur to the Colorado River fishes and critical habitats within the Upper Colorado River Basin from individual water depletions projects up to 4,500 acre-feet/year (Service 2009c).

The following provides the Service's analysis of adverse effects from the Project's 49.5 acre-foot depletion to listed Colorado River fish and critical habitat.

Effects to Colorado River Fishes

In the programmatic small water depletions biological opinion, the Service determined that individual projects with either a new or historic average annual water depletion of 100 acre-feet or less up to a cumulative total of an additional 4,500 acre-feet in the Upper Basin may adversely affect Colorado pikeminnow, razorback sucker, bonytail chub, and humpback chub. In general, the proposed action would adversely affect the four listed fish by reducing the amount of water available to them, increasing the likelihood of water quality issues, increasing their vulnerability to predation, and reducing their breeding opportunities by shrinking the amount of breeding habitat within their ranges.

A natural hydrological regime creates and maintains important fish habitats, such as spawning habitats, reduces the likelihood of adverse water quality issues, and decreases vulnerability of endangered species to predation. Generally, water depletions result in reduction of available habitats will affect individuals of all four Colorado River species by decreasing reproductive potential and foraging and sheltering opportunities. Many of the habitats required for Colorado River fishes' breeding become severely diminished when flows are reduced. As a result, individual fish may not be able to find a place to breed or will deposit eggs in less than optimal habitats more prone to failure or predation. In addition, reduction in flow rates lessens the ability of a river to inundate bottomlands and floodplains, a source of nutrient supply for fish productivity. Water depletions also exacerbate competition and predation on endangered fish by nonnative fishes by altering flow and temperature regimes toward conditions that favor nonnatives. For these reasons, the Service considers all water depletions in the upper Colorado River basin, regardless of volume, timing, or duration, to adversely affect Colorado River fishes.

Removing 49.5 acre-feet of water from the Ham's Fork River over one year would cause some minor changes in the natural hydrological regime downstream in Colorado River fishes' occupied habitats in the Green River and Colorado River, with resultant adverse effects to water quality, physical habitats, and biological environments that support Colorado River fishes.

The proposed Project depletion adversely affects water quality in the action area by causing a minor reduction in the river's natural dilution potential, and resulting in a small increase in concentrations of heavy metals, selenium, salts, pesticides, and other contaminants in the action area. Project-related concentrating of selenium in the action area is of particular concern to the Service due to selenium's adverse effects on fish reproduction and its tendency to concentrate in low velocity areas that are important habitats for Colorado pikeminnow and razorback suckers. However, the resultant minor increase in contaminant concentrations in the Green River and Colorado River would likely not result in a measurable increase in the bioaccumulation of these contaminants in the food chain, and therefore ultimately have an immeasurable impact on the Colorado River fishes.

The proposed Project also would adversely affect the physical condition of habitat for the four listed Colorado River fishes by reducing water volume during the fall and winter period, when annual river flows are naturally lowest. Any flow reductions during this period will have greater relative ability to reduce the availability of physical habitats than other seasons where more flow is naturally available. However, due to the small depletion volume that is spread over the fall and winter, these Project-related flow depletions will have a minor impact on sufficient quantity or quality of Colorado River fishes' physical habitats.

The Project's depletion and corresponding reduction in flow would adversely affect the biological environment in the Green River and Colorado River. Reduced flows contribute to endangered fishes' habitat alteration, including altered water temperatures, sediment levels, and modified habitat conditions. Modified Colorado River fishes' habitat conditions have encouraged the establishment and expansion of nonnative fishes. Increases in nonnative fish populations and distribution has resulted in increased competition with and predation on Colorado River fishes. However, due to the small volume depleted over fall and winter from the upper Green River, these Project-related flow depletions will have a minor impact on Colorado River fishes' biological environment.

The Service notes that the Project's relatively minor 49.5 acre-foot depletion, removed from the Ham's Fork River over the fall and winter of an entire construction season, will spread the 49.5 acre-foot depletion over a long period of time, and reduce adverse effects to endangered fish. Additionally, the Project's depletions will occur above a major water storage project (Flaming Gorge reservoir and dam), and operations of this water storage feature will additionally mute any Project depletion-related adverse effects to Colorado River fishes. For these reasons, and the additional reasons provided above, the Service has determined these Project depletions will have a minor, but still adverse, effect on Colorado River fishes. The effects of the proposed depletion are consistent with and tier to the small water depletions biological opinion.

Effects to Colorado River Fishes Critical Habitat

All four of the listed Colorado River fishes require the same PCEs essential for their survival. Therefore, we are combining our analysis of effects to critical habitat for all four Colorado River fishes into one section. Because the amount of designated critical habitat varies for each of the four species, the amount of habitat will vary; however, the effects would be the same for all critical habitats within the action area.

The programmatic small water depletions biological opinion identifies water, physical habitat, and the biological environment as PCEs of critical habitat. This includes a quantity of water of sufficient quality that is delivered to specific habitats in accordance with a hydrologic regime that is required for the particular life stage for the species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other rearing habitats are included. Food supply, predation, and competition are important elements of the biological environment.

Primary Constituent Element – Water. The Project's 49.5 acre-foot depletion would affect the water PCE of critical habitat for the four listed Colorado River fishes. Removing water from the upper Green River system changes the natural hydrological regime that creates and maintains important fish habitats, such as spawning habitats, and reduces the frequency and duration of availability of these habitats of the four endangered fish. In addition, reduction in flow rates lessens the ability of the river to inundate bottomland, a source of nutrient supply for fish productivity and important nursery habitat for razorback sucker. Water depletions change flow and temperature regimes toward conditions that favor nonnative fish, thus adding to pressures of competition and predation by these nonnative fishes as discussed above. Increases in water depletions will cause associated reductions in assimilative capacity and dilution potential for any contaminants that enter critical habitat in the Green River and Colorado River. However, since the Project's 49.5 acre-foot depletion would occur only once over a several month period in the fall and winter, the depletion will not occur directly in critical habitat, and there is a large water storage facility between the depletion and designated critical habitat, adverse effects to the water PCE of critical habitat within the action area will be minor.

Primary Constituent Element - Physical Habitat. The Project's 49.5 acre-foot depletion would affect the physical habitat PCE of critical habitat for the four Colorado River listed fishes. Adequate summer and winter flows are important for providing a sufficient quantity of preferred habitats for a duration and at a frequency necessary to support all life stages of viable populations of all endangered fishes. However, because the Project's 49.5 acre-foot depletion would occur only once over a several month period in the fall and winter, the depletion will not occur directly in critical habitat, and there is a large water storage facility between the depletion and designated critical habitat, minor adverse effects to the physical habitat PCE of critical habitat within the action area will occur.

Primary Constituent Element - Biological Environment. The Project's 49.5 acre-foot depletion would affect the biological environment PCE of critical habitat for the four Colorado River listed fishes. Reduced flows contribute to habitat alteration, allowing for an increase in nonnative fish populations in the action area, and with increased competition with and predation on listed Colorado River fishes. However, because the Project's 49.5 acre-foot depletion would occur only once over a several month period in the fall and winter, the depletion will not occur directly in critical habitat, and there is a large water storage facility between the depletion and designated critical habitat, minor adverse effects to the biological environment PCE of critical habitat within the action area will occur.

Based on the above analysis, a depletion of 49.5 acre-feet for one year would cause minor, but still adverse, effects to the water, physical habitat, and biological environment PCEs of designated critical habitat reaches for Colorado River fishes in the Green River and Colorado River. The Service anticipates these minor adverse effects to Colorado River fishes designated critical habitat from Project water depletions will not influence the recovery role of these critical habitat reaches. The effects of the proposed depletion are consistent with and tier to the small water depletions biological opinion.

Cumulative Effects

'Cumulative effects' are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Cumulative effects that reduce the ability of a listed species to meet its biological requirements may increase the likelihood that the proposed action will result in jeopardy to that listed species or in destruction or adverse modification of designated critical habitat. The following sections describe the other cumulative effects likely to occur in the Project's action area.

Lahontan Cutthroat Trout, Warner Sucker, Modoc Sucker, Shortnose Sucker, and Lost River Sucker

The BA provided a brief analysis of reasonably foreseeable projects in the action area, based on input from federal agencies, county planning and zoning departments crossed by the project, and by other entities during FERC's NEPA review process for the Project. The majority of the reasonably foreseeable projects reviewed by FERC were federal projects that will be reviewed through separate ESA consultations, and therefore are not included in FERC's cumulative effects review. A single reasonably foreseeable project, consisting of a habitat restoration project on retired ranch land in the Willow Creek watershed in Elko County, Nevada, was identified in the BA as a project that had potential for beneficial cumulative effects to Lahontan cutthroat trout.

Recreation is a common private activity that is likely to occur in the action area. Although state and federal resource management agencies manage recreational activities in the action area to some degree (*i.e.*, campgrounds, trailheads, OHV trails, access for angling), a considerable amount of dispersed, unmanaged recreation occurs on both federal and nonfederal lands. Expected impacts to listed fishes from this type of unmanaged recreation include minor increases in turbidity and sedimentation, impacts to water quality, short-term barriers to fish movement, and minor changes to riparian and inwater habitat structures. Streambanks, riparian vegetation, and spawning and rearing areas can be disturbed wherever human use is concentrated.

Livestock grazing is likely to occur in the action area along private land waterbodies, and, depending upon livestock management strategy and consistency of application, can result in improved riparian and inwater habitat conditions, or continued suppression of woody and herbaceous riparian vegetation, unstable stream banks, increased sediment delivery to the waterbody, and reductions in aquatic and riparian habitat quality.

Water diversion from waterbodies on private land is likely to continue occuring in the action area. Current water diversions have reduced downstream flows and created fish passage barriers. Adverse effects from reduced flows and fish passage barriers in streams was discussed above; the Service anticipates these types of adverse effects to listed fishes from reduced flows would be similar when reduced flows occur in the future from private activities.

Mining and associated dewatering are anticipated to continue occurring in portions of the Lahontan cutthroat trout action area, especially in North Fork Humboldt and Maggie Creek subbasins. Mining will impact riparian, stream bank, and stream bed conditions, and associated dewatering will impact fish habitat and fish passage.

Recreational fishing within the action area is expected to continue, as regulated by state wildlife management agencies and tribes. In Nevada and Oregon it is expected that legal and illegal angling activities will contribute to a limited lethal harvest of Lahontan cutthroat trout and the ESA-listed sucker species in this BO. The level of lethal harvest is expected to remain at relatively low levels.

Ruby Pipeline LLC has voluntarily committed to fund several conservation actions in the action area that, when implemented in the future, would be beneficial to listed fishes and their habitats, and that will eventually contribute to the conservation and recovery of these fishes. As noted in the Description of Proposed Action section, while Ruby has committed to implementing the following voluntary ESA conservation commitments, and the FERC certificate Condition 1 will require the implementation of these conservation actions, FERC did not propose Ruby's voluntary Endangered Species Conservation Action Plan conservation commitments as part of the BA's proposed action. The Service considers these voluntary conservation actions to be reasonably certain to occur, to be implemented by Ruby in the future, and therefore analyzes their effects herein this Cumulative Effects section of the BO. To the extent that these future conservation actions will cause adverse effect and/or take to a listed species, a separate consultation and/or permitting may be necessary.

1) Ruby Pipeline LLC will voluntarily fund or partially fund four Lahontan cutthroat trout conservation projects. The following is a brief description of each conservation action:
    a. Marys River Diversion Replacement - Ruby Pipeline LLC will contribute funding for replacement of one irrigation diversion that currently prevents fish passage and causes entrainment of Lahontan cutthroat trout into irrigated fields. This diversion would be replaced with a structure that would allow for upstream Lahontan cutthroat trout passage and prevent any loss of Lahontan cutthroat trout due to entrainment.

   b. North Fork Humboldt River Barrier – Ruby Pipeline LLC will contribute to funding the construction of a fish migration barrier on the upper North Fork Humboldt River to protect a population of Lahontan cutthroat trout from invasive non-native trout.
   c. Willow Creek Restoration Projects – Ruby Pipeline LLC will contribute to funding for stream habitat restoration and improvement work on Rock and Willow creeks that would allow for an eventual increase in Lahontan cutthroat trout occupied stream miles.
   d. Happy Creek Diversion Screen – Ruby Pipeline LLC will contribute to funding the installation of a fish screen on a private landowner water diversion to prevent Lahontan cutthroat trout from becoming entrained. Ruby Pipeline LLC would also contribute funds towards reintroduction of Lahontan cutthroat trout.
2) Ruby Pipeline LLC will voluntarily fund or partially fund three conservation projects for Warner sucker. The following is a brief description of each conservation action:
   a. Warner Sucker Spawning and Rearing Habitat Investigations – Ruby Pipeline LLC will contribute funds that enable continued research and monitoring efforts for Warner sucker populations. Continued monitoring of Warner sucker populations is necessary to track the species' status and distribution in the Warner Basin, including as fish passage structures are modified to improve fish passage connectivity in the Warner Basin.
   b. Dyke Diversion Passage and Screening – Ruby Pipeline LLC will contribute funding for the construction of fish passage and fish screening features on the Dyke Diversion dam on Twelvemile Creek. Fish passage would allow Warner sucker to access additional upstream habitats, and fish screening would ensure entrainment of downstream migrating fish did not occur.
   c. Deep Creek Passage and Screening - Ruby Pipeline LLC will contribute funding for the construction of fish passage and fish screening on the Deep Creek Diversion dam. Fish passage would allow Warner sucker to access additional upstream habitats, and fish screening would ensure entrainment of downstream migrating fish did not occur.
3) Ruby Pipeline LLC will voluntarily fund or partially fund one conservation project for Modoc sucker. The following is a brief description of the conservation action:
   a. Thomas Creek Road Reconstruction – Ruby Pipeline LLC will voluntarily contribute to fund portions of the reconstruction and improvement to Road 28 along Thomas Creek. Forest Road 28 is adjacent to Thomas Creek, the only water body occupied by Modoc sucker in Oregon. This will provide an opportunity to reduce road impacts to Thomas Creek, which include sedimentation. Reduced sedimentation from road improvement will benefit spawning and rearing habitats for Modoc sucker.

4) Ruby Pipeline LLC will voluntarily fund or partially fund three projects for both shortnose sucker and Lost River sucker. The following is a brief description of each conservation action:
    a. Big Springs Fish Passage Evaluation – Ruby Pipeline LLC will contribute funds to evaluate the effectiveness of the existing Big Springs Fish Passage project and make any necessary improvements to encourage voluntary use of the fish ladder by shortnose sucker and Lost River sucker.
    b. Upper Lost River Basin Sucker Distribution Evaluation – Ruby Pipeline LLC will contribute funds to complete an evaluation of shortnose sucker and Lost River sucker distributions within the upper Lost River Basin. This contemporary, basin-wide status and distribution survey for shortnose sucker and Lost River sucker would be beneficial for informing final designation of critical habitat as well as recovery planning for these two listed fishes.
    c. Upper Lost River Basin Fish Passage Improvement – Ruby Pipeline LLC will contribute funds to identify the location of fish passage barriers in the upper Lost River Basin. For each barrier, fish passage feasibility will be assessed. Eventually providing fish passage in the Upper Lost River Basin will help with recovery efforts for both shortnose sucker and Lost River sucker.

When considered together, these cumulative effects from nonfederal activities are likely to have both negative and positive effects on listed fish population abundance, productivity, and spatial structure in the action area. The Service anticipates the nonfederal activities identified above that cause negative effects will continue to suppress instream and riparian habitats in certain areas, and restrict listed fish abundance and distribution in those areas. However, based on the limited role of the action area on the survival and recovery of each of these listed fish, these negative cumulative effects in the action area will have minimal negative influence on the survival and recovery of each of these fish species. The Service also anticipates the nonfederal actions identified above that result in positive effects will expand listed fishes' distributions, improve knowledge of fish needs and occurrences, and provide additional protection from entrainment-related mortality. From the standpoint of species survival and recovery, many of the beneficial conservation actions will have significant survival and recovery benefit to individual species, especially for Lahontan cutthroat trout and Warner sucker, which will eventually experience significant enhancement of habitat connectivity in the action area.

Warner Sucker Critical Habitat

Warner sucker critical habitat occurs on both federal and nonfederal lands in the action area. Nonfederal activities discussed above that adversely affect Warner sucker will also have adverse effects on the PCEs of Warner sucker critical habitat, including recreational activities, livestock grazing, and water diversions that will continue to suppress and degrade riparian zones and reduce amount and connectivity of flowing water. Projects to remove passage barriers and improve knowledge about status of Warner sucker will have beneficial effects on the PCEs of Warner sucker critical habitat. These cumulative effects on Warner sucker critical habitat in the action will have both a negative and, in the case of passage barrier removal, will have a substantially positive influence on the recovery function of the PCEs of Warner sucker critical habitat.

Colorado River Fishes

Reasonably foreseeable future activities that may adversely affect Colorado River fishes and their critical habitat in the action area include oil and gas exploration and development, irrigation and other water depletions not associated with the Recovery Program, urban development, industrial development, and recreational activities such as angling. Implementation of these activities and projects may adversely affect water quantity and quality, and have adverse effects on Colorado River fishes and their critical habitat, and have a negative influence on the recovery role of the affected critical habitat reaches.

Cumulative effects to the Colorado River endangered fishes in the action area would likely include the following types of impacts:

- Changes in land use patterns that would remove or further fragment Colorado River fishes' habitat or designated critical habitat;
- Shoreline recreational activities and encroachment of human development that would remove upland or riparian/wetland vegetation and degrade water quality;
- Increased competition with, and predation by, exotic fish species introduced by anglers or other sources;
- Water depletions for various non-federal activities, including the construction of ponds, reservoirs, ditches, and water diversion structures for activities such as irrigation, stock watering, power production, municipal use, and industrial needs.

Cumulative effects to the designated critical habitat for Colorado River endangered fishes in the action area would likely include the following types of impacts:

- Changes in land use patterns that would remove or further fragment Colorado River fishes' habitat would adversely affect the physical habitat PCE for the four Colorado River listed fish;
- Shoreline recreational activities and encroachment of human development that would remove upland or riparian/wetland vegetation and degrade water quality would adversely affect the water quality and physical habitat PCEs for the four Colorado River listed fish;
- Increased competition with, and predation by, exotic fish species introduced by anglers or other sources would adversely affect the biological environment PCE for the four Colorado River listed fish;
- Water depletions for various non-federal activities, including the construction of ponds, reservoirs, ditches, and water diversion structures for activities such as irrigation, stock watering, power production, municipal use, and industrial needs would adversely affect the water, physical habitat, and biological environment PCEs for the four Colorado River listed fish.

Ruby Pipeline LLC has voluntarily committed to fund a conservation action in the action area that, when implemented in the future, would be beneficial to Colorado River fishes and their concludes that the Project's limited adverse effects will not result in an appreciable reduction in the survival and recovery of Lahontan cutthroat trout.

Warner Sucker and Critical Habitat

The Project will cross two occupied Warner sucker streams that also contain designated Warner sucker critical habitat. The Project will also cross three additional streams with connectivity to occupied Warner sucker habitat and designated Warner sucker critical habitat. The Service anticipates 25 Warner sucker will be killed during work site isolation and other construction activities, and 5,720 linear feet of Warner sucker habitat will be impacted during and immediately after construction of a total of eight waterbody crossings of intermittent and perennial streams in occupied and connected Warner sucker habitat. Limited amounts of PCEs of Warner sucker critical habitat occur at the two designated critical habitat waterbody crossings and a limited amount of riparian vegetation and other components of critical habitat that currently occur at these two waterbody crossing sites will be removed or altered.

Project-related loss or degradation of aquatic and riparian habitat, in addition to future nonfederal activities, will have adverse effects to Warner sucker, and are important considerations in the range-wide survival and recovery needs of this species. However, at the two occupied waterbody crossings (Twelvemile and Twentymile Creeks), existing geomorphological conditions and other Project protective measures will minimize adverse effects to critical habitat to the extent that the role of the affected habitat relative to the intended recovery function of the affected critical habitat (which is to support, in part, a viable population of the Warner sucker) is likely to be maintained. Additionally, certain nonfederal actions are likely to occur in the action area that are anticipated to contribute to the recovery of Warner sucker and will have a beneficial effect to Warner sucker and its designated critical habitat in the action area as well as rangewide by improving habitat access and connectivity. For those reasons, the Service concludes that the Project's limited adverse effects will not result in an appreciable reduction in the survival and recovery of Warner sucker, and will not appreciably reduce the recovery function of its critical habitat at the action area and rangewide scales.

Modoc Sucker

The Project will cross a single waterbody with occupied Modoc sucker habitat, but the crossing will occur downstream of normal areas of habitat occupancy by this species in Thomas Creek. The Service anticipates four Modoc sucker will be killed during work site isolation and construction activities, and 715 linear feet of Modoc sucker habitat impacted during and immediately after construction of one waterbody crossing in occupied Modoc sucker habitat.

These limited mortalities and habitat impacts will affect a minor component of the Modoc sucker population within the action area, and are not likely to permanently reduce the viability of this population or that of the rangewide Modoc sucker population. For those reasons, the Service concludes the proposed Project is not likely to appreciably reduce the likelihood of survival and recovery of the Modoc sucker at the rangewide scale.

critical habitats, and that will eventually provide a minor contribution to the conservation and recovery of these species.

l) Ruby Pipeline LLC will voluntarily fund a Water Conservation and Enhancement of Riparian Habitat project in the Green River Basin. This commitment will contribute to water conservation and riparian habitat enhancement by supporting initiatives to eradicate the non-native shrub, *Tamarix* spp. in the Green River basin, while restoring native riparian vegetation along select tributaries.

CONCLUSION

After reviewing the current status of Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, shortnose sucker, Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub, and designated critical habitat for Warner sucker, Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub, the environmental baseline for these listed fishes and their designated critical habitats within the action area, the effects of the proposed action, and cumulative effects, it is the Service's biological opinion concludes that the Project is not likely to jeopardize the continued existence of Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, shortnose sucker, Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub, or adversely modify or destroy designated critical habitat for Warner sucker, Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub. The Service reached these conclusions for the following reasons.

Lahontan Cutthroat Trout

The Project has carefully sited its numerous waterbody crossings to avoid known occupied Lahontan cutthroat trout habitats. Avoidance of known occupied Lahontan cutthroat trout habitat reduces the Project's potential for direct adverse impacts to Lahontan cutthroat trout and its habitats. However, the Service has determined that 75 Project waterbody crossings at perennial and intermittent streams are connected, either biologically or geomorphologically, to occupied Lahontan cutthroat trout habitat, and there is likelihood that Lahontan cutthroat trout could be at these waterbodies at the time of construction. At these 75 connected waterbody crossing sites the Service anticipates up to 230 Lahontan cutthroat trout will be killed and 53,625 linear feet of Lahontan cutthroat trout habitat impacted during and immediately following construction of these 75 waterbody crossings.

The Project's action area contains a limited number of habitats occupied by limited numbers of Lahontan cutthroat trout. At the Eastern GMU as well as rangewide scales, these limited Lahontan cutthroat trout mortalities in the action area represent a very small component of the Lahontan cutthroat trout's population or habitat. The Lahontan cutthroat trout and habitats impacted by the proposed Project contribute a minor role in the viability of the Eastern GMU as well as in the range-wide survival and recovery needs of Lahontan cutthroat trout. Certain nonfederal actions identified in the Cumulative Effects section are anticipated to contribute to the recovery of Lahontan cutthroat trout and will have a beneficial effect to Lahontan cutthroat trout in the action area, in the Eastern GMU, as well as rangewide. For these reasons, the Service

INCIDENTAL TAKE STATEMENT

Introduction

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the action agencies so that they become binding conditions of any grant or permit issued to any applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The action agencies have a continuing duty to regulate the activities covered by this Incidental Take Statement. If the action agencies (1) fail to assume and implement the terms and conditions or (2) fail to require cooperators to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the action agencies must report the progress of the action and its impact on the species to the Service as specified in this Incidental Take Statement. [50 CFR §402.14(i)(3)]

This Incidental Take Statement consists of two sections. The first section addresses Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker. The second section addresses Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub.

Lahontan Cutthroat Trout, Warner Sucker, Modoc Sucker, Lost River Sucker, and Shortnose Sucker

Amount or Extent of Take Anticipated

The Service anticipates that activities associated with the Project's proposed action are reasonably certain to result in incidental take of Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker. Incidental take to Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker, in the forms of harm and mortality, would occur because of adverse effects from Project waterbody crossings. Waterbody crossing work site isolation, fish salvage, and blasting may cause direct mortality of Lahontan

Lost River Sucker and Shortnose Sucker

The Project will cross three occupied Lost River sucker and shortnose sucker streams. At one of these waterbody crossings, the Lost River, the Project will construct in occupied Lost River sucker and shortnose sucker habitat using a dry-trench method with blasting. The Project will also cross two additional streams with connectivity to occupied Lost River sucker and shortnose sucker habitat. The Service anticipates 19 shortnose sucker and 19 Lost River sucker will be killed during work site isolation and construction activities, and 3,575 linear feet of combined shortnose sucker and Lost River sucker habitat impacted during and immediately after construction of a combined total of five waterbody crossing in overlapping occupied and connected shortnose sucker and Lost River sucker habitat.

Project-related loss or degradation of aquatic and riparian habitat and the killing of 19 shortnose sucker and 19 Lost River sucker represent a minor component of the Lost River sucker and shortnose sucker populations and their habitat within the action area and an even smaller component of the Lost River sucker and shortnose sucker populations and their habitat across the range of these species. For these reasons, the proposed Project is not likely to permanently reduce the viability of Lost River sucker and shortnose sucker populations at the action area or rangewide scales. For those reasons, the Service concludes the proposed Project is not likely to cause an appreciable reduction in the survival and recovery of Lost River sucker and shortnose sucker.

Colorado River Fishes and Critical Habitat

The Project's water depletion amount (49.5 acre-feet) over several months of one construction season is a minor reduction in flow in downstream habitats of the Green and Colorado Rivers occupied by ESA-listed Colorado River fishes, and will have adverse, yet minor impact to these listed fishes and to the PCEs of designated critical habitat in various designated critical habitat reaches of the Green and Colorado Rivers.

Although the programmatic small water depletions biological opinion states that small depletions cause an adverse impact, the experience of the Service since implementation of the Recovery Program has shown that the individual depletions in and of themselves cause minimal impact because of their size and scattered locations. Additionally, the Service has determined that sufficient progress is currently being accomplished in the recovery of the Colorado River fishes, thereby improving the status of the listed Colorado River fishes and their critical habitat, and allowing for the continued exemption of depletion fees for projects that deplete 100 acre-feet or less from the Upper Basin. The Recovery Program's sufficient progress assists in offsetting the minor Project adverse effects on the Colorado River fishes and their critical habitat. For those reasons, the Service concludes the proposed action is not likely to appreciably reduce the survival and recovery of the listed Colorado River fishes or adversely modify or destroy their critical habitat.

cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker. Waterbody crossing-related riparian, stream bank and streambed habitat alterations will harm Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker. As described in the BO, above, incidental take from habitat alterations cannot reasonably be quantified in terms of individuals of the affected listed species. Instead, in the accompanying BO, the Service describes how linear feet of stream habitat is an appropriate surrogate for quantifying take of individuals of the affected listed species. In the accompanying BO, the Service determined that this level of anticipated take of Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker is not likely to result in jeopardy to any of these species. The extent of the take is limited to Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker within the action area.

The following levels of incidental take in the form of mortality to Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker are anticipated from waterbody crossing work site isolation, fish salvage, inwater equipment operation, and blasting activities (from Table 6).

Species	Isolation/Salvage	Blasting	Total
Warner sucker	16	9	25
Modoc sucker	2	2	4
Lost River sucker	10	9	19
shortnose sucker	10	9	19
Lahontan cutthroat trout (adult)	150	80	230
Lahontan cutthroat trout (eggs and fry)	All eggs and fry within 10 higher-elevation waterbody crossings. Mortality per stream limited to the 115 ft wide work area.	All eggs and fry within and adjacent to 8 higher-elevation waterbody crossings. Mortality limited to areas 200 feet upstream and downstream from the isolated work area.	All eggs and fry within/adjacent to higher-elevation waterbody crossings.

The following levels of incidental take in the form of harm to Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker are anticipated from waterbody crossing-related riparian, stream bank and streambed habitat alterations (from Table 7).

Species	Occupied	Connected	Total
Warner sucker	1,430 ft	4,290 ft	5,720 ft
Modoc sucker	715 ft	n/a	715 ft
Lost River sucker and shortnose sucker	2,145 ft	1,430 ft	3,575 ft
Lahontan cutthroat trout	n/a	53,625 ft	53,625 ft

Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of incidental take of Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker resulting caused by the proposed Project. In order to monitor the impacts of incidental take, FERC or Ruby must report the progress of the action and its impact on Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker to the Service as specified below. The reporting requirements are established in accordance with 50 CFR 13.45 and 18.27 and 50 CFR 220.45.

The FERC shall require Ruby to implement the following measures:

Reasonable and Prudent Measure 1. Reduce direct mortality impacts to listed fishes by implementing protective fish exclusion, work site isolation, and fish salvage measures at waterbody crossings with perennial or intermittent flow.

Reasonable and Prudent Measure 2. Reduce harm to listed fishes from indirect habitat impacts by implementing site-specific waterbody crossing assessment, protective measures, restoration actions, and monitoring at all waterbody crossings.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, FERC and/or Ruby, including contractors and subcontractors, must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

Term and Condition 1.1 At waterbody crossings involving trenching identified in Tables 1, 2, 3, and 4, in streams with perennial or intermittent flows, utilize a dry-ditch method with work site isolation, fish salvage, and flumed fish passage. Flumed passage would not be required in intermittent streams. Unless Oregon or Nevada fish and wildlife agency fish salvage requirements are more restrictive, use the following fish salvage sequence:

a. install block nets outside of location of coffer dam placement;
b. under direction of a qualified fish biologist, conduct initial fish salvage pass;
c. attempt to keep block nets in place during subsequent placement of coffer dams;
d. install fish screening per ODFW small pump screen or more protective standards (approach velocity, screen material open area, screen opening size, and wetted screen area) at pump intakes to ensure fish are not impinged on screens or entrained into the water diversion system. If passive pump screen is used, water approach velocity at screen must be 0.2 feet per second or less; and
e. under direction of a qualified fish biologist, conduct a second salvage pass of dewatered area after coffer dams are set in place and water has been almost pumped out.

Term and Condition 1.2 At waterbody crossings identified in Tables 1, 2, 3, and 4, where blasting is used in streams with intermittent or perennial flows:

a. Do not blast in Lahontan cutthroat trout streams until after July 15;
b. Utilize a dry-trench method with work site isolation and fish salvage;
c. Prior and during blasting, install and maintain block nets outside of coffer dams to reduce number of fish adjacent to blast area;
d. Relocate salvaged fish to a location sufficient distance away from blast site to ensure no additional blast-related injury or mortality occurs to salvaged fish;
e. Use time-delay detonation to reduce the overall detonation impact to fish when multiple charges are required; and
f. Subdivide large charges into a series of smaller detonations to reduce overall detonation impact to fish.

Term and Condition 1.3 At waterbody crossings identified in Tables 1, 2, 3, and 4, in streams with intermittent or perennial flows, implement the following allowable inwater work windows for all inwater phases of waterbody crossing construction.

a. For Lahontan cutthroat trout = July 1-Dec 31;
b. For Warner sucker = July 15-Sept 30;
c. For Modoc sucker = July 15-Sept 30;
d. For Lost River sucker and shortnose sucker = July 1-Jan 31; except
e. October 15-January 31 for Lost River sucker and shortnose sucker at the Lost River waterbody crossing.

Term and Condition 1.4 At waterbody crossings identified in Tables 1, 2, 3, and 4, where vegetation clearing equipment will cross streams with intermittent or perennial flows before a temporary construction bridge is installed:

a. Comply with appropriate inwater work windows; and
b. Employ fish exclusion methods prior to crossing each waterbody.

Term and Condition 2.1 Develop a Service-approved waterbody crossing plan (Waterbody Plan) applicable to waterbody crossings identified in tables 1, 2, 3, and 4, but excluding those ephemeral streams where Ruby's analysis indicates these streams do not have ability to transport sediment (see Waterbody Plan subsection 3.2, below). The Waterbody Plan should describe the Project's process to collect and analyze data, design waterbody crossings based on risk, and how the Project will implement, restore, and monitor the waterbody crossings. Recommended sections of the Waterbody Plan are identified below. Implementation of the Service-approved Waterbody Plan before, during, and after Project construction at waterbodies identified in Tables 1, 2, 3, and 4 will ensure that adverse impacts to listed species from Project waterbody crossings are minimized.

1. Introduction
    1.1. Project description
2. Waterbody Crossing Data
    2.1. List of stream data attributes
    2.2. Excluded waterbodies
    2.3. Data collection methods, quality, and resolution

2.4. Data storage and retrieval process
3. Waterbody Crossing Risk Assessment
   3.1. Risk assessment results summary
   3.2. Ephemeral channel exclusion analysis
   3.3. HDD streams
   3.4. Fish passage streams
4. Design Approach by Risk Category
   4.1. Low Risk -- prescriptive design
   4.2. Moderate Risk – design by stream and/or crossing type
   4.3. High Risk – individual analysis and design
5. Implementation
   5.1. Pre-construction waterbody crossing surveys methodology
   5.2. Construction methodology
   5.3. General site restoration
   5.4. Implementation/compliance monitoring
6. Effectiveness Monitoring
   6.1. Random sampling plan for Low Risk streams
   6.2. Stratified random sampling plan for Moderate Risk streams
   6.3. Sampling plan for High Risk streams
7. Summary and Conclusions
8. References
9. List of Figures
10. List of Tables
11. Appendices

Term and Condition 2.2 Implement the following additional actions associated with the Waterbody Plan for sites identified in tables 1, 2, 3, and 4.

a. Any Waterbody Plan site specific data collection that is deferred until just prior to an individual waterbody crossing construction action shall be completed before any vegetation clearing equipment is allowed to cross that waterbody crossing;
b. The Project Environmental Inspector (EI) shall be assisted by a qualified stream restoration technical expert during streambed, streambank, and upslope restoration activities;
c. The Project's riparian, stream bank, and stream bed restoration contractor must be experienced and qualified to implement riparian and aquatic restoration activities at Project waterbody crossings;
d. Herbicides may not be used for treating noxious weeds within ESA streams;
e. Minimize loss of riparian habitat in work zone to the extent possible by cutting, not grubbing, riparian vegetation;
f. Do not use temporary culverts or other stream bed or floodplain fill as part of a temporary equipment bridge.
g. Specific measures shall be employed and monitored to ensure sediment does not build up on temporary construction bridges and minimizes entry into adjacent waterbodies;
h. Place impermeable seal on fractured rock after blasting to minimize water loss;
i. No bank hardening methods (e.g., rip rap and gabion baskets) will be used;

j. No chemical soil stabilizers should be added to banks or adjacent slopes during any phase of Project construction or restoration.

Term and Condition 2.3 For any stream on tables 1, 2, 3, and 4 where more than one waterbody crossing of the same stream or stream/tributary complex occurs within a short distance, determine feasibility of moving some or all of a closely spaced set of waterbody crossings to a primarily upland location or use HDD method to span these multiple, closely spaced waterbody crossings. If feasible, implement measures to reduce number of closely spaced waterbody crossings within one reach of stream or stream/tributary complex.

Term and Condition 2.4 The following activities shall be implemented at all access road crossings of waterbodies.

a. No upgrades of existing road crossings over waterbodies;
b. Use a spanning structure over floodplain and stream. Do not use any fill in the floodplain or the stream;

Term and Condition 2.5 Ruby shall identify all locations in the action area where the pipeline will cross a floodplain but not associated waterbody, and develop a Service-approved plan to minimize floodplain impacts at these sites.

Term and Condition 3 Prior to construction, Ruby shall design, in coordination with and under approval of the Service, and implement a waterbody crossing-associated activities monitoring and reporting plan (Monitoring Plan) addressing each species that a take exemption is provided for. The purpose of the Monitoring Plan is to document the impacts of incidental take and to provide information basis to the Service regarding any reinitiation of consultation based on exceedance of incidental take. If monitoring indicates exceedance of any incidental take, any operations causing such take must be stopped until the Service determines if reinitiation is appropriate. The following shall be components and commitments of the Monitoring Plan:

a. Employ trained monitors to ensure all protective measures identified in the Proposed Action section or in the above Terms and Conditions are (as appropriate) in place or implemented before, during, and after waterbody crossing activities commence;
b. Trained monitors also shall implement the following monitoring and reporting actions:
    i. Document and report number of fish successfully handled and killed associated with salvage, dewatering, and blasting activities;
    ii. Document and report compliance with inwater construction activities staying within the maximum allowable waterbody crossing widths;
    iii. Document and report any excessive sediment deposition events greater than 715 feet below the downstream edge of each waterbody crossing;
c. Implement and report all monitoring (implementation and effectiveness) results associated with the Service-approved Waterbody Crossing Plan identified in Term and Condition 2.1.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take of Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, and shortnose sucker caused by the proposed action. If, during the course of the action, the level of incidental take for Lahontan cutthroat trout, Warner sucker, Modoc sucker, Lost River sucker, or shortnose sucker is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. FERC must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Colorado River Fishes

The programmatic small water depletions biological opinion outlines the following in regards to the Incidental Take Statement for the listed Colorado River fishes resulting from depletions of 100 acre-feet or less: Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker are harmed from the reduction of water in their habitats resulting from the subject action in the following manner--1) individuals using habitats diminished by the proposed water depletions could be more susceptible to predation and competition from non-native fish; and 2) habitat conditions may be rendered unsuitable for breeding because reduced flows would impact habitat formulation and maintenance as described in the biological opinion.

Estimating the number of individuals of these species that would be taken as a result of water depletions is difficult to quantify for the following reasons--(1) determining whether an individual forwent breeding as a result of water depletions versus natural causes would be extremely difficult to determine; (2) finding a dead or injured listed fish would be difficult, due to the large size of the action area and because carcasses are subject to scavenging; (3) natural fluctuations in river flows and species abundance may mask depletion effects, and (4) effects that reduce fecundity are difficult to quantify. However, we believe the level of take of these species can be monitored by tracking the level of water reduction and adherence to the Recovery Program. Specifically, if the Recovery Program (and relevant RIPRAP measures) is not implemented, or if the current anticipated level of water depletion is exceeded, we fully expect the level of incidental take to increase as well. Therefore, via the programmatic small water depletions biological opinion that this BO tiers to, we exempt all take in the form of harm that would occur from the Project's removal of 49.5 acre-feet of water. This level of take is well within the 100 acre-feet or less of water per small depletion up to a cumulative total of an additional 4,500 acre-feet anticipated under the small water depletions biological opinion. Water depletions above the 4,500 acre-feet addressed in the programmatic small water depletions biological opinion would exceed the anticipated level of incidental take and are not exempt from the prohibitions of section 9 of the Act.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

The Service has the following recommendation regarding the proposed action considered in this BO:

1. During operations and for the life of the Project, we recommend that Ruby, or their designated representative, participate as a member of a team consisting of the Service, BLM, Forest Service, state wildlife agencies and others as necessary to develop conservation actions for recovery of listed species.

The goal of the team will be to meet annually to discuss status of actions implemented in the ESA Conservation Action Plan and define future actions and find funding opportunities, including future possible voluntary contributions by Ruby, to implement actions that meet the recovery needs of listed species in the Project area.

REINITIATION NOTICE

This concludes formal consultation on FERC's proposed issuance of a final license for the Ruby Pipeline Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Sincerely

Michael Thabault
Assistant Regional Director, Ecological Services

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APPENDIX A. Conference Report for Lost River Sucker and Shortnose Sucker Proposed Critical Habitat.

Ruby Pipeline, LLC, proposes to construct and operate a natural gas pipeline that would begin near the Opal Hub in Lincoln County, Wyoming, and proceed westerly through Wyoming, Utah, Nevada, and Oregon, terminating near the Oregon-California state line in Klamath County, Oregon. For more complete details, please refer to the 'Description of the Proposed Action' within the Biological Opinion. The Ruby pipeline (hereafter, Project) would cross streams known to contain federally-listed fishes, including the Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*), that are endemic to the upper Klamath River basin. A total of two streams were determined to have proposed Lost River sucker and shortnose sucker critical habitat at Project waterbody crossings: the South Arm of East Willow Creek and the North Fork of Willow Creek.

Critical habitat for the suckers was proposed in 1994, but has not been finalized (USFWS 1994). There are six proposed critical habitat units (PCHUs): 1) Clear Lake and watershed; 2) Tule Lake; 3) Klamath River; 4) Upper Klamath Lake and watershed; 5) Williamson and Sprague Rivers; and 6) Gerber Reservoir and watershed. The primary constituent elements identified in the proposal are as follows: (1) water of sufficient quantity and suitable quality; (2) sufficient physical habitat, including water quality refuge areas, and habitat for spawning, feeding, rearing, and travel corridors; and (3) a sufficient biological environment, including adequate food levels, and patterns of predation, parasitism, and competition that are compatible with recovery.

The Project lies within or adjacent to the Clear Lake and watershed proposed critical habitat unit. Water quantity, water quality and physical habitat for spawning, feeding, rearing, and travel corridors are generally sufficient for Lost River sucker and shortnose sucker. However, during extended drought conditions when Clear Lake recedes to a small size with low lake levels, reduced water quality, primarily low DO, both in summer and in winter below an ice cover are likely to occur. Under these stressful conditions fish are at greater risk of disease parasitism, and fish die-offs. Competition and predation by non-native fish species, including Sacramento perch and brown bullhead, likely impact sucker populations particularly at low lake levels. A migration barrier at Clear Lake Dam isolates Lost River sucker and shortnose sucker populations and prevents genetic exchange with other populations in the Upper Klamath Basin.

Project crossings at the South Arm of East Willow Creek and the North Fork of Willow Creek will employ work area isolation via a dry-ditch construction method. Blasting is proposed for pipeline installation in the South Arm of East Willow Creek crossing. Subsequent blasting activities would occur "in the dry", and all blasting activities would occur within the local inwater work period for the respective listed fishes (see BO for additional construction details). Project construction could adversely affect Lost River sucker and shortnose sucker proposed critical habitat through sedimentation and turbidity, habitat alteration, stream bank erosion, and blasting.

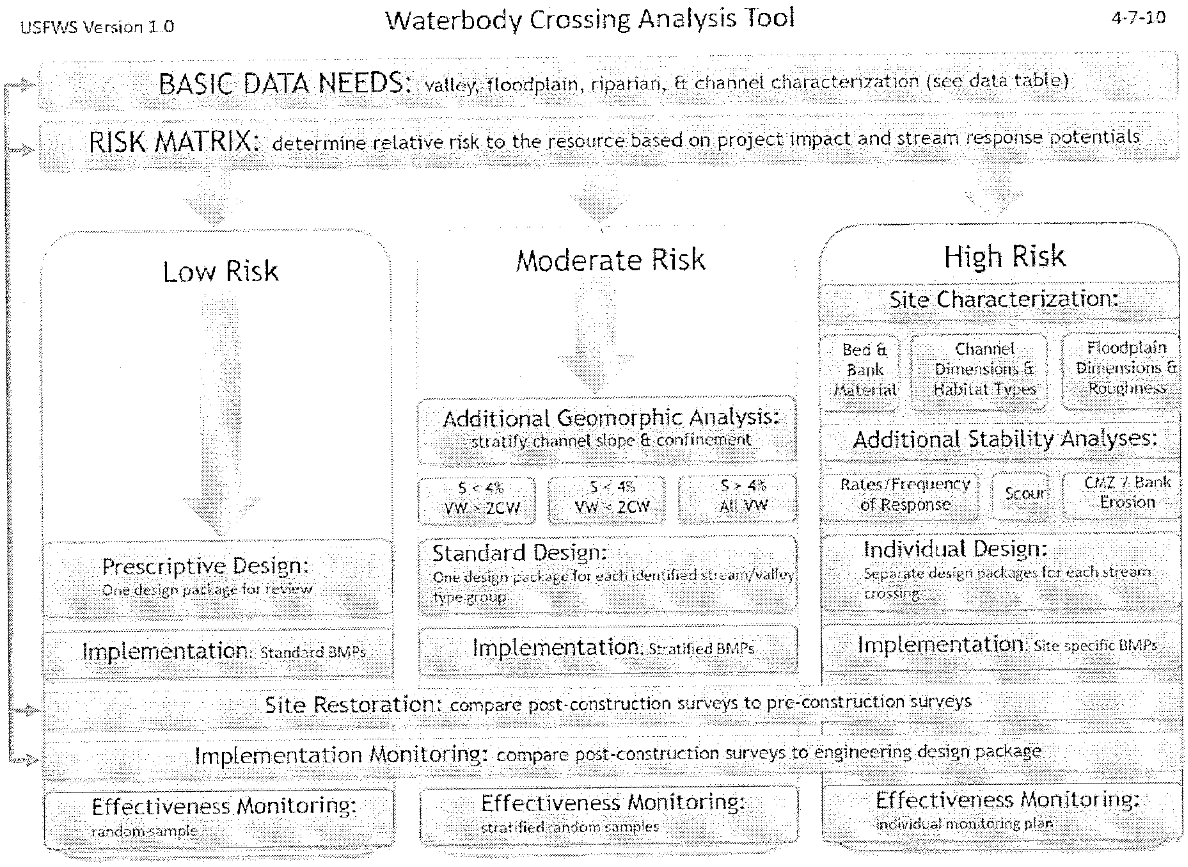
Short-term water quality impacts may result from erosion and sedimentation during grading or other earthwork activities. There also is a potential for introduction of toxic materials from accidental spills, improper storage of petrochemicals or mechanical failure. These will cause adverse effects to proposed critical habitat PCE 1 (water quantity and quality). The Project proposes to minimize impacts to proposed Lost River sucker and shortnose sucker critical habitat by restricting temporary extra workspaces outside of the 50 ft proposed critical habitat zone and limiting the construction right-of-way width to 115 feet. Inwater work creates a higher likelihood for impacts because of the potential for turbidity created by these activities. However, riparian vegetation will replanted after construction and monitoring and remedial actions will ensure riparian vegetation is rapidly restored to these crossings. Water quantity will not be reduced as part of the Project action.

The Project also will have minor adverse effects to PCEs 2 (sufficient physical habitat) and 3 (sufficient biological environment) of proposed critical habitat. Trenching and blasting at these two sites will modify a limited amount of physical habitat and impact the local biological environment. Due to the short section of disturbed habitat at these two crossings, the adverse effects will not have a significant, adverse effect on the recovery function of these PCEs. Moreover, the South Arm of East Willow Creek and the North Fork of Willow Creek are high desert streams that may be dry or partially dry during the inwater construction windows. These streams are particularly prone to being dry during the summer and fall in years of low precipitation (such as in this current year [2010]). Other adverse construction-related effects to PCEs of proposed critical habitat will be minimized by the Project-proposed conservation measures.

Recommendations to Conserve the PCEs of Proposed Lost River sucker and shortnose sucker Critical Habitat

1. Implement the BO's Reasonable and Prudent Measure 2, with associated Terms and Conditions 2.1 through 2.5, at the South Arm of East Willow Creek and the North Fork of Willow Creek waterbody crossings.
2. Monitor, implement, and report on water quality in Project area before and after construction.
3. For road removal projects within riparian areas, recontour the affected area to mimic natural floodplain contours and gradient to the greatest degree possible.
4. When obliterating or removing segments immediately adjacent to the stream, consider using sediment control barriers between the Project and the stream.
5. Dispose of slide and waste material in stable sites out of the flood prone area.
6. Minimize disturbance of existing vegetation at stream crossings to the greatest extent possible.

APPENDIX B. Examples of Information and Analysis Necessary for a Waterbody Crossing Plan.



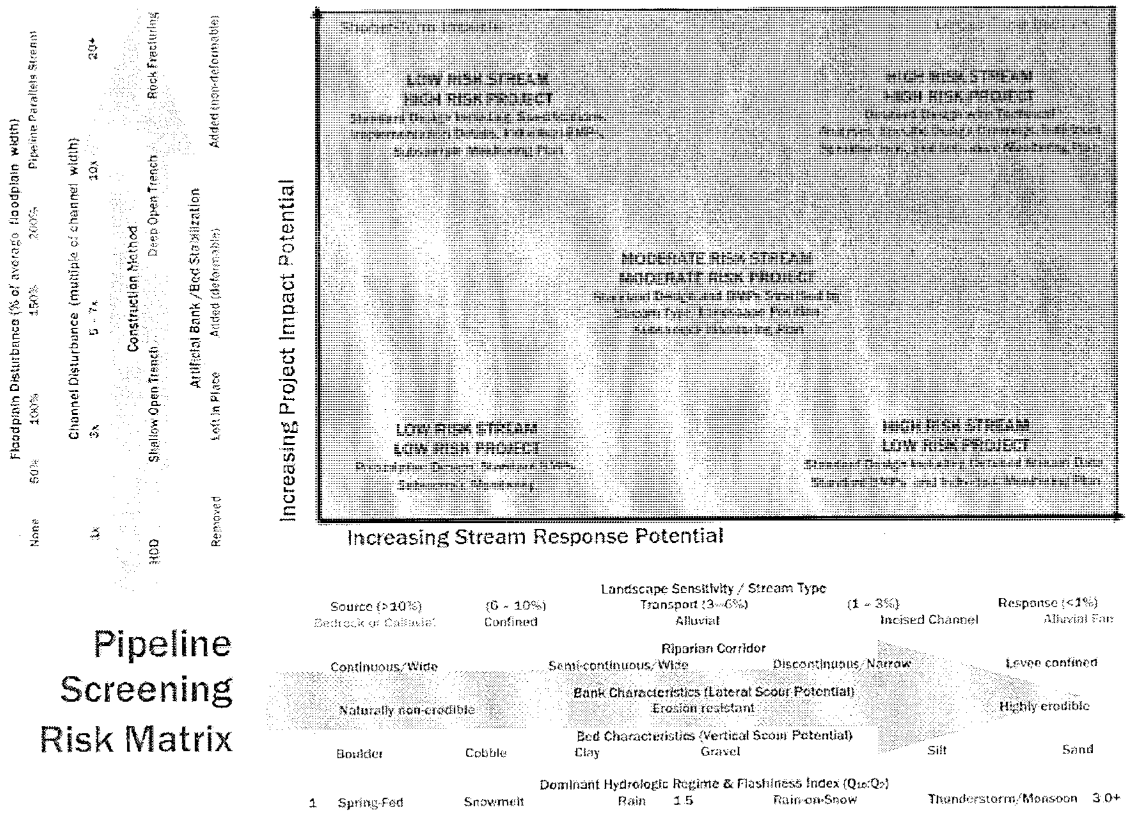
Basic Data Needs for All Waterbody Crossings:

Data Type:	Where Obtained:	When Needed:	Intended Use :
Brief description of the data needed and the appropriate scale/resolution **Reach** = stream length of at least 20x channel width **Site** = within the project area	**Office** = GIS, LiDAR, photos, maps, reports **Field** = on-the ground site visits	**Permit Review** = at the time of permit application and/or initiation of consultation **Pre-construction** = up to the time of ground disturbing activities covered by a permit or BO	**Risk Matrix** = data are needed to complete a risk analysis; the specific evaluation factor(s) is listed **Geomorphic Analysis** = data are needed to perform (1) project stratification based on channel width, valley width, and channel slope, and (2) appropriate channel types for moderate risk projects **Design** = more detailed data are needed to perform specific technical analyses on high risk projects **Site Restoration** = data are needed to ensure the project site is restored to pre-project conditions, herein referred to as "stream simulation" **Implementation Monitoring** = baseline data are needed for shorter-term monitoring to determine if designs, BMPs, construction specifications, and performance criteria were adhered to during construction **Effectiveness Monitoring** = baseline data are needed for longer-term monitoring to determine if the desired physical/biological outcomes were achieved
Drainage area	Office	Permit Review	**Risk Matrix:** flashiness index (discharge estimate) **Design:** hydrologic analyses to determine channel size, frequency of out-of-bank flow, elevation of the floodplain where applicable, flow and sediment rating curves
Stream type (Reach)	Office or Field – observation of bedrock, colluvial, or alluvial	Permit Review	**Risk Matrix:** landscape sensitivity/stream type, bank characteristics, bed characteristics, construction method **Geomorphic Analysis:** appropriate channel types **Design:** threshold vs. mobile bed channel, boundary conditions
Stream slope (Reach)	Office	Permit Review	**Risk Matrix:** landscape sensitivity factor, bed characteristics (vertical scour potential) **Geomorphic Analysis:** appropriate channel types **Design:** hydraulics, sediment transport **Site Restoration:** stream simulation **Implementation Monitoring**
	Field	Pre-construction	
Channel dimensions (Site)	Office – estimate of channel width @ OHW	Permit Review	**Risk Matrix:** channel disturbance, riparian corridor, landscape sensitivity/stream type **Geomorphic Analysis:** channel confinement, appropriate channel types **Design:** hydraulics, sediment transport, channel stability **Site Restoration:** stream simulation **Implementation Monitoring** **Effectiveness Monitoring**
	Field – measurement of channel width, average depth, cross-sectional area @ OHW. One cross section per aquatic habitat unit	Pre-construction	
Valley width (Reach)	Office	Permit Review	**Risk Matrix:** riparian corridor, landscape sensitivity/stream type, floodplain disturbance **Geomorphic Analysis:** channel confinement, appropriate channel types **Design:** sinuosity and slope range
Floodplain dimensions (Reach)	Office – estimate of floodplain width	Permit Review	**Risk Matrix:** riparian corridor, landscape sensitivity/stream type, floodplain disturbance **Geomorphic Analysis:** channel confinement, appropriate channel types **Design:** hydraulics, sediment storage **Site Restoration:** stream simulation and floodplain connectivity **Implementation Monitoring** **Effectiveness Monitoring**
	Field – measurement of floodplain width and elevation	Pre-construction	
Bed materials (Site)	Field	Permit Review	**Risk Matrix:** bed characteristics, artificial bank/bed stabilization **Geomorphic Analysis:** appropriate channel types **Design:** sediment transport, hydraulics, channel stability **Site Restoration:** stream simulation **Implementation Monitoring** **Effectiveness Monitoring**
Bank materials (Site)	Field	Permit Review	**Risk Matrix:** bank characteristics, artificial bank/bed stabilization **Geomorphic Analysis:** appropriate channel types **Design:** bank stability, channel stability, channel migration zone, hydraulics **Site Restoration:** stream simulation **Implementation Monitoring**
Grade controls (Reach)	Field	Permit Review	**Risk Matrix:** bed characteristics, landscape sensitivity/stream type, artificial bank/bed stabilization, construction method **Geomorphic Analysis:** appropriate channel types, incision potential **Implementation Monitoring:** to ensure that natural grade control has not been effected
Riparian corridor (Reach)	Office – estimate of riparian width for each side of the channel	Permit Review	**Risk Matrix:** riparian corridor, bank characteristics, artificial bank/bed stabilization **Geomorphic Analysis:** appropriate channel types **Design:** channel and floodplain roughness, hydraulics, channel stability, streambank stability **Site Restoration:** typical species, density, structure of riparian vegetation and planting plan

	Field – composition, density, and distribution	Pre-construction	**Implementation Monitoring:** species composition, stocking levels **Effectiveness Monitoring:** survival rates and invasive species
Discharge (Site) 10 – year 2 – year Baseflow Construction	Office – regression equations or similar	Permit Review	**Risk Matrix:** flashiness index, channel disturbance, landscape sensitivity/stream type **Design:** hydraulics, sediment transport, channel size, floodplain elevation, aquatic species passage **Site Restoration:** stream simulation, stability of bed and bank materials **Implementation Monitoring**
Channel sinuosity (Reach)	Office or Field	Permit Review	**Geomorphic Analysis:** appropriate channel types **Design:** hydraulics, sediment transport, channel slope **Site Restoration:** stream simulation **Implementation Monitoring** **Effectiveness Monitoring**
Large wood loading (Site)	Field – measurement of size class and configuration	Pre-construction	**Geomorphic Analysis:** appropriate channel types **Design:** channel and floodplain roughness, channel stability, vertical scour, flood elevations **Site Restoration:** stream simulation **Implementation Monitoring** **Effectiveness Monitoring**
Streambank erosion (Reach)	Field	Pre construction	**Geomorphic Analysis:** appropriate channel types **Design:** sediment transport, channel stability, streambank stability, channel migration zone **Implementation Monitoring** **Effectiveness Monitoring**
Mass wasting (Reach – upstream only)	Field	Pre-construction	**Geomorphic Analysis:** appropriate channel types **Design:** sediment transport, channel stability, channel migration zone **Implementation Monitoring** **Effectiveness Monitoring**
Aquatic habitat units (Site)	Field	Pre-construction	**Site Restoration:** stream simulation **Design:** hydraulics, channel roughness **Implementation & Effectiveness Monitoring**

Data Needs & Analyses for High Risk Streams:

Data Type:	Where Obtained:	When Needed:	Intended Use :
Scour depth (Site)	Office	Pre-construction	**Design:** localized stability analyses, constriction & general **Effectiveness Monitoring**
Vertical stability analysis (Reach)	Office	Pre-construction	**Design:** systemic channel stability analyses, channel incision potential, aquatic species passage **Effectiveness Monitoring**
Channel migration zone delineation/ lateral stability analysis (Reach)	Office	Pre-construction	**Geomorphic Analysis:** appropriate channel types **Design:** systemic channel stability analyses, streambank stability, planting plan **Effectiveness Monitoring**
Detailed cross-sectional morphology by aquatic habitat units (Site)	Field	Pre-construction	**Design:** hydraulics, aquatic species passage **Site Restoration:** stream simulation **Implementation Monitoring** **Effectiveness Monitoring**
Longitudinal profile showing habitat units (Reach)	Field	Pre-construction	**Design:** hydraulics, aquatic species passage, channel stability **Site Restoration:** stream simulation **Implementation Monitoring** **Effectiveness Monitoring**
Floodplain soil description(s) (Site)	Office and Field	Pre-construction	**Design:** systemic channel stability analyses, streambank stability, planting plan **Site Restoration** **Implementation Monitoring**
Bank material characterization for bank restoration (Site)	Field	Pre construction	**Design:** geotechnical analyses, streambank stability, planting plan **Site Restoration:** need for additional stabilization measures **Implementation Monitoring**
Bed material particle size distribution (Site)	Field	Pre-construction	**Design:** sediment transport, channel stability, hydraulics **Site Restoration:** stream simulation bed material gradation **Implementation Monitoring:** ensure streambed is not too porous **Effectiveness Monitoring**



Pipeline Screening Risk Matrix

PIPELINE SCREENING RISK MATRIX: A User's Guide

BACKGROUND

The "Pipeline Screening Risk Matrix" is an outgrowth of a broader Federal effort to more efficiently and effectively evaluate risk associated with stream management projects. The River Restoration Assessment Tool (RiverRAT) provides a thorough and comprehensive approach to the review and evaluation of proposed stream actions and projects (restorationreview.com). To help reviewers identify the risks to natural resources inherent in a particular proposal, a risk screening tool has been developed as a part of this effort. The Risk Matrix is intended to help reviewers develop an approach to stratifying review time and intensity for various project types. This modified version of the Project Screening Risk Matrix is intended to facilitate a qualitative analysis of relative risk to stream habitat due to pipeline projects.

The primary purpose of a screening risk matrix is to ensure that high risk project proposals are adequately identified, designed, and reviewed, and that lower risk projects are dealt with more expeditiously. A minimum level of site characterization is required for all proposed stream crossings in order to properly apply the risk screening tool (see *"Basic Data Needs for All Waterbody Crossings"* table).

The screening tool is not an alternative to professional experience and judgment.

DESCRIPTION OF THE RISK MATRIX SCREENING TOOL

The screening tool is in the form of a two-axis matrix in which the:

X-axis = Risk to Resource due to Stream Response Potential
Y-axis = Risk to Resource due to Project Impact Potential

The principle underlying the pipeline risk matrix is that waterbody crossings should do no lasting harm to aquatic habitat on-site, upstream, or downstream, and that short and long-term negative impacts will be avoided where possible, minimized to the greatest extent, and mitigated where necessary.

X-Axis

Increasing Stream and Site Response Potential

Landscape Sensitivity / Stream Type

Source (>10%) Bedrock or Colluvial — (6 – 10%) — Transport (3—6%) Alluvial — (1 – 3%) Incised Channel — Response (<1%) Alluvial Fan

Riparian Corridor

Continuous/Wide — Semi-continuous/Wide — Discontinuous/Narrow — Levee confined

Bank Characteristics (Lateral Scour Potential)

Naturally non-erodible — Erosion resistant — Highly erodible

Bed Characteristics (Vertical Scour Potential)

Boulder — Cobble — Clay — Gravel — Silt — Sand

Dominant Hydrologic Regime & Flashiness Index ($Q_{10}:Q_2$)

1 Spring-Fed — Snowmelt — Rain 1.5 — Rain-on-Snow — Thunderstorm/Monsoon 3.0+

Y-Axis

Increasing Project Impact Potential

Floodplain Disturbance (% of average floodplain width)

None	50%	100%	150%	200%	Pipeline Parallels Stream

Channel Disturbance (multiple of channel width)

1x	3x	5 – 7x	10x	20+

Construction Method

HDD	Shallow Open Trench	Deep Open Trench	Rock Fracturing

Artificial Bank /Bed Stabilization

Removed	Left in Place	Added (deformable)	Added (non-deformable)

EXPLANATION OF THE AXES

The x-axis represents the risk to natural resources associated with stream sensitivity to disturbance and response potential. Disturbances may be natural, such as those caused by a flood or drought, or anthropogenically driven -- engineering intervention, management action, or restoration project that affects the flow or sediment regime, channel processes, channel geometry, and/or the characteristics of the bed and bank materials. This axis, therefore, uses indicative watershed, landscape, stream and channel attributes to assist reviewers in making an initial, qualitative assessment of the overall risk to resources stemming from the inherent sensitivity of the fluvial system within which the project is to be implemented. Because the level of risk is associated with inherent sensitivity, risk along this axis cannot be reduced unless the project site is moved to another, more resilient, stream segment. Additionally, because of the inherent stream sensitivity, long-term impacts are more likely to occur.

The y-axis represents the risk to resources associated with the proposed action or project itself. Some disturbance to the fluvial system is inevitable when performing engineering, management or restoration actions in or near a stream. This axis, therefore, uses indicators of the level of disturbance, descriptors of the potential for its design elements to remove or introduce artificial constraints, and information on the construction method to assist in making an initial, qualitative assessment of the overall risk to resource likely to arise if the proposed action or project were to be implemented. Because the level of risk is related to the proposed action, reducing risk on the y-axis is often feasible through project redesign and implementation of Best Management Practices (BMPs).

EXPLANATION OF THE RISK FACTORS

X-axis: Risk Factors related to Stream Response Potential

- **Landscape Sensitivity / Stream Type**

This risk factor is relevant at the reach scale and should be evaluated in the context of an entire stream reach (similar slope and confinement). Reach breaks may include, but are not limited to, natural or artificial grade control, significant changes in channel slope, confluence with a significant tributary, changes in channel confinement, and/or changes in bed or bank materials.

Some streams are naturally resilient to disturbance, while others are highly sensitive. This depends largely on the landscape setting within which the stream is located and the capability of the channel-floodplain system to adapt to changes in the flow and sediment regimes without sudden morphological changes that trigger loss of habitat. Generally, the wider the floodplain, the lower the sensitivity of the fluvial system. Incised channels and, especially, those crossing alluvial fans are particularly sensitive and prone to destabilization by what appear to be relatively minor disturbances. An incised channel is generally defined as a stream that has eroded it bed to such an extent that flows no longer access the floodplain during low to moderate flow events (2 to 10-year). In contrast, a confined stream is constrained by valley walls and does not have an associated floodplain.

Channel response to disturbance also varies by channel type. A classification system that provides a basis for predicting the risk to resource associated with a stream based on the balance between sediment supply and sediment transport capacity is useful when evaluating a stream project. "Response" channels correspond to transport limited channel types, "Transport" channels correspond to supply-limited channel types, and "Source" channels are dominated by local sediment inputs from hill slopes (Montgomery & Buffington 1998). Consequently, the channel-related risks intrinsic to the stream are lowest in Source (colluvial & bedrock) reaches, are intermediate in Transport (step-pool, cascade) reaches and greatest in Response (plane-bed, pool-riffle, dune-riffle) reaches. Stream slope is often used as a surrogate for Source (>10%), Transport (>3%, <10%), and Response (<3%) reaches.

If a stream is bedrock or colluvially dominated, then the remaining risk factors of riparian corridor, and bank and bed characteristics are generally not applicable. Alternatively, if the channel is on an alluvial fan, the site response potential will likely remain high even if the other risk factors are all rated low.

Stream sensitivity also includes the potential for disturbance to propagate upstream and/or downstream. An example of upstream disturbance propagation is erosion of the channel bed, creation of a headcut, and the headward migration of this nick point. This erosion process sets off a series of feedback mechanisms that can cause sedimentation downstream, channel widening, loss of base flows, and other related impacts. This potential risk is highly influenced by stream type; headcuts are unlikely to migrate upstream through a high gradient, colluvial reach, but may migrate many miles up a lower gradient, response reach.

- **Riparian Corridor (for stream slopes <4%)**

The riparian corridor defines the area available to the stream within which the channel may adjust its morphology in response to natural or artificial disturbance. This adjustability infers an alluvial stream channel with the ability to move laterally, and hence also indicates the presence of a floodplain. *This risk factor should only be evaluated for stream reaches with average channel slopes of less than 4%.* The capacity of the stream to absorb disturbances without harm to habitat and species generally increases with the width of the riparian corridor. However, the probability that the stream may be destabilized increases when the riparian corridor is narrow or discontinuous. Riparian vegetation provides both a surface function of reducing flow velocity, and a subsurface function of increasing soil strength. The risk to resource is greatest in urban and levee-confined streams that lack the space necessary to respond naturally to disturbance and change.

- **Bank Characteristics (Lateral Scour Potential)**

The propensity for marked morphological response to disturbance of fluvial processes (flow and sediment transport) is reduced in channels with naturally non-erodible bank materials, such as rock or highly cohesive clay. Similarly, heavily vegetated banks resist erosion and reduce the potential for disturbances to destabilize the channel and impact habitat. Conversely, risks are greater in channels with banks that are highly erodible. Channels with artificially revetted banks are also classed as high risk because fluvial forces or changes in bed morphology (due either to a flood in excess of the design event or associated with longer-term change in process drivers such as the flow or sediment regime) may cause failure of the revetment, leading to rapid and unnatural rates of channel change.

- **Bed Characteristics (Vertical Scour Potential)**

Morphological response to disturbance of fluvial processes is increased in channels with naturally erodible bed materials such as sand. Channels with artificial grade control are also classed as high risk because it is evident that vertical channel stability is of concern. In addition, grade control structures are prone to failure and thus may result in rapid propagation of a channel regrade (channel incision as described above). Conversely, a streambed composed of large boulders has a much lower risk of a channel response through incision, and propagation of incision upstream.

- **Dominant Hydrologic Regime & Flashiness Index (Q_{10}:Q_2)**

The relative "flashiness" of a stream system is defined by the difference in flow volume (Q) between two indexed values. A standard index in hydrology is the relationship between the Q_2, which approximates the channel forming flow, and the Q_{10}, which approximates the upper limit where human induced changes to flood flows can be reliably detected. It is also the range of flows which encompasses the most effective discharge range in most alluvial stream systems, and as such is a surrogate for the work performed by the stream.

Spring-fed stream systems have a low flashiness index, often below 1.1, while stream hydrology that is dominated by convective storm events often have a high flashiness index. Additionally, stream reaches that are located in transition areas should be evaluated for changes in hydrologic regime over time due to climate change. For instance, if a stream reach is located 500-feet in elevation above the current snow level, it is possible that this reach will become a rain-on-snow dominated system in the future. Streams with co-dominant hydrologic regimes should be evaluated at the higher risk level of the two regimes.

Y-axis Risk Factors related to Project Impact Potential

- **Floodplain Disturbance (average floodplain width / disturbed width)**

This risk element is only applicable to alluvial streams with floodplains, which generally includes streams with gradients less than 4 percent. Stream system resilience is decreased as a greater portion of the floodplain is disturbed. For example (see the figure below), if the average floodplain width within the reach of interest is approximately 100 feet (blue line), then a perpendicular pipeline crossing would affect 100% of the floodplain. However, if there were a narrower section of the floodplain (green line), then the percent disturbance may be reduced. Alternatively, if a 100 foot wide floodplain were crossed at a 45 degree angle (red line), then the disturbance would be 150%. The worst case scenario, in terms of floodplain disturbance, would be where the pipeline parallels the stream through the floodplain.

- **Channel Disturbance (construction corridor / stream width)**

This risk element is intended to capture potential effects to stream habitat by indexing the level of channel disturbance related to channel width at ordinary high water. For instance, if a construction corridor is 75 feet wide across a stream channel that is 150 feet wide, then the disturbance index would be 0.5; however, if the channel is only 15 feet wide, then the disturbance index would be 5. The risk is higher for smaller streams because more habitat units would be affected. Stream habitat is generally scaled to channel width. For example, it is common for pool/riffle streams to have pool spacing at 5 to 7 channel widths. If a project disturbed 15x the channel width, then 3 pools and 3 riffles could potentially be impacted. Reconstructing single habitat units after construction can be difficult, but constructing multiple habitat units that will be self-sustaining over time is even more challenging.

- **Construction Method**

The waterbody construction method greatly influences the project impact potential. Horizontal directional drilling (HDD) is generally considered to be low risk because of minimal impacts to the stream, while rock fracturing is considered to be high risk because of the potential for all flows to be captured into fissures created by the fracturing process.

While HDD is considered to be a low risk construction method, an analysis of the length of the HDD required for the crossing is still necessary to ensure that lateral channel migration will not expose the pipe in the future.

- **Artificial Bank/Bed Stabilization**

This factor considers the degree to which the proposed action or project may impede the capability of the stream to accommodate future changes in the flow and sediment regimes due, for example, to extreme floods, land use change, or climate change. In this respect, projects that introduce new constraints on (1) fluvial processes, (2) the capacity of the channel to adjust morphologically, or (3) opportunities for sediment exchange between the channel and floodplain are generally riskier than projects that either remove existing constraints or leave them undisturbed. In this context, the potential risk to resources associated with channel stabilization measures is lower for temporary, deformable structures than for permanent, rigid ones.

Deformable structures are defined as those structures that are designed to provide short-term stability (5 to 10-years) before degrading, which would allow for vegetative reestablishment. Construction material may include large wood, soil lifts, brush mattresses, and other forms of bioengineering using live materials. Non-deformable structures are generally designed to last longer (50+ years) and are composed of non-degradable materials such as rock and synthetic geotextiles.

Short vs. Long-term Impacts and Associated Monitoring

The left hand side of the Risk Matrix, that representing low stream response potential, is indicative of scenarios where the project type dictates the overall impact; hence minimizing direct impacts during construction to reduce short-term impacts is of greatest importance. Because the stream has a low response potential, focus is placed on minimization of construction impacts, standard Best Management Practices, and randomized subsample monitoring.

The right hand side of the Risk Matrix, that representing high stream response potential, is indicative of scenarios where the stream type dictates overall impact; hence while minimization of construction impacts is important, it is the longer-term processes that may result in on-going impacts to the stream system.

Level of Review/Design/Monitoring

Once projects have been screened and defined into one of nine general categories, the level of data collection, analysis, design, review, and monitoring can be determined.

LOW RISK STREAM HIGH RISK PROJECT Standard Design including: Specifications, Implementation Details, Individual BMPs, Subsample Monitoring Plan	**MODERATE RISK STREAM HIGH RISK PROJECT** Individual Design including: Specifications, Implementation Details, Individual BMPs, Stratified Monitoring Plan	**HIGH RISK STREAM HIGH RISK PROJECT** Detailed Design with Supporting Technical Analyses, Specific Design Drawings, Implementation Details, and Individual Specifications, BMPs, and Monitoring Plan
LOW RISK STREAM MODERATE RISK PROJECT Standard Design including: Specifications, Implementation Details, Standard BMPs, Subsample Monitoring Plan	**MODERATE RISK STREAM MEDIUM RISK PROJECT** Standard Design and BMPs Stratified by Stream Type/Landscape Position Stratified Monitoring Plan	**HIGH RISK STREAM MODERATE RISK PROJECT** Individual Design including Detailed Stream Data, Standard BMPs, and Individual Monitoring Plan
LOW RISK STREAM LOW RISK PROJECT Prescriptive Design, Standard BMPs, Subsample Monitoring	**MODERATE RISK STREAM LOW RISK PROJECT** Standard Design including Specific Stream Data, Standard BMPs, and Stratified Monitoring Plan	**HIGH RISK STREAM LOW RISK PROJECT** Standard Design including Detailed Stream Data, Standard BMPs, and Individual Monitoring Plan

Prescriptive designs are very general and include the design approach, but do not include any site specific drawings. They are meant to be widely applicable and rely heavily upon minimization of construction impacts (e.g. dewatering/rewatering or staging of equipment) and BMPs.

Standard designs are more specific to the stream type. As an example, a standard design for crossing confined stream channels, with a step-pool morphology that range between 3 and 6% could be developed). BMPs appropriate for the specific stream type would also be included.

Individual and detailed designs are developed for each crossing separately and include both the breadth of depth of analyses required for that particular site.

Using the Risk Matrix to Screen Project Proposals

Once the risk factors described above, and represented in the axes of the matrix, have been assessed, projects can be screened based on the overall level of risk to resources. In doing so, risks can be combined and analyzed in at least three different ways.

First, each of the risk factors could be considered to be critical to avoid resource harm. In this case, the precautionary principle suggests that the overall risk category should be defined by the highest risk factor on each of the x and y axes. A good example of this precautionary principle are streams on alluvial fans which would always receive a high risk rating for stream response potential.

Second, none of the risk factors would be considered to be individually critical to the resource. In this case, the overall risk category should defined by the average of the risk factors on each of the x and y axes. There would be a balance between factors.

Third, some of the risk factors may be considered to be more important than the others, but with no single factor completely dominating the overall risk. In this case, the overall risk category is the defined by weighting the risk factors on each of the x and y axes.

There is no 'cook book' solution to deciding how to select the overall risk category as each project and stream presents different challenges and risks. What is required is consistent critical thinking and transparent, evidence-based decision-making. Often the level of risk will be reduced when more data are available, or if there is more familiarity of the site by the reviewer. When best professional judgement is used to modify a risk rating, it should be adequately documented and described for future reference.