
Final Technical Memorandum

**Section 203(a),
Uinta Basin Replacement Project**

Prepared by
Central Utah Water Conservancy District

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CHAPTER 1

Introduction

This Technical Memorandum was prepared in support of the Final Environmental Assessment (Final EA) for the Section 203(a), Uinta Basin Replacement Project (Section 203 Project) proposed by the Department of the Interior (DOI) and the Central Utah Water Conservancy District (CUWCD). This Technical Memorandum provides additional information on six of the resource areas analyzed in the Final EA, including the following:

- Water Resources and Hydrology
- Water Quality and Contaminants
- Aquatic Resources
- Wetland and Riparian Resources
- Wildlife Resources
- Cultural Resources

All information on threatened and endangered species is presented in the Final EA because that document also serves as the Biological Assessment (BA) for the project's Section 7 consultation with the U.S. Fish and Wildlife Service (FWS), as required by the Endangered Species Act (ESA).

Chapter 2 of this Technical Memorandum provides a very brief overview of the Proposed Action, two other action alternatives, and a No Action Alternative. Chapter 3 of this Technical Memorandum describes the affected environment and environmental consequences for the six identified resource areas. The appendices contain related supporting information. Detailed descriptions of project features for the Proposed Action and alternatives and of project purpose and need, history and background, and authorizing actions, permits, and licenses are contained in the Final EA.

CHAPTER 2

Overview of the Proposed Action and Alternatives

The Proposed Action and three alternatives are as follows:

- Proposed Action—Lake Fork Section 203 Alternative
- Revised Section 203 Alternative
- Twin Pots Section 203 Alternative
- No Action Alternative

The Proposed Action and each action alternative consist of a combination of features that work together as a unit. Table 2.1-1 lists specific features of the Proposed Action and each action alternative.

TABLE 2-1
Project Features Associated with the Proposed Action and Alternatives

Proposed Action—Lake Fork Section 203 Alternative	Revised Section 203 Alternative	Twin Pots Section 203 Alternative
Dams and Reservoirs		
Big Sand Wash Enlargement (12,000 ac-ft) ^a :	Big Sand Wash Enlargement (12,000 ac-ft):	Big Sand Wash Enlargement (12,000 ac-ft):
- 2,500 ac-ft Irrigation	- 9,000 ac-ft Irrigation	- 2,500 ac-ft Irrigation
- 3,000 ac-ft M&I ^b	- 3,000 ac-ft M&I	- 3,000 ac-ft M&I
- 6,500 ac-ft High Mountain Lakes		- 6,500 ac-ft High Mountain Lakes
Moon Lake Dam Outlet Works Modification (winter flow releases)		
Diversion Structures		
Big Sand Wash Feeder	Big Sand Wash Feeder	Big Sand Wash Feeder Lake Fork—Yellowstone
Pipelines		
Big Sand Wash Feeder Big Sand Wash—Roosevelt	Big Sand Wash Feeder Big Sand Wash—Roosevelt	Big Sand Wash Feeder Big Sand Wash—Roosevelt Lake Fork—Yellowstone

TABLE 2-1
Project Features Associated with the Proposed Action and Alternatives

Proposed Action–Lake Fork Section 203 Alternative		Revised Section 203 Alternative	Twin Pots Section 203 Alternative	
High Mountain Lakes’ Stabilization				
<u>Lake Fork</u>	<u>Yellowstone</u>		<u>Lake Fork</u>	<u>Yellowstone</u>
Brown Duck Island	Bluebell Drift		Brown Duck Island	Bluebell Drift
Kidney	Five Point		Kidney	Five Point
Clements	Superior Farmers East Timothy White Miller Deer Water Lily		Clements	Superior Farmers East Timothy White Miller Deer Water Lily
Fish and Wildlife Mitigation and Enhancement				
Wetland/Riparian Creation	Wetland/Riparian Creation		Wetland/Riparian Creation	
Fish Passage	Fish Passage		Fish Passage	
Instream Flows	Big Sand Wash Reservoir Boat		Twin Pots Reservoir Improvement	
Big Sand Wash Reservoir Boat	Ramp		Big Sand Wash Reservoir Boat	
Ramp			Ramp	

^aac-ft = acre-feet

^bM&I = Municipal and Industrial

The Proposed Action was formulated to fulfill the same need, with the least long-term environmental impact, as the facilities specifically authorized in Section 203(a) of the Central Utah Project Completion Act (CUPCA). The following features comprise the Proposed Action: 1) the enlarged Big Sand Wash Dam and Reservoir; 2) the modified outlet works at Moon Lake Reservoir; 3) the Big Sand Wash Feeder Diversion Structure; 4) high mountain lakes’ stabilization; 5) the Big Sand Wash Feeder Pipeline; 6) the Big Sand Wash–Roosevelt Pipeline; and 7) fish and wildlife mitigation and enhancement. Map 2.2-1 in Chapter 2 of the Final EA shows the locations of specific features of the Proposed Action.

Specific features of the Revised Section 203 Alternative and their locations are shown on Map 2.3-1 in the Final EA and listed in Table 2.1-1. The most significant changes from the Proposed Action are the deletion of the stabilization of the 13 high mountain lakes in the wilderness area, no provisions for instream flows in the Lake Fork River between Moon Lake Reservoir and the Big Sand Wash Feeder Diversion Structure, and no provisions for bypass instream flows past the Yellowstone Feeder and “C” Canal Diversions.

Specific features of the Twin Pots Section 203 Alternative and their locations are shown on Map 2.4-1 in the Final EA and listed in Table 2.1-1. The most significant changes from the Proposed Action are: 1) the rehabilitation and stabilization of Twin Pots Dam and Reservoir as an additional fish and wildlife enhancement measure; 2) no provisions for instream flows in the Lake Fork River between Moon Lake Reservoir and the Big Sand Wash Feeder Diversion Structure; 3) no provisions for bypass instream flows past the Yellowstone Feeder

and “C” Canal Diversions; and 4) the inclusion of the Lake Fork–Yellowstone Diversion Structure and Pipeline.

Under the No Action Alternative, none of the features proposed in the Proposed Action or action alternatives would be constructed. Existing water supply conditions within the Section 203 project area would continue, and the needs and purposes of the project would remain unmet. Anticipated environmental impacts of the project would not occur, and proposed fish and wildlife measures would not be implemented. Authorization to construct the Section 203 Project would terminate in November 2001, pursuant to provisions of Section 203(a) of the CUPCA, and any unexpended budget authority would remain available under Section 202(c) of the CUPCA.

Resource Discussions

3.1 Water Resources and Hydrology

3.1.1 Introduction

This section addresses potential changes to, and impacts on, surface water and groundwater resources and hydrology resulting from the Proposed Action and alternatives of the Section 203 Project. The discussion focuses on the affected (baseline) environment followed by a summary of potential direct, indirect, total, and/or cumulative water resource and hydrologic effects.

3.1.2 Issues Eliminated from Further Analysis

All water resource issues identified during public scoping for the Upalco Unit Draft Environmental Impact Statement (DEIS) that are relevant to the Section 203 Project were considered in this analysis.

3.1.3 Issues Addressed in the Impact Analysis

The following issues and concerns related to water resources were identified by federal, state, and local agencies, and the public during scoping for the Upalco Unit DEIS. Many or portions of these same issues and concerns also apply to the Section 203 Project.

- Existing and future beneficial uses of water are determined by the quantity and quality of water available for direct or indirect use.
- There is concern that changes to and impacts on water quantity and quality will occur.
- All impacts on water quantity and quality must be accounted for, including modification of peak and low flows, and effects on groundwater recharge, floodplains, and downstream loading of salts and other contaminants.
- Each project feature, including dam and reservoir enlargement, pipeline construction, and water conservation measures, will affect site and local hydrology and the related environment.
- The collective impacts of project features will impact downstream water resources.
- Modification of peak flows will impact the river ecosystem.
- Water conservation measures and systems, such as improved delivery systems, should be provided.
- There is a desire to decrease downstream salt loads.

Issues, concerns, and environmental impacts on “Water Quality and Contaminants,” “Aquatic Resources,” “Wetland and Riparian Resources,” and “Wildlife Resources” that are

either directly or indirectly related to changes in water resource conditions, and which would result from the proposed Section 203 Project, are identified and described in those sections of this chapter. These potential environmental effects may be related to changes in the quantity or quality of surface water, groundwater, and/or recharge.

3.1.4 Description of Area of Influence

The area of influence for water resources in the Section 203 project area includes the headwaters and tributaries of the Lake Fork and Yellowstone Rivers downstream to the confluence of the Lake Fork River with the Duchesne River near Myton (see Map 1.4-1 in Chapter 1 of the Final EA). The project area of influence also includes the Colorado River because of potential flow and salinity impacts downstream at Imperial Dam. The seven-state Colorado River Basin Salinity Control Forum has worked with the Environmental Protection Agency (EPA) and affected states to develop salinity standards for the Colorado River, as well as an implementation plan for controlling/reducing salinity in the Colorado River system (including the project area).

3.1.5 Affected Environment

This section describes existing (baseline) hydrologic and water resource conditions potentially affected by the Proposed Action and each of the alternatives. The discussion includes a general description of the water resource characteristics best addressed on a project area-wide basis, and those that need to be addressed on a more localized basis.

3.1.5.1 Proposed Action Lake Fork Section 203

3.1.5.1.1 Surface Water Hydrology The Lake Fork and Yellowstone Rivers make up the primary drainage system of the project area. These rivers originate in the Uinta Mountains and flow south through deep canyons cut through bedrock and broad, alluvial floodplains. Annual precipitation ranges from more than 38 inches in the upper part of the project area to less than 8 inches in the lower part of the project area.

Most of the water in the project area originates in high mountain and upland areas as snowfall in late winter and early spring. Precipitation in the lower basin is primarily from thunderstorms during the summer and is generally ineffective as a source of water for streams or groundwater recharge. From 1940 to 1976, the precipitation data at the City of Roosevelt show July was the driest month and October was the wettest.

Collectively, the Lake Fork River above Moon Lake Reservoir and the Yellowstone River above the Yellowstone Feeder Canal provide most of the incoming surface water to the basin with average annual flows of 90,327 and 99,343 ac-ft, respectively. Project area-wide, the total average annual inflow from all tributaries is about 191,694 ac-ft. Of this total, about 169,377 ac-ft (88 percent) is diverted for irrigation through a network of canals and pipelines, and 10,700 ac-ft (6 percent) returns to the Lake Fork River near the southern part of the basin as agricultural return flows.

3.1.5.1.1.1 High Mountain Lakes. Of the 13 high mountain lakes proposed for stabilization under the Proposed Action, four are located in the upper Lake Fork River watershed and nine are located in the upper Yellowstone River watershed within the High Uintas Wilderness (HUW) (see Map 2.2-1 in Chapter 2 of the Final EA). Existing lake characteristics

are summarized in Chapter 2 of the Final EA. Collectively, the 13 lakes contribute an average annual delivery of 6,347 ac-ft of non-project irrigation water, and have water storage rights total 7,989 ac-ft of active storage.

The lake outlet gates are typically closed about mid-October (after the primary irrigation water right has been met) to store inflow for delivery during the irrigation season. The lakes may not refill until high runoff occurs in the spring and/or summer. Once the lakes are filled, inflow passes through the lakes via spillways with little or no reduction in peak flow. Usually in late June or early July, the outlet gates are opened and left for a 2-week period before they are readjusted to maintain a constant flow. This cycle is repeated until the lakes are drawn down to the outlet level and diversions for secondary water-right holders have ended.

During normal and high-flow years, the high mountain lakes have little effect on peak annual runoff since they fill before peak spring/summer runoff occurs. During low-flow years, however, some spring/summer runoff may be stored in these lakes, which helps attenuate peak flows.

3.1.5.1.1.2 Dams and Reservoirs. The existing Big Sand Wash Dam and Reservoir are located offstream on Big Sand Wash, a tributary of Dry Gulch Creek. The existing reservoir has a storage capacity of 12,000 ac-ft (about 6 percent of the project area's average annual inflow) and receives water from the Lake Fork River via the "C" Canal. Diversions from the Lake Fork River into the "C" Canal typically fill Big Sand Wash Reservoir by mid-March and average about 48,000 ac-ft/yr. Peak reservoir inflow usually occurs in May and averages about 10,000 ac-ft.

During the nonirrigation season from October through March, end-of-month storage steadily rises as the existing Big Sand Wash Reservoir is operated to store surplus winter flows for delivery during the irrigation season from April through September. Because of icing conditions in the "C" Canal, hardly any water is diverted during the months of January and February. No reservoir releases occur until the irrigation season. During the irrigation season, end-of-month storage generally fluctuates from April through June, declines in July and August, and rises in September as the existing reservoir is operated to meet irrigation demands. Reservoir releases generally increase from April through July and decline in August and September.

3.1.5.1.1.3 River Reaches. In the upper part of the project area basin, the Lake Fork and Yellowstone Rivers generally flow in deep, narrow glacial valleys up to 2,000 feet deep. The rivers join in the middle part of the basin and flow southeast in multiple channels, joining the Duchesne River near Myton. In the middle and lower part of the basin, the river valleys become shallower and broader as they flow across broad, alluvial floodplains and glacial outwash deposits.

Most irrigation diversions occur during spring and early summer when river flows are high and sufficient water is available. Diversions exceeding crop consumptive use (CU) requirements are common during this time of year as irrigators attempt to compensate for water shortages that occur in late summer during lower-flow periods. This overdiversion of water decreases irrigation efficiency by increasing surface runoff and irrigation deep percolation. Some of this runoff and deep percolation is used on croplands lower in the

basin, some is used by phreatophytes (for example, in wetland areas and other non-crop areas), and some returns to the river as drainage and agricultural return flows.

Using the Water Budget Model developed for Uinta Basin studies, baseline flows by month in wet, average, and dry years were estimated for 17 river reaches (5 on the Yellowstone River and 12 on the Lake Fork River). Map 3.1-1 shows these river reach locations. Baseline flows are presented in later tables by designated river reach and are compared with modeled flows under the Proposed Action and alternatives.

Baseline ranked annual peak (maximum) flows also were developed from model data and also are presented in later tables. The 2-year return period data reflect channel and wetland maintenance flows; the 5-, 10-, and 20-year data reflect overbank flows that are essential to regenerate and maintain riparian and wetland plants; and the 20- and 50-year data reflect peak flood discharges that can affect fluvial processes.

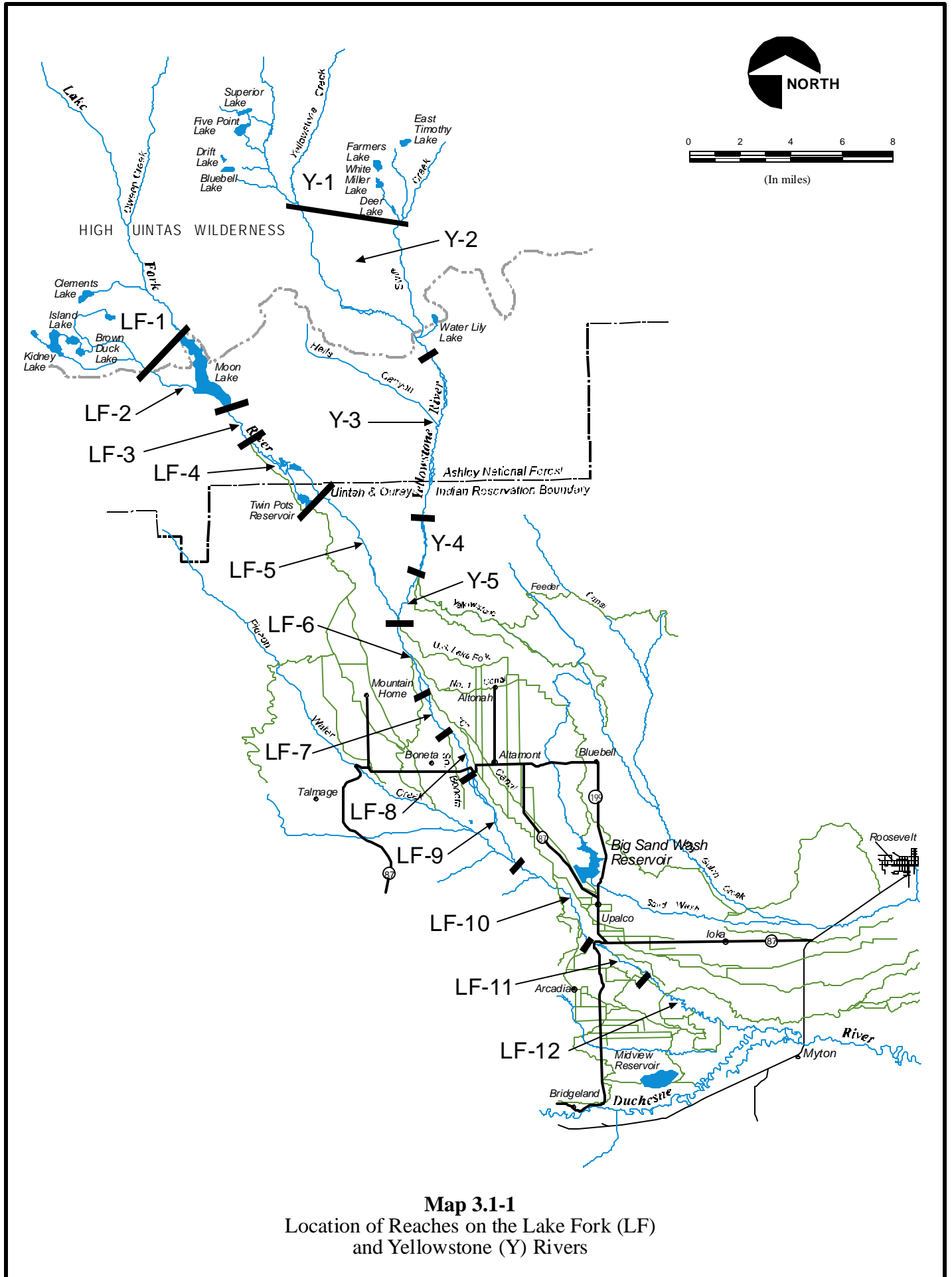
3.1.5.1.1.4 Irrigation Canals and Seepage. Canals in the Section 203 project area are generally unlined. There is no proposal to line these canals, although there would be an estimated water conservation of 925 ac-ft annually from conveying a portion of the water that is now conveyed by several canals through two new pipelines. Even with this reduction in conveyance losses, canal seepage losses project area-wide would continue to be approximately 22,000 ac-ft annually, reducing conveyance efficiency and overall irrigation efficiency.

3.1.5.1.2 Groundwater Hydrology Two types of aquifers are present in the study area: shallow, unconfined aquifers in the unconsolidated glacial/alluvial deposits; and a deep, confined, regional aquifer in the consolidated bedrock formations. For the Uinta Basin, total groundwater storage is estimated to be about 28 million ac-ft (Hood and Fields 1978).

Groundwater in the shallow, unconfined aquifers moves southward, generally following the topographic gradient, and discharges to surface waters in the southern part of the basin. These aquifers contain much less water than the large regional aquifer, and groundwater movement through them occurs more rapidly. Groundwater storage in the shallow aquifers is estimated to be about 2 million ac-ft, or about 7 percent of the total groundwater volume in the Uinta Basin (Hood and Fields 1978). Hydraulic conductivities range from 2 to 1,800 feet per day, but are generally in the order of 20 to 80 feet per day (Hood 1976). Overall, as the size of the aquifer material (glacial outwash and alluvium) declines from north to south, the hydrologic conductivities also decline. Therefore, the lowest hydrologic conductivities generally occur in the southern part of the basin.

In bench and upland areas, shallow groundwater moves toward streams and rivers and discharges as springs where low-permeability bedrocks outcrop in valley walls. These aquifers are primarily recharged locally by high stream flows during spring runoff and through infiltration from leaky canals and irrigation-deep percolation. They also respond rapidly to changes in recharge or discharge, such as canal seepage and well pumping.

The deep, regional aquifer consists of deeply circulating groundwater that moves south-southeast from its recharge area in the Uinta Mountains. The main areas of discharge are in the southern and eastern parts of the basin. Of the estimated 300,000 ac-ft of annual discharge, about 160,000 ac-ft occurs as evapotranspiration, about 12,000 ac-ft is discharged by well pumping, and the rest (128,000 ac-ft) is discharge from springs and diffuse seepage.



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Near the southern part of the basin, the regional aquifer is under artesian pressure. The hydrostatic pressure has been measured from 50 to 120 feet above ground surface, which indicates upward leakage (Hood and Fields 1978).

Because of distinctive geologic and hydrologic differences in the shallow aquifers, the project area was divided into three subunits. The Upper Subunit consists of the Uinta Mountains; mountain lake basins; and deep, glacially cut river valleys underlain by coarse-grained shallow aquifers recharged by precipitation and snowmelt. The Middle Subunit consists of flat benchlands and uplands underlain by shallow aquifers recharged by surface waters, canal seepage, and irrigation-deep percolation. The Lower Subunit consists of wide, flat river valleys underlain by fine-grained shallow aquifers that discharge to surface waters.

3.1.5.1.2.1 Upper Subunit. The high mountain lakes area consists of gravelly, sandy, and silty glacial ground moraine or bouldery talus overlying quartzite bedrock. The area is covered by deep snow much of the year, and serves as a major recharge area for the entire project area. Groundwater is very shallow and many saturated bogs, meadows, and springs are present in the lake basins. Currently, when the high mountain lakes are drawn down for irrigation, groundwater drains from adjacent meadows and glacial till into the lakes. The shallow aquifer recharges local tributary streams and rivers, which eventually recharge shallow aquifers farther south in the basin. Water percolating into bedrock material eventually moves down into the deep, regional aquifer.

Farther south, the valley bottom alluvium is estimated to be more than 100 feet thick (Stetson Engineers 1995a) and contains a shallow, unconfined, highly permeable aquifer that is recharged primarily by Yellowstone River percolation and seepage from valley walls. Because the hydraulic conductivity of the alluvium is high (30 to 200 feet per day), the shallow aquifer shows a direct and rapid response to changes in river levels and flows. Typically, valley-bottom shallow aquifers are at or near the same elevation as adjacent surface waters.

3.1.5.1.2.2 Middle Subunit. Overlying the Duchesne River and Uinta Formations are glacial moraines, glacial outwash gravels, alluvium, and related coarse-grained deposits that range in thickness from a few feet to more than 200 feet. These unconsolidated deposits form a nearly continuous sheet of material that comprises the prolific shallow aquifer in the middle subunit. Shallow aquifer recharge occurs primarily from river loss/percolation, canal seepage, and agricultural return flows (surface runoff and irrigation-deep percolation). Depth to groundwater varies seasonally, but it is usually within 10 feet of the surface.

The shallow aquifers in the middle subunit provide water to numerous shallow wells and springs in the area. Based on historical shallow well data (Hood and Fields 1978), these wells experience large fluctuations because of factors such as yearly precipitation and seasonal irrigation patterns. No definitive trend in well water levels could be determined from the historical data, but natural and human-induced fluctuations already occur.

Springs occur where rivers downcut through bench gravels into low-permeability bedrock, forcing shallow groundwater to move laterally and discharge at bedrock outcrops. Shallow groundwater discharging out of valley walls as springs is an important hydrogeologic feature in the middle subunit.

The Lake Fork River flows through a wide, flat-bottomed valley in the middle subunit. The floodplain is underlain by sand and gravel and contains shallow, unconfined groundwater, which responds rapidly to changes in river flow. Some recharge to the floodplain shallow aquifer occurs through seepage from the shallow aquifers on adjacent benches and uplands.

No alluvial or glacial outwash material that would contain shallow groundwater is present at the Big Sand Wash Reservoir site. Deeper groundwater is present in the Duchesne River Formation beneath the reservoir site, but this groundwater is part of the regional aquifer, which is confined by low-permeability shales, siltstones, and sandstones in the area.

3.1.5.1.2.3 Lower Subunit. The Lake Fork River in the lower subunit is a meandering stream that has a low gradient and carries a large, suspended, sediment load. The river alluvium is largely fine-grained and contains a lower permeability aquifer than farther upstream. Groundwater input to this shallow, alluvial aquifer occurs through discharge from adjacent shallow aquifers and upward leakage from the regional aquifer.

Outcrops of Duchesne River and Uinta Formation bedrock are prevalent in the lower subunit. Groundwater in these bedrock formations has an upward gradient and discharges as springs under artesian pressure. The lower part of the subunit tends to be an area of discharge for both aquifers.

3.1.5.1.2.4 Shallow Aquifer Groundwater Budget. Table 3.1-1 shows the shallow aquifer groundwater budget for the project area. Currently, most shallow aquifer recharge occurs during peak spring runoff in May and June with little recharge later in the summer after the peak flow is past. Canal seepage loss, irrigation deep percolation, and downward river percolation are the primary sources of shallow aquifer recharge. Under baseline conditions, approximately 47,350 ac-ft annually recharges the shallow aquifer.

TABLE 3-1
Shallow Aquifer Groundwater Budget for the Section 203 Project Area—Baseline Conditions

Project Area Recharge	Precipitation	Canal Seepage	Irrigation Deep Percolation	River Loss	Total
Baseline (ac-ft/yr)	1,000	22,000	5,350	19,000	47,350

Project area-wide, canal seepage losses are about 22,000 ac-ft. This represents about 46 percent of the total shallow aquifer recharge budget, or about 13 percent of the 169,337 ac-ft diverted for irrigation annually. Recharge to the shallow aquifer from irrigation-deep percolation is currently about 5,350 ac-ft, or half the annual agricultural return flow (10,700 ac-ft).

3.1.5.2 Revised Section 203 Alternative

The affected environment and baseline hydrologic conditions for the Revised Section 203 Alternative are the same as described for the Proposed Action, except that no high mountain lakes would be stabilized and there would be no provision for instream flows.

3.1.5.3 Twins Pots Section 203 Alternative

The affected environment and baseline hydrologic conditions for the Twin Pots Section 203 Alternative are the same as described for the Proposed Action, except as noted in the following text. Also, there would be no provision for instream flows for fish.

A pipeline from the Lake Fork River to the Yellowstone River above the Yellowstone Feeder Canal would be included in this alternative. This pipeline would allow water to be transferred from the Lake Fork River to the Yellowstone Feeder Canal.

Twin Pots Dam and Reservoir, which are part of the proposed Twin Pots Section 203 Alternative, are located offstream on an unnamed channel just west of the Lake Fork River (see Map 2.4-1 in Chapter 2 of the Final EA). The existing reservoir has an estimated capacity of 4,050 ac-ft and receives water from the Lake Fork River via the Farnsworth Canal. A 100-cfs turnout from the Farnsworth Canal near the northwest end of the reservoir provides the reservoir water supply. Average annual diversions for Twin Pots Reservoir total about 3,800 ac-ft, or about 4 percent of the average annual inflow above Moon Lake Reservoir. The reservoir, operated and maintained by the Moon Lake Water Users Association, is typically drained by the end of the irrigation season with only the dead (inactive) pool remaining.

Twin Pots Reservoir is surrounded by glacial moraine that consists of unsorted and unstratified gravel, sand, and silt. The thickness of the moraine deposits appears to be several hundred feet at the reservoir site and likely contains shallow, unconfined groundwater that is recharged locally by reservoir seepage and snowmelt infiltration.

3.1.6 Impact Analysis

This section identifies and describes the environmental impacts of the Section 203 Proposed Action and each alternative on surface water and groundwater resources. The discussion focuses on the hydrologic changes and effects expected from project construction and operation.

3.1.6.1 Potential Impacts Eliminated from Further Analysis

Under the Proposed Action and each evaluated action alternative (Revised Section 203 and Twin Pots Section 203), construction-related impacts would be essentially the same and would include minor water use and temporary stream diversion activities. A small amount of water would be used to construct the project features proposed. Construction impacts on water quantity would be negligible compared to available water supplies.

In the fall preceding the summer construction season, the outlet works for each high mountain lake proposed for stabilization would be left open to allow each lake to be drawn down to its lowest level and to pass subsequent lake inflows downstream. Surface water hydrology during lake stabilization would not be affected since lake inflows would be diverted around the work site and released downstream. Dam embankment materials removed would be spread over an area near the embankment and below the high water line. Stabilization of the high mountain lakes would not begin until Big Sand Wash Reservoir enlargement is completed and water would be available for irrigation purposes.

Both Big Sand Wash and Twin Pots Reservoirs are existing offstream reservoir facilities. Construction work related to increasing the capacity of Big Sand Wash Reservoir would occur primarily outside the existing reservoir and would not affect, or have minimal effects on, current reservoir operations. Twin Pots Dam rehabilitation activities would occur primarily in and near the reservoir area. During the construction period, up to 4,050 ac-ft of water would be unavailable for irrigation purposes because the reservoir would be drained prior to rehabilitation of the dam. Minimal cofferdam or diversion facilities would be needed to divert surface water inflow around the Twin Pots work site.

New diversion structure construction would not impact surface or groundwater hydrology since no significant change in river flows would occur. Concrete used to construct the Big Sand Wash Feeder Diversion Structure would be placed during low flow periods (March through May and October through December) on one side of the river first, while water is diverted to the other side. An earthen coffer dike or sheetpile wall would separate the construction area from the side of the river used to convey river flow. After construction of half of the diversion structure, flows would be diverted over the newly built concrete section and a sandbag coffer dike would be installed to separate river flow from the construction area on the other side of the river.

Potential short-term impacts would be avoided or reduced by following the standard construction and operating requirements contained in Appendix A of the Final EA.

3.1.6.2 Proposed Action Lake Fork Section 203

3.1.6.2.1 Potential Operational Impacts on Surface Water Hydrology The operation of project features including reservoirs, diversions, pipelines, high mountain lakes, and the commitment to instream flows, would cause changes in the surface water hydrology through the storage, delivery, and use of an additional 4,963 ac-ft of water. Individual project features are discussed only when notable hydrologic changes would occur.

Changing the quantity and timing of surface water flows would enhance beneficial uses of water for municipal and industrial purposes, crop production, instream flows, and other project purposes. Increased water efficiencies and greater water conservation would provide an opportunity for instream flows, more irrigation water evenly distributed throughout the growing season, and possibly an extension in late season irrigation deliveries. These improvements in water management would decrease the amount of water leaving the project area and Uinta Basin. Project water would only be delivered to lands that are currently irrigated. No new lands would be allowed to be brought under irrigation with the project irrigation water developed by construction of these new project facilities.

The Water Budget Model was used to quantify potential changes in project area river flows and reservoir storage. Based on the hydrologic changes identified, potential environmental effects on water quality, environmental contaminants, and biological resources were determined and evaluated.

3.1.6.2.1.1 High Mountain Lakes. With the stabilization of 4 high mountain lakes in the upper Lake Fork River watershed and 9 high mountain lakes in the upper Yellowstone River watershed, the outlet pipes would be plugged and water surface elevations maintained year-round at the stabilized elevations proposed. Past drawdowns ranging from 11 feet (Brown Duck and Clements) to 18 feet (Kidney) in the Lake Fork drainage, and from 6 feet

(Bluebell) to 27 feet (East Timothy) in the Yellowstone drainage would be eliminated because the lakes would no longer be used for irrigation. Water surface fluctuations would be limited to those associated with natural flow conditions. Table 2.2-3 in the Final EA summarizes existing and future lake characteristics following stabilization.

In the Lake Fork drainage, a total of about 2,755 ac-ft of project water would be required for a one-time filling of the four lakes to the stabilized elevations. Once this initial filling has taken place, lake inflow and outflow would mirror natural conditions. Winter and spring flows that were used in the past to fill the lakes and provide an average of 4,347 ac-ft of non-project irrigation water would pass downstream, be re-regulated in Moon Lake Reservoir, provide instream flows to the Lake Fork River, and then would be stored in the enlarged Big Sand Wash Reservoir.

In the upper Yellowstone drainages, about 1,770 ac-ft of additional project water would be required for a one-time filling of the 9 lakes to the stabilized elevations. Once this initial filling has taken place, the inflow and outflow for these 9 lakes would mirror natural conditions. Winter and spring flows that were used in the past to fill the lakes and provide an average of 1,945 ac-ft of non-project irrigation water would pass downstream and be stored in the enlarged Big Sand Wash Reservoir. The Operating Agreement stipulates provisions for bypass instream flows past the Yellowstone Feeder and “C” Canal Divisions using this high mountain lakes’ water.

The water rights for the 13 high mountain lakes are owned by the MLWUA, who would file an application with the Utah State Engineer to transfer them to the enlarged Big Sand Wash Reservoir. The stabilization of these 13 lakes and the transfer of the water rights would not only benefit the fishery in the 13 lakes, but would provide the restoration of natural conditions within the wilderness area. Consequently, the streamflows in the upper Lake Fork and Yellowstone watersheds would be uncontrolled and follow natural runoff patterns. Recreational values within the wilderness area would be enhanced, and fish habitat and water quality would be improved.

3.1.6.2.1.2 Dams and Reservoirs. After enlargement, Big Sand Wash Reservoir would have a total storage capacity of 24,100 ac-ft. This represents about 13 percent of the average annual flow in the Lake Fork River in the project area. The water supply for the enlarged Big Sand Wash Reservoir would come from the Lake Fork River via the existing “C” Canal and via the proposed Big Sand Wash Feeder Pipeline. The enlarged reservoir would fill most often in March and, on an annual basis, would fill about 67 percent of the time.

The operation of Big Sand Wash Reservoir would be coordinated with Moon Lake Reservoir to provide an instream flow from Moon Lake Dam to the Big Sand Wash Feeder Diversion Structure. Big Sand Wash Reservoir storage space allocations, operations, maintenance, and the inflow and distribution of project and non-project water are described in detail in Chapter 2 of the Final EA.

3.1.6.2.1.3 River Reaches. Using the Water Budget Model, both baseline and “with project” flows (by month) were estimated for wet, average, and dry years. Map 3.1-1 shows river reach locations in the Lake Fork (LF) and Yellowstone (Y) Rivers. Table 3.1-2 shows, by river reach and month, the difference (in cfs) expected under the Proposed Action compared to baseline/“without project” conditions during wet, average, and dry years. It should be

Table 3.1-2

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Lake Fork Section 203 Alternative (Proposed Action)

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Y-1¾ Yellowstone High Mountain Lakes Storage (ac-ft)													
Wet ^a	Baseline	772	1,187	1,602	2,017	2,467	3,001	3,773	3,994	3,994	2,034	74	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-772	-1,187	-1,602	-2,017	-2,467	-3,001	-3,773	-3,994	-3,994	-2,304	-74	0
Average	Baseline	594	891	1,188	1,485	1,782	2,198	2,792	3,861	3,994	2,034	74	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-594	-891	-1,188	-1,485	-1,782	-2,198	-2,792	-3,861	-3,994	-2,034	-74	0
Dry ^b	Baseline	416	594	772	970	1,148	1,445	1,861	2,573	3,464	1,504	0	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-416	-594	-772	-970	-1,148	-1,445	-1,861	-2,573	-3,464	-1,504	0	0
Y-2, Y-3, & Y-4¾ Yellowstone High Mountain Lakes to Yellowstone Feeder Diversion (cfs)													
Wet ^a	Baseline	134	86	67	56	50	51	61	295	818	491	237	157
	Alternative	137	89	70	59	53	54	65	302	827	481	220	148
	Difference	3	3	3	3	3	3	4	7	9	-10	-17	-9
Average	Baseline	90	68	56	49	45	47	70	284	482	217	141	111
	Alternative	93	71	59	52	48	50	74	290	484	207	126	102
	Difference	3	3	3	3	3	3	4	6	2	-10	-15	-9
Dry ^b	Baseline	61	49	42	40	37	38	74	162	181	106	82	60
	Alternative	64	52	45	43	40	41	77	167	186	97	70	50
	Difference	3	3	3	3	3	3	3	5	5	-9	-12	-10
Y-5¾ Yellowstone Feeder Diversion to Confluence (cfs)													
Wet ^a	Baseline	70	85	67	56	50	50	49	237	683	392	189	137
	Alternative	73	87	70	59	53	53	50	236	694	378	157	103
	Difference	3	2	3	3	3	3	1	-1	11	-14	-32	-34
Average	Baseline	23	63	55	49	45	46	56	225	381	150	91	85
	Alternative	25	66	58	52	48	49	56	228	382	130	74	70
	Difference	2	3	3	3	3	3	0	3	1	-20	-17	-15
Dry ^b	Baseline	3	32	37	40	37	37	60	125	123	70	70	51
	Alternative	6	35	40	43	40	40	59	124	122	68	64	41
	Difference	3	3	3	3	3	3	-1	-1	-1	-2	-6	-10

Table 3.1-2

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Lake Fork Section 203 Alternative (Proposed Action)

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-1³/₄ Lake Fork High Mountain Lakes Storage (ac-ft)													
Wet ^a	Baseline	356	593	830	1,067	1,304	1,660	2,075	385	4,859	2,483	107	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-356	-593	-830	-1,067	-1,304	-1,660	-2,075	-385	-4,859	-2,483	-107	0
Average	Baseline	297	475	653	831	1,009	1,306	1,662	3,444	891	1,889	0	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-297	-475	-653	-831	-1,009	-1,306	-1,662	-3,444	-891	-1,889	0	0
Dry ^b	Baseline	237	356	475	594	713	951	1,248	3,030	4,218	1,545	0	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-237	-356	-475	-594	-713	-951	-1,248	-3,030	-4,218	-1,545	0	0
LF-2³/₄ Lake Fork High Mountain Lakes to Moon Lake (cfs)													
Wet ^a	Baseline	91	58	43	34	28	28	42	303	819	411	154	99
	Alternative	97	62	47	38	32	34	49	333	789	371	153	103
	Difference	6	4	4	4	4	6	7	30	-30	-40	-1	4
Average	Baseline	58	43	34	30	27	28	57	312	550	200	99	71
	Alternative	63	46	37	33	30	33	63	342	520	150	99	65
	Difference	5	3	3	3	3	5	6	30	-30	-50	0	-6
Dry ^b	Baseline	40	35	28	26	26	30	72	213	248	74	56	41
	Alternative	44	37	30	28	28	33	77	243	228	48	56	44
	Difference	4	2	2	2	2	3	5	30	-20	-26	0	3
LF-3³/₄ Moon Lake to Farnsworth Diversion (cfs)													
Wet ^a	Baseline	1	0	0	0	7	8	47	229	644	439	267	165
	Alternative	11	11	11	11	11	11	49	201	621	449	244	153
	Difference	10	11	11	11	4	3	2	-28	-23	10	-23	-12
Average	Baseline	4	3	2	2	2	2	46	226	458	393	261	107
	Alternative	11	10	9	9	9	9	51	205	413	400	262	119
	Difference	7	7	7	7	7	7	5	-21	-45	7	1	12
Dry ^b	Baseline	1	0	0	0	0	0	42	240	398	111	55	39
	Alternative	5	4	4	4	4	4	48	200	347	179	55	40
	Difference	4	4	4	4	4	4	6	-40	-51	68	0	1

Table 3.1-2

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Lake Fork Section 203 Alternative (Proposed Action)

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-4^{3/4}Farnsworth Diversion to Rowley Diversion (cfs)													
Wet ^a	Baseline	0	0	0	0	7	7	21	125	513	304	158	108
	Alternative	11	11	11	11	11	11	23	97	490	314	136	96
	Difference	11	11	11	11	4	4	2	-28	-23	10	-22	-12
Average	Baseline	3	2	2	2	2	2	20	125	330	279	198	82
	Alternative	10	9	9	9	8	8	24	106	284	283	196	94
	Difference	7	7	7	7	6	6	4	-19	-46	4	-2	12
Dry ^b	Baseline	0	0	0	0	0	0	16	149	313	100	52	36
	Alternative	4	4	4	4	4	4	22	114	240	160	54	38
	Difference	4	4	4	4	4	4	6	-35	-73	60	2	2
LF-5^{3/4}Rowley Diversion to Confluence (cfs)													
Wet ^a	Baseline	10	17	27	22	20	18	32	156	644	341	197	112
	Alternative	21	21	21	21	21	21	33	107	500	324	146	106
	Difference	11	4	-6	-1	1	3	1	-49	-144	-17	-51	-6
Average	Baseline	14	14	14	14	14	15	33	173	404	307	246	101
	Alternative	20	19	19	19	18	18	34	116	294	293	206	104
	Difference	6	5	5	5	4	3	1	-57	-110	-14	-40	3
Dry ^b	Baseline	10	10	10	10	10	10	25	173	343	209	97	58
	Alternative	14	14	14	14	14	14	32	124	250	170	64	48
	Difference	4	4	4	4	4	4	7	-49	-93	-39	-33	-10
LF-6^{3/4}Confluence to "C" Canal Diversion (cfs)													
Wet ^a	Baseline	80	103	94	79	70	69	31	194	1,076	476	179	141
	Alternative	94	108	90	80	74	74	33	144	943	445	96	102
	Difference	14	5	-4	1	4	5	2	-50	-133	-31	-83	-39
Average	Baseline	37	77	69	63	59	61	40	199	535	208	154	92
	Alternative	45	85	77	71	66	68	40	145	426	181	110	87
	Difference	8	8	8	8	7	7	0	-54	-109	-27	-44	-5
Dry ^b	Baseline	13	42	47	50	47	48	35	99	232	111	47	40
	Alternative	20	49	54	56	53	54	41	54	147	95	29	32
	Difference	7	7	7	6	6	6	6	-45	-85	-16	-18	-8

Table 3.1-2

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Lake Fork Section 203 Alternative (Proposed Action)

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-7¾"C Canal Diversion to South Boneta Diversion (cfs)													
Wet ^a	Baseline	10	52	44	67	67	56	13	78	650	268	63	71
	Alternative	14	14	39	80	74	55	20	65	626	237	84	74
	Difference	4	-38	-5	13	7	-1	7	-13	-24	-31	21	3
Average	Baseline	3	12	20	61	57	39	14	75	239	72	38	22
	Alternative	10	12	16	71	66	35	22	79	226	81	48	30
	Difference	7	0	-4	10	9	-4	8	4	-13	9	10	8
Dry ^b	Baseline	0	0	2	50	47	15	8	40	46	28	22	13
	Alternative	7	7	7	56	53	12	18	46	60	38	22	16
	Difference	7	7	5	6	6	-3	10	6	14	10	0	3
LF-8¾South Boneta Diversion to Big Sand Wash Feeder Pipeline Diversion (cfs)													
Wet ^a	Baseline	10	59	63	79	70	56	12	95	758	287	71	84
	Alternative	14	14	39	80	74	55	20	63	622	232	81	72
	Difference	4	-45	-24	1	4	-1	8	-32	-136	-55	10	-12
Average	Baseline	3	14	23	63	59	41	15	92	287	71	38	24
	Alternative	10	12	16	71	66	35	21	77	222	78	46	29
	Difference	7	-2	-7	8	7	-6	6	-15	-65	7	8	5
Dry ^b	Baseline	0	0	2	50	47	15	7	38	44	33	25	14
	Alternative	7	7	7	56	53	12	17	44	58	37	22	15
	Difference	7	7	5	6	6	-3	10	6	14	4	-3	1
LF-9¾Big Sand Wash Feeder Pipeline Diversion Purdy Diversion (cfs)													
Wet ^a	Baseline	13	55	46	69	71	62	16	76	648	266	61	70
	Alternative	3	3	28	46	41	47	10	47	603	222	70	61
	Difference	-10	-52	-18	-23	-30	-15	-6	-29	-45	-44	9	-9
Average	Baseline	6	15	23	63	61	45	18	73	237	70	36	22
	Alternative	3	5	8	18	17	31	11	62	205	68	35	18
	Difference	-3	-10	-15	-45	-44	-14	-7	-11	-32	-2	-1	-4
Dry ^b	Baseline	3	3	5	52	50	21	12	39	45	29	23	14
	Alternative	3	3	2	5	6	12	8	29	44	27	11	4
	Difference	0	0	-3	-47	-44	-9	-4	-10	-1	-2	-12	-10

Table 3.1-2

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Lake Fork Section 203 Alternative (Proposed Action)

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-10^{3/4}Purdy Ditch Diversion to Red Cap Diversion (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	14	86	747	276	62	80
	Alternative	3	3	28	46	41	47	9	40	590	209	62	56
	Difference	-10	-59	-37	-35	-32	-15	-5	-46	-157	-67	0	-24
Average	Baseline	6	17	25	66	63	47	17	84	277	61	31	20
	Alternative	3	5	8	18	17	31	11	56	194	60	30	15
	Difference	-3	-12	-17	-48	-46	-16	-6	-28	-83	-1	-1	-5
Dry ^b	Baseline	3	3	5	52	50	21	9	29	35	30	24	13
	Alternative	3	3	2	5	6	12	7	24	36	24	11	4
	Difference	0	0	-3	-47	-44	-9	-2	-5	1	-6	-13	-9
LF-11^{3/4}Red Cap Diversion to Hamilton-Knudsen Diversion (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	7	59	713	240	33	65
	Alternative	3	3	28	46	41	47	4	17	556	174	35	41
	Difference	-10	-59	-37	-35	-32	-15	-3	-42	-157	-66	2	-24
Average	Baseline	6	17	25	66	63	47	10	56	242	26	4	6
	Alternative	3	5	8	18	17	31	5	34	161	28	8	5
	Difference	-3	-12	-17	-48	-46	-16	-5	-22	-81	2	4	-1
Dry ^b	Baseline	3	3	5	52	50	21	2	2	2	1	0	0
	Alternative	3	3	2	5	6	12	1	2	8	4	0	0
	Difference	0	0	-3	-47	-44	-9	-1	0	6	3	0	0
LF-12^{3/4}Hamilton-Knudsen Diversion to Duchesne River (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	6	57	711	238	31	64
	Alternative	3	3	28	46	41	47	4	16	553	171	34	41
	Difference	-10	-59	-37	-35	-32	-15	-2	-41	-158	-67	3	-23
Average	Baseline	6	17	25	66	63	47	9	55	240	24	2	6
	Alternative	3	5	8	18	17	31	5	33	159	26	7	4
	Difference	-3	-12	-17	-48	-46	-16	-4	-22	-81	2	5	-2
Dry ^b	Baseline	3	3	5	52	50	21	2	0	0	0	0	0
	Alternative	3	3	2	5	6	12	1	2	7	4	0	0
	Difference	0	0	-3	-47	-44	-9	-1	2	7	4	0	0

^aWet years include 1941, 1944, 1965, 1983

^bDry years include 1934, 1977, 1988, 1989

noted that the estimated monthly flow in dry and/or average years may exceed the flow in average and/or wet years because of the timing of reservoir inflows and releases.

Yellowstone River. With high mountain lakes' stabilization, flows originating in the upper Yellowstone River watershed (High Uintas Wilderness Area) would be uncontrolled and would follow natural runoff patterns. Because the lakes would generally be stabilized near natural levels, peak flows below the lakes would be similar to natural (pre-1900s) conditions. Flow changes described for the Yellowstone River in the following text reflect the effects of stabilizing the nine high mountain lakes.

From the high mountain lakes down to the Lake Fork River confluence (Reaches Y-1 through Y-5), average flows would usually be from about 3 cfs (up to about 10 percent) higher than baseline from October through June (see Table 3.1-2). From July through September, average flows downstream to the Yellowstone Feeder-Payne diversion (Reaches Y-1 through Y-4) would be from 9 to 15 cfs (up to about 10 percent) lower than baseline flows. Average flows in the Yellowstone River downstream of this diversion (Reach Y-5) from July through September would be from 15 to 20 cfs (up to about 20 percent) lower than baseline flows. Much of the river's flow would continue to be diverted into the Yellowstone Feeder and Payne Canals for irrigation use during this time. However, unlike the present, the Operating Agreement stipulates a bypass flow of high mountain lakes' water of 2.5 cfs in July, 2 cfs in August and September, and 3 cfs during the rest of the year. At present, except for some relatively minor accretion, the Yellowstone River is essentially dewatered from the Yellowstone Feeder-Payne diversion downstream to the confluence with the Lake Fork River (Reach Y-5) for about 1 month each year. This condition would no longer occur under the Proposed Action because of the bypass instream flows past this diversion.

Lake Fork River. Flows in the upper Lake Fork River above Moon Lake Dam (Reaches LF-1 and LF-2) would generally be similar to present, except slightly higher in fall, winter, and spring, and slightly lower in summer because of stabilizing four lakes (see Table 3.1-2). From October through April, flows in the Lake Fork River below Moon Lake Dam downstream to the Big Sand Wash Feeder Diversion Structure (Reaches LF-3 through LF-8) would almost always be higher than at present because of the release of instream flows for fish. As described in Chapter 2 of the Final EA and shown in Table 2.2-4, instream flow releases for fish would vary from 3.5 cfs in a dry year to 7.0 cfs in an average year to 10.5 cfs in a wet year. Presently, no water is released from Moon Lake Reservoir from mid-October through mid-April. As a result, river reaches below the dam downstream to the confluence with the Yellowstone River (Reaches LF-3 through LF-5) are either dewatered or experience substantive flow reductions from mid-fall through early spring. Flows for fish also would be released from Moon Lake Dam in August and September, but the amounts (from 6 cfs in a dry year to 11 cfs in average and wet years) would almost always be exceeded by irrigation releases from Moon Lake Reservoir during these 2 months. Expected benefits to fish habitat from the flow releases, which are planned for all water years, are discussed in the *Aquatic Resources* section of this chapter.

From Moon Lake Dam to the Rowley Ditch diversion (Reaches LF-3 and LF-4), average flows from mid-October through mid-April would increase from about 2 cfs under baseline conditions (effects of accretion) to about 9 cfs under the Proposed Action (increase of 350 percent) (see Table 3.1-2). During the remainder of the year, average flows in these 2 reaches of the Lake Fork would be much higher, ranging from 94 to 412 cfs, with some

months up to 12 cfs higher (increase of 15 percent) than baseline and other months up to 46 cfs lower (decrease of 14 percent) than baseline. Below the Rowley Ditch diversion to the confluence with the Yellowstone River (Reach LF-5), average flows from mid-October through mid-April would increase from about 14 cfs under baseline conditions to about 19 cfs under the Proposed Action (increase of 36 percent). From May through August, average flows in this river reach would be considerably higher, ranging from 104 to 294 cfs, but from 14 to 110 cfs (5 to 27 percent) lower than under baseline conditions. Flows would be about 3 cfs (3 percent) higher in August (104 cfs) than baseline.

From the Lake Fork's confluence with the Yellowstone River to the "C" Canal diversion (Reach LF-6), Proposed Action average flows would be 0 to 8 cfs (0 to 22 percent) higher than baseline from October through April and 5 to 109 cfs (5 to 20 percent) lower than baseline from May through September (see Table 3.1-2). From the "C" Canal diversion to the Big Sand Wash Feeder Pipeline diversion (Reaches LF-7 and LF-8), Proposed Action average flows would be up to about 10 cfs (about 26 percent) higher than baseline during more than half of the year and from 2 to 65 cfs (14 to 23 percent) lower than baseline primarily during late spring and early summer.

The "C" Canal Diversion Structure would be operated in a manner to accommodate the passage of instream flows released from Moon Lake Reservoir downstream to the Big Sand Wash Feeder Diversion Structure, as well as designated bypass flows originating at stabilized high mountain lakes in the upper Yellowstone drainage. The benefits of leaving flows in the river would be most apparent during dry water years when Reaches LF-7 and LF-8 between the "C" Canal diversion and the proposed Big Sand Wash Feeder Diversion Structure have little or no flow in late summer and fall. The hydrologic model tends to mask these absolute flow commitments during an "average" water year because predicted flows are based on all water years, including the 4 wet water years (see Table 3.1-2). This causes "average" flow values to exceed the instream flow commitments between the "C" Canal and Big Sand Wash Feeder diversion structures. Instream flows for fish are defined by values that were presented in Table 2.2-4 of the Final EA.

From the Big Sand Wash Feeder Pipeline diversion to the river's confluence with the Duchesne River (Reaches LF-9 through LF-12), Proposed Action average flows would be generally lower than baseline, especially in January, February, and June (about 40 to 80 cfs and 30 to 70 percent lower than baseline).

Table 3.1-3 shows the 2-, 5-, 10-, 20- and 50-year ranked annual peak flows and percent change in flows estimated for the Proposed Action. These data were used to assess potential impacts on aquatic and wildlife resources, wetlands, and threatened and endangered species. The 20- and 50-year data, which illustrate the potential effect on peak flood discharges and fluvial processes, show that peak flood discharges downstream of Moon Lake Dam would decline up to about 10 percent but not change significantly compared to baseline conditions. Depending on river reach, 20-year flood flows would vary from 1,171 to 2,068 cfs compared to baseline values of 1,162 to 2,167 cfs; 50-year flood values would vary from 1,317 to 2,251 cfs under the Proposed Action, compared to baseline values of 1,292 to 2,396 cfs.

**Table 3.1-3
Ranked Annual Peak Flows for the Lake Fork Section 203 Alternative (Proposed Action)**

Reach	Return Period ^a	Baseline ^b (cfs)	Lake Fork 203 ^b (cfs)	Percent Change ^c	Reach	Return Period ^a	Baseline ^b (cfs)	Lake Fork 203 ^b (cfs)	Percent Change ^c
Y-2 through Y-4	Yellowstone High Mountain Lakes to Yellowstone Feeder Diversion				LF-6	Confluence to "C" Canal Diversion			
	2-yr	741	749	0%		2-yr	829	706	-15%
	5-yr	980	966	0%		5-yr	1,463	1,381	-6%
	10-yr	1,179	1,178	0%		10-yr	1,943	1,857	-4%
	20-yr	1,302	1,311	0%		20-yr	2,167	2,068	-5%
	50-yr	1,432	1,607	12%		50-yr	2,396	2,251	-6%
Y-5	Yellowstone Feeder Diversion to Confluence				LF-7	"C" Canal Diversion to South Boneta Diversion			
	2-yr	601	609	0%		2-yr	494	345	-30%
	5-yr	840	826	0%		5-yr	1,111	992	-11%
	10-yr	1,039	1,038	0%		10-yr	1,629	1,457	-11%
	20-yr	1,162	1,171	0%		20-yr	1,776	1,668	-6%
	50-yr	1,292	1,467	14%		50-yr	2,017	1,851	-8%
LF-2	Lake Fork High Mountain Lakes to Moon Lake				LF-8	South Boneta Bypass to Big Sand Wash Feeder			
	2-yr	1,011	1,011	0%		2-yr	489	340	-31%
	5-yr	1,516	1,516	0%		5-yr	1,106	988	-11%
	10-yr	1,742	1,742	0%		10-yr	1,624	1,452	-11%
	20-yr	1,820	1,820	0%		20-yr	1,771	1,664	-6%
	50-yr	1,948	1,948	0%		50-yr	2,012	1,847	-8%
LF-3	Farnsworth Diversion Inflow				LF-10	Purdy Ditch Diversion to Red Cap Diversion			
	2-yr	711	716	0%		2-yr	480	310	-35%
	5-yr	968	968	0%		5-yr	1,096	962	-12%
	10-yr	1,246	1,166	-6%		10-yr	1,613	1,421	-12%
	20-yr	1,410	1,303	-8%		20-yr	1,761	1,633	-7%
	50-yr	1,448	1,448	0%		50-yr	2,002	1,817	-9%
LF-4	Rowley Ditch Diversion Inflow				LF-11	Red Cap Diversion to Hamilton-Knudsen Diversion			
	2-yr	579	583	0%		2-yr	445	276	-38%
	5-yr	849	848	0%		5-yr	1,061	927	-13%
	10-yr	1,116	1,035	-7%		10-yr	1,580	1,386	-12%
	20-yr	1,283	1,171	-9%		20-yr	1,726	1,599	-7%
	50-yr	1,317	1,317	0%		50-yr	1,968	1,782	-9%

**Table 3.1-3
Ranked Annual Peak Flows for the Lake Fork Section 203 Alternative (Proposed Action)**

Reach	Return Period ^a	Baseline ^b (cfs)	Lake Fork 203 ^b (cfs)	Percent Change ^c	Reach	Return Period ^a	Baseline ^b (cfs)	Lake Fork 203 ^b (cfs)	Percent Change ^c
LF-5	Rowley Ditch Diversion to Confluence				LF-12	Hamilton-Knudsen Diversion to Duchesne River			
	2-yr	620	593	-4%		2-yr	443	274	-38%
	5-yr	964	858	-11%		5-yr	1,059	924	-13%
	10-yr	1,178	1,045	-11%		10-yr	1,577	1,383	-12%
	20-yr	1,343	1,181	-12%		20-yr	1,724	1,597	-7%
	50-yr	1,368	1,327	-3%		50-yr	1,966	1,780	-9%

Notes:

Flows ranked largest to smallest by California Method (Chow 1964).

^aThe return period is the average duration required to experience the given flow (or greater). For example, the baseline peak flow of 620 cfs will be reached or exceeded once within a 2-year period, on average, at the Rowley Ditch Diversion to Confluence.

^b5-, 10-, 20- and 50-year return period flows are linearly interpolated.

^cPercent change rounded to the nearest whole number; values less than 0.5 percent shown as 0 percent.

The 5-year and 10-year peak flows downstream of Moon Lake Dam would decline up to about 13 percent, but not significantly compared to baseline conditions (see Table 3.1-3). Depending on river reach, the 5-year flood flows would vary from 826 to 1,381 cfs compared to baseline values of 840 to 1,463 cfs; 10-year flood flows would vary from 1,035 to 1,857 cfs compared to baseline values of 1,039 to 1,943 cfs. By comparison, the 2-year flood flows would decline by a larger percentage (up to 38 percent in some reaches), ranging from 274 to 716 cfs under the Proposed Action versus 443 to 829 cfs under baseline conditions, again depending on river reach.

Effects on fish habitat that would result from these modeled flow changes are discussed in the *Aquatic Resources* section of this chapter.

3.1.6.2.1.4 Irrigation Canals and Seepage. Overall, less water would be diverted for agricultural use during spring high-flow periods than under baseline conditions. Changes in spring diversion patterns could cause the following effects:

- Reduced river diversions during spring would reduce the quantity of water (return flows) in small creeks and drainages.
- Limited overirrigation would reduce subsurface drainage and shallow groundwater recharge, making less subsurface drainage available for discharge to creeks and drains.
- Reduced water availability in spring may encourage improved water management and capital improvements that would increase irrigation efficiency.

Project M&I water would be available throughout the year as needed, and project irrigation water would be available during summer to supplement natural flows and to extend late season irrigation deliveries possibly by as much as 2 to 3 weeks. Changes in summer diversion patterns and in late season irrigation deliveries could cause the following effects:

- More late-summer subsurface drainage would discharge to creeks and drains.
- More late-summer water would increase crop production.
- Increased crop production potential would encourage water management improvements to increase irrigation efficiency and crop production.
- Prolonged flows in the river channels and canals would extend the water source for fish, wildlife, and/or vegetation.

With increased project storage capacity, late-season irrigation deliveries would be extended and irrigation diversions better matched to crop consumptive use (CU) requirements. These changes would increase crop production and thereby crop CU (water used by crops where initially applied), and decrease indirect CU (runoff water used by downstream irrigators, wetlands, and phreatophytes). Water leaving the project area by outflow from the Lake Fork River to the Duchesne River would decrease from 27,200 ac-ft to 23,855 ac-ft, or by 12 percent (3,345 ac-ft), annually, and is described in the following text. The Proposed Action provides 6,500 ac-ft of replacement storage for high mountain lakes' water in the enlarged Big Sand Wash Reservoir. However, this 6,500 ac-ft of storage and use is already occurring in the Lake Fork system and, therefore, would not represent new water depletion. The remaining 5,500 ac-ft of storage in the enlarged Big Sand Wash Reservoir would be for

new project water. This would consist of 3,000 ac-ft of storage for M&I water and 2,500 ac-ft of storage for irrigation water. Half of the 3,000 ac-ft of M&I water, or 1,500 ac-ft, is estimated to return to the system, representing a depletion of 1,500 ac-ft. The 2,500 ac-ft of storage for irrigation water is estimated to yield 1,963 ac-ft of water; an estimated 6 percent or 118 ac-ft of this diverted water would return to the system as return flow. (The 6 percent estimate is the same used in estimating baseline return flows for irrigation diversions.) The net depletion associated with irrigation diversions would be 1,963 ac-ft minus 118 ac-ft, or 1,845 ac-ft. The total net depletion under the Proposed Action would be 1,500 ac-ft associated with M&I water plus 1,845 ac-ft associated with irrigation water, or a total of 3,345 ac-ft.

3.1.6.2.2 Potential Operational Impacts on Groundwater Hydrology

3.1.6.2.2.1 Upper Subunit. With high mountain lakes stabilization, higher shallow groundwater levels in adjacent meadows and glacial till would be maintained year-round since lake drawdown and related groundwater discharge into the lakes would be eliminated. For those lakes situated in bedrock and surrounded by talus deposits, stabilization would not affect the local groundwater regime because shallow groundwater is essentially absent.

3.1.6.2.2.2 Middle Subunit. Most shallow aquifer recharge occurs during peak spring runoff in May and June with little recharge later in the summer after the peak flow is past. Canal seepage losses, irrigation-deep percolation, and downward river percolation are the primary sources of shallow aquifer recharge in the middle subunit.

Under the Proposed Action, water use changes and improved water management would cause an estimated 20 percent decrease (1,100 ac-ft/yr) in shallow aquifer recharge from irrigation-deep percolation. This change would occur because of increased crop consumptive use and improved irrigation efficiencies. No canals are lined, so only changes in irrigation water management would result in changes to shallow aquifer recharge. Total recharge to the shallow aquifer would be about 46,250 ac-ft/yr compared to 47,350 ac-ft/yr under baseline conditions. Minor changes in localized shallow well water levels are anticipated, but they cannot be quantified with available information.

Enlarging Big Sand Wash Reservoir likely would not change any local groundwater conditions because the reservoir overlies relatively impermeable bedrock of the Duchesne River formation. No potential adverse effects on groundwater are expected.

When shallow aquifer levels are closely and directly tied to river levels, changes in groundwater levels can be approximated by estimating changes in water surface elevations. Water surface elevation changes in July and August were estimated at three Lake Fork River locations within the middle subunit. The July and August analysis period was selected because this is typically the driest period for wetland and riparian habitat. Of particular concern is the potential effect changes in river elevation could have on habitat used by the Ute ladies'-tresses orchid (*Spiranthes diluvialis*), a federally listed threatened species.

Under the Proposed Action, water surface elevations in an average water year would decrease 0.3 foot in July and decrease 0.7 foot in August above the "C" Canal diversion; increase 0.1 foot in July and not change in August above the Big Sand Wash Feeder Diversion Structure; and increase 0.6 foot in July and decrease 0.2 foot in August above the

Hamilton-Knudsen diversion. Water surface elevations in a dry water year would decrease 0.4 foot in July and decrease 0.6 foot in August above the “C” Canal diversion; decrease 0.2 foot in July and decrease 0.1 foot in August above the Big Sand Wash Feeder Diversion Structure; and decrease 0.5 foot in July and decrease 0.2 foot in August above the Hamilton-Knudsen diversion. Similar localized changes in shallow groundwater levels are anticipated adjacent to these Lake Fork River locations.

3.1.6.2.2.3 Lower Subunit. This part of the shallow aquifer is not an area of aquifer recharge but discharge through seepage into adjacent surface waters. Maintaining groundwater levels more consistently throughout the year would maintain more stable discharges to surface waters.

Upward leakage in the lower subunit from the regional aquifer to the shallow aquifer would not change. The regional aquifer is recharged in the upper basin (Uinta Mountains), and is under artesian pressure and confined by low-permeability strata in the lower subunit, which protects it from changes in the shallow aquifer.

3.1.6.3 Revised Section 203 Alternative

Similar to the Proposed Action, construction and operation of the Revised Section 203 Alternative would change the timing and quantity of surface water flows in the project area and would allow an additional 10,297 ac-ft of project water to be used for M&I purposes, crop production, instream flows (although there are no instream flow commitments), and other project purposes. Water use changes such as M&I use, increased crop use, more even water use throughout the growing season, and possibly a 2- to 3-week extension in late season irrigation deliveries, as well as improved water management such as water delivery matched to crop requirements, would decrease the amount of water leaving the project area and Uinta Basin. Project water would be delivered to the same lands currently irrigated.

3.1.6.3.1 Potential Operational Impacts on Surface Hydrology. Impacts on surface water hydrology would be the same as described for the Proposed Action, except as noted in the following text.

3.1.6.3.1.1 High Mountain Lakes. There would be no stabilization of high mountain lakes under this alternative. Therefore, flow in the upper reaches of the basin would not change from baseline.

3.1.6.3.1.2 Dams and Reservoirs. Under the Revised Section 203 Alternative, Big Sand Wash Reservoir would be enlarged and operated as described under the Proposed Action. The enlarged reservoir would fill most often in March and, on an annual basis, would fill about 50 percent of the time. Reservoir storage space allocations, operations, maintenance, and the inflow and distribution of project and non-project water are described in detail in Chapter 2 of the Final EA.

3.1.6.3.1.3 River Reaches. Table 3.1-4 shows, by river reach and month, the difference (in cfs) and in flow expected under the Revised Section 203 Alternative compared to baseline conditions.

Table 3.1-4

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Revised Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Y-1¾ Yellowstone High Mountain Lakes Storage (ac-ft)													
Wet ^a	Baseline	772	1,187	1,602	2,017	2,467	3,001	3,773	3,994	3,994	2,034	74	0
	Alternative	772	1,187	1,602	2,017	2,467	3,001	3,773	3,994	3,994	2,034	74	0
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Average	Baseline	594	891	1,188	1,485	1,782	2,198	2,792	3,861	3,994	2,034	74	0
	Alternative	594	891	1,188	1,485	1,782	2,198	2,792	3,861	3,994	2,034	74	0
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Dry ^b	Baseline	416	594	772	970	1,148	1,445	1,861	2,573	3,464	1,504	0	0
	Alternative	416	594	772	970	1,148	1,445	1,861	2,573	3,464	1,504	0	0
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Y-2, Y-3, & Y-4¾ Yellowstone High Mountain Lakes to Yellowstone Feeder Diversion (cfs)													
Wet ^a	Baseline	134	86	67	56	50	51	61	295	818	491	237	157
	Alternative	134	86	67	56	50	51	61	295	818	491	237	157
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Average	Baseline	90	68	56	49	45	47	70	284	482	217	141	111
	Alternative	90	68	56	49	45	47	70	284	482	217	141	111
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Dry ^b	Baseline	61	49	42	40	37	38	74	162	181	106	82	60
	Alternative	61	49	42	40	37	38	74	162	181	106	82	60
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Y-5¾ Yellowstone Feeder Diversion to Confluence (cfs)													
Wet ^a	Baseline	70	85	67	56	50	50	49	237	683	392	189	137
	Alternative	70	86	67	56	50	50	49	236	682	393	188	125
	Difference	0	1	0	0	0	0	0	-1	-1	1	-1	-12
Average	Baseline	23	63	55	49	45	46	56	225	381	150	91	85
	Alternative	24	63	55	49	45	46	56	226	385	149	88	80
	Difference	1	0	0	0	0	0	0	1	4	-1	-3	-5
Dry ^b	Baseline	3	32	37	40	37	37	60	125	123	70	70	51
	Alternative	3	32	37	40	37	37	59	126	124	68	75	52
	Difference	0	0	0	0	0	0	-1	1	1	-2	5	1

Table 3.1-4

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Revised Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-1³/₄ Lake Fork High Mountain Lakes Storage (ac-ft)													
Wet ^a	Baseline	356	593	830	1,067	1,304	1,660	2,075	385	4,859	2,483	107	0
	Alternative	356	593	830	1,067	1,304	1,660	2,075	385	4,859	2,483	107	0
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Average	Baseline	297	475	653	831	1,009	1,306	1,662	3,444	891	1,889	0	0
	Alternative	297	475	653	831	1,009	1,306	1,662	3,444	891	1,889	0	0
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Dry ^b	Baseline	237	356	475	594	713	951	1,248	3,030	4,218	1,545	0	0
	Alternative	237	356	475	594	713	951	1,248	3,030	4,218	1,545	0	0
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
LF-2³/₄ Lake Fork High Mountain Lakes to Moon Lake (cfs)													
Wet ^a	Baseline	91	58	43	34	28	28	42	303	819	411	154	99
	Alternative	91	58	43	34	28	28	42	303	819	411	154	99
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Average	Baseline	58	43	34	30	27	28	57	312	550	200	99	71
	Alternative	58	43	34	30	27	28	57	312	550	200	99	71
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
Dry ^b	Baseline	40	35	28	26	26	30	72	213	248	74	56	41
	Alternative	40	35	28	26	26	30	72	213	248	74	56	41
	Difference	0	0	0	0	0	0	0	0	0	0	0	0
LF-3³/₄ Moon Lake to Farnsworth Diversion (cfs)													
Wet ^a	Baseline	1	0	0	0	7	8	47	229	644	439	267	165
	Alternative	2	22	16	12	9	8	51	223	738	433	219	137
	Difference	1	22	16	12	2	0	4	-6	94	-6	-48	-28
Average	Baseline	4	3	2	2	2	2	46	226	458	393	261	107
	Alternative	5	5	5	6	6	6	55	239	454	374	243	107
	Difference	1	2	3	4	4	4	9	13	-4	-19	-18	0
Dry ^b	Baseline	1	0	0	0	0	0	42	240	398	111	55	39
	Alternative	1	0	0	0	0	0	49	217	362	205	55	39
	Difference	0	0	0	0	0	0	7	-23	-36	94	0	0

Table 3.1-4

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Revised Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-4^{3/4}Farnsworth Diversion to Rowley Diversion (cfs)													
Wet ^a	Baseline	0	0	0	0	7	7	21	125	513	304	158	108
	Alternative	2	22	16	12	9	7	25	119	607	299	111	80
	Difference	2	22	16	12	2	0	4	-6	94	-5	-47	-28
Average	Baseline	3	2	2	2	2	2	20	125	330	279	198	82
	Alternative	4	5	5	5	5	5	28	137	324	253	167	74
	Difference	1	3	3	3	3	3	8	12	-6	-26	-31	-8
Dry ^b	Baseline	0	0	0	0	0	0	16	149	313	100	52	36
	Alternative	0	0	0	0	0	0	23	125	254	178	54	37
	Difference	0	0	0	0	0	0	7	-24	-59	78	2	1
LF-5^{3/4}Rowley Diversion to Confluence (cfs)													
Wet ^a	Baseline	10	17	27	22	20	18	32	156	644	341	197	112
	Alternative	12	32	26	22	19	17	35	129	617	309	121	90
	Difference	2	15	-1	0	-1	-1	3	-27	-27	-32	-76	-22
Average	Baseline	14	14	14	14	14	15	33	173	404	307	246	101
	Alternative	14	15	15	15	15	15	38	147	334	263	177	84
	Difference	0	1	1	1	1	0	5	-26	-70	-44	-69	-17
Dry ^b	Baseline	10	10	10	10	10	10	25	173	343	209	97	58
	Alternative	10	10	10	10	10	10	33	135	264	188	64	47
	Difference	0	0	0	0	0	0	8	-38	-79	-21	-33	-11
LF-6^{3/4}Confluence to "C" Canal Diversion (cfs)													
Wet ^a	Baseline	80	103	94	79	70	69	31	194	1,076	476	179	141
	Alternative	81	118	93	78	69	68	34	167	1,048	444	103	107
	Difference	1	15	-1	-1	-1	-1	3	-27	-28	-32	-76	-34
Average	Baseline	37	77	69	63	59	61	40	199	535	208	154	92
	Alternative	38	78	70	64	60	62	44	174	470	164	84	71
	Difference	1	1	1	1	1	1	4	-25	-65	-44	-70	-21
Dry ^b	Baseline	13	42	47	50	47	48	35	99	232	111	47	40
	Alternative	13	42	47	50	47	48	42	67	159	95	34	37
	Difference	0	0	0	0	0	0	7	-32	-73	-16	-13	-3

Table 3.1-4

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Revised Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-7¾"C" Canal Diversion to South Boneta Diversion (cfs)													
Wet ^a	Baseline	10	52	44	67	67	56	13	78	650	268	63	71
	Alternative	0	17	41	78	69	40	19	91	745	275	63	102
	Difference	-10	-35	-3	11	2	-16	6	13	95	7	0	31
Average	Baseline	3	12	20	61	57	39	14	75	239	72	38	22
	Alternative	2	7	9	64	60	23	22	98	269	86	48	31
	Difference	-1	-5	-11	3	3	-16	8	23	30	14	10	9
Dry ^b	Baseline	0	0	2	50	47	15	8	40	46	28	22	13
	Alternative	0	0	0	50	47	0	16	56	63	41	24	16
	Difference	0	0	-2	0	0	-15	8	16	17	13	2	3
LF-8¾South Boneta Diversion to Big Sand Wash Feeder Pipeline Diversion (cfs)													
Wet ^a	Baseline	10	59	63	79	70	56	12	95	758	287	71	84
	Alternative	0	17	41	78	69	40	18	87	741	271	60	100
	Difference	-10	-42	-22	-1	-1	-16	6	-8	-17	-16	-11	16
Average	Baseline	3	14	23	63	59	41	15	92	287	71	38	24
	Alternative	2	7	9	64	60	23	22	95	265	83	46	30
	Difference	-1	-7	-14	1	1	-18	7	3	-22	12	8	6
Dry ^b	Baseline	0	0	2	50	47	15	7	38	44	33	25	14
	Alternative	0	0	0	50	47	0	16	53	59	40	24	16
	Difference	0	0	-2	0	0	-15	9	15	15	7	-1	2
LF-9¾Big Sand Wash Feeder Pipeline Diversion to Purdy Diversion (cfs)													
Wet ^a	Baseline	13	55	46	69	71	62	16	76	648	266	61	70
	Alternative	3	20	43	41	45	46	13	66	697	237	38	75
	Difference	-10	-35	-3	-28	-26	-16	-3	-10	49	-29	-23	5
Average	Baseline	6	15	23	63	61	45	18	73	237	70	36	22
	Alternative	5	10	11	16	19	29	15	73	233	58	26	19
	Difference	-1	-5	-12	-47	-42	-16	-3	0	-4	-12	-10	-3
Dry ^b	Baseline	3	3	5	52	50	21	12	39	45	29	23	14
	Alternative	3	3	2	4	5	6	13	34	37	19	5	6
	Difference	0	0	-3	-48	-45	-15	1	-5	-8	-10	-18	-8

Table 3.1-4

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Revised Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-10^{3/4}Purdy Ditch Diversion to Red Cap Diversion (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	14	86	747	276	62	80
	Alternative	3	20	43	41	45	46	10	58	684	225	32	70
	Difference	-10	-42	-22	-40	-28	-16	-4	-28	-63	-51	-30	-10
Average	Baseline	6	17	25	66	63	47	17	84	277	61	31	20
	Alternative	5	10	11	16	19	29	12	65	221	50	22	16
	Difference	-1	-7	-14	-50	-44	-18	-5	-19	-56	-11	-9	-4
Dry ^b	Baseline	3	3	5	52	50	21	9	29	35	30	24	13
	Alternative	3	3	2	4	5	6	10	27	30	16	4	5
	Difference	0	0	-3	-48	-45	-15	1	-2	-5	-14	-20	-8
LF-11^{3/4}Red Cap Diversion to Hamilton-Knudsen Diversion (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	7	59	713	240	33	65
	Alternative	3	20	43	41	45	46	3	32	650	190	6	56
	Difference	-10	-42	-22	-40	-28	-16	-4	-27	-63	-50	-27	-9
Average	Baseline	6	17	25	66	63	47	10	56	242	26	4	6
	Alternative	5	10	11	16	19	29	5	40	188	19	1	4
	Difference	-1	-7	-14	-50	-44	-18	-5	-16	-54	-7	-3	-2
Dry ^b	Baseline	3	3	5	52	50	21	2	2	2	1	0	0
	Alternative	3	3	2	4	5	6	3	1	1	0	0	0
	Difference	0	0	-3	-48	-45	-15	1	-1	-1	-1	0	0
LF-12^{3/4}Hamilton-Knudsen Diversion to Duchesne River (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	6	57	711	238	31	64
	Alternative	3	20	43	41	45	46	3	31	647	188	5	56
	Difference	-10	-42	-22	-40	-28	-16	-3	-26	-64	-50	-26	-8
Average	Baseline	6	17	25	66	63	47	9	55	240	24	2	6
	Alternative	5	10	11	16	19	29	5	38	186	18	0	4
	Difference	-1	-7	-14	-50	-44	-18	-4	-17	-54	-6	-2	-2
Dry ^b	Baseline	3	3	5	52	50	21	2	0	0	0	0	0
	Alternative	3	3	2	4	5	6	3	0	0	0	0	0
	Difference	0	0	-3	-48	-45	-15	1	0	0	0	0	0

^aWet years include 1941, 1944, 1965, and 1983

^bDry years include 1934, 1977, 1988, and 1989

Yellowstone River. With no high mountain lakes stabilization, flows originating in the upper Yellowstone River watershed (Uinta Mountains) downstream to the confluence with the Lake Fork River would not change.

Lake Fork River. No flow changes would occur in the upper Lake Fork River watershed since high mountain lakes located above Moon Lake Reservoir would not be stabilized but operated for irrigation purposes as in the past. From Moon Lake Dam to the river's confluence with the Duchesne River, monthly flows and flow patterns under the Revised Section 203 Alternative (see Table 3.1-4) would be somewhat similar to those described for the Proposed Action. The main difference under the Revised Section 203 Alternative is that there would be no releases of instream flows for fish from Moon Lake Reservoir that would remain in the Lake Fork River downstream to the Big Sand Wash Feeder Diversion Structure and no provision for bypass instream flows past the Yellowstone Feeder and "C" Canal diversions.

Table 3.1-5 shows the ranked annual peak flows and percent change in flows estimated for the Revised Section 203 Alternative as compared to baseline conditions. Changes in peak flows would be similar to or slightly less than the changes described for the Proposed Action.

3.1.6.3.1.4 Irrigation Canals and Seepage. Project area-wide effects resulting from changes in spring and summer diversion patterns would generally be similar to those described for the Proposed Action. Water leaving the project area would decrease by 8,359 ac-ft, as described here. The entire 12,000 ac-ft of storage in the enlarged Big Sand Wash Reservoir would be for new project water under the Revised Section 203 Alternative. The 12,000 ac-ft of enlarged storage would consist of 3,000 ac-ft of storage for M&I water and 9,000 ac-ft of storage for irrigation water. Half of the 3,000 ac-ft of M&I water, or 1,500 ac-ft, is estimated to return to the system, representing a depletion of 1,500 ac-ft. The 9,000 ac-ft of storage for irrigation water is estimated to yield 7,297 ac-ft of water; an estimated 6 percent or 438 ac-ft of this diverted water would return to the system as return flow. (The 6 percent estimate is the same as used in estimating baseline return flows for irrigation diversions.) The net depletion associated with irrigation diversions would be 7,297 ac-ft minus 438 ac-ft, or 6,859 ac-ft. The total net depletion under the Revised Section 203 Alternative would be 1,500 ac-ft associated with M&I water plus 6,859 ac-ft associated with irrigation water, or a total of 8,359 ac-ft.

3.1.6.3.2 Potential Operational Impacts on Groundwater Hydrology Changes in groundwater hydrology would be similar to those under the Proposed Action.

3.1.6.4 Twin Pots Section 203 Alternative

Somewhat similar to the Proposed Action, construction and operation of the Twin Pots Section 203 Alternative would impact the timing and quantity of surface water flows in the project area, and would yield an additional 4,600 ac-ft of project water to be used for M&I purposes, crop production, and other project purposes. Water use changes such as increased M&I use, crop use, more even water use throughout the growing season, and possibly a 2- to 3-week extension in late season irrigation deliveries, as well as improved water management such as water delivery matched to crop requirements, would decrease the amount of water leaving the project area and Uinta Basin. Project water would be delivered to the same lands currently irrigated.

**Table 3.1-5
Ranked Annual Peak Flows for the Revised Section 203 Alternative**

Reach	Return Period ^a	Baseline ^b (cfs)	Revised 203 ^b (cfs)	Percent Change ^c	Reach	Return Period ^a	Baseline ^b (cfs)	Revised 203 ^b (cfs)	Percent Change ^c
Y-2 through Y-4	Yellowstone High Mountain Lakes to Yellowstone Feeder Diversion				LF-6	Confluence to "C" Canal Diversion			
	2-yr	741	741	0%		2-yr	829	703	-15%
	5-yr	980	980	0%		5-yr	1,463	1,423	-3%
	10-yr	1,179	1,179	0%		10-yr	1,943	1,899	-2%
	20-yr	1,302	1,302	0%		20-yr	2,167	2,126	-2%
	50-yr	1,432	1,432	0%		50-yr	2,396	2,349	-2%
Y-5	Yellowstone Feeder Diversion to Confluence				LF-7	"C" Canal Diversion to South Boneta Diversion			
	2-yr	601	601	0%		2-yr	494	405	-18%
	5-yr	840	840	0%		5-yr	1,111	1,052	-5%
	10-yr	1,039	1,039	0%		10-yr	1,629	1,673	3%
	20-yr	1,162	1,162	0%		20-yr	1,776	1,726	-3%
	50-yr	1,292	1,292	0%		50-yr	2,017	1,949	-3%
LF-2	Lake Fork High Mountain Lakes to Moon Lake				LF-8	South Boneta Bypass to Big Sand Wash Feeder			
	2-yr	1,011	1,011	0%		2-yr	489	401	-18%
	5-yr	1,516	1,516	0%		5-yr	1,106	1,047	-5%
	10-yr	1,742	1,742	0%		10-yr	1,624	1,668	3%
	20-yr	1,820	1,820	0%		20-yr	1,771	1,721	-3%
	50-yr	1,948	1,948	0%		50-yr	2,012	1,945	-3%
LF-3	Farnsworth Diversion Inflow				LF-10	Purdy Ditch Diversion to Red Cap Diversion			
	2-yr	711	690	-3%		2-yr	480	340	-29%
	5-yr	968	1,017	5%		5-yr	1,096	987	-10%
	10-yr	1,246	1,254	1%		10-yr	1,613	1,608	0%
	20-yr	1,410	1,410	0%		20-yr	1,761	1,662	-6%
	50-yr	1,448	1,448	0%		50-yr	2,002	1,885	-6%
LF-4	Rowley Ditch Diversion Inflow				LF-11	Red Cap Diversion to Hamilton-Knudsen Diversion			
	2-yr	579	579	0%		2-yr	445	307	-31%
	5-yr	849	880	4%		5-yr	1,061	954	-10%
	10-yr	1,116	1,125	1%		10-yr	1,580	1,574	0%
	20-yr	1,283	1,283	0%		20-yr	1,726	1,627	-6%
	50-yr	1,317	1,317	0%		50-yr	1,968	1,851	-6%

**Table 3.1-5
Ranked Annual Peak Flows for the Revised Section 203 Alternative**

Reach	Return Period^a	Baseline^b (cfs)	Revised 203^b (cfs)	Percent Change^c	Reach	Return Period^a	Baseline^b (cfs)	Revised 203^b (cfs)	Percent Change^c
LF-5	Rowley Ditch Diversion to Confluence				LF-12	Hamilton-Knudsen Diversion to Duchesne River			
	2-yr	620	589	-5%		2-yr	443	304	-31%
	5-yr	964	890	-8%		5-yr	1,059	951	-10%
	10-yr	1,178	1,135	-4%		10-yr	1,577	1,572	0%
	20-yr	1,343	1,293	-4%		20-yr	1,724	1,625	-6%
	50-yr	1,368	1,327	-3%		50-yr	1,966	1,849	-6%

Notes:

Flows ranked largest to smallest by California Method (Chow 1964).

^aThe return period is the average duration required to experience the given flow (or greater). For example, the baseline peak flow of 620 cfs will be reached or exceeded once within a 2-year period, on average, at the Rowley Ditch Diversion to Confluence.

^b5-, 10-, 20- and 50-year return period flows are linearly interpolated.

^cPercent change rounded to the nearest whole number; values less than 0.5 percent shown as 0 percent.

Compared to the Proposed Action, additional hydrologic changes would occur under the Twin Pots Alternative because of no commitments for instream flows and the construction of the Lake Fork–Yellowstone Diversion Structure and Pipeline.

3.1.6.4.1 Potential Operational Impacts on Surface Water Hydrology. Hydrology on surface water hydrology would be the same as for the Proposed Action, except as noted in the following text. Effects from high mountain lakes stabilization would be the same as described for the Proposed Action (see Section 3.1.6.2.1.1).

3.1.6.4.1.1 Dams and Reservoirs. Big Sand Wash Reservoir would be enlarged as described under the Proposed Action. After enlargement, the reservoir would fill most often in March and, on an annual basis, would fill about 41 percent of the time. Reservoir storage space allocations, operations, maintenance, and the inflow and distribution of project and non-project water are described in detail in Chapter 2 of the Final EA.

After dam replacement, Twin Pots Reservoir would have a total active storage capacity of 3,768 ac-ft (about 2 percent of the average annual basin inflow) and would no longer be used for irrigation purposes. When the Farnsworth Canal is operational, reservoir water levels would be maintained at full pool by diverting enough water from the Lake Fork River under the Tribe's 1861 priority water right to replace any evaporation and seepage losses, maintain water quality, and assure maintenance of a viable sport fishery and riparian habitat. The annual diversion requirement is estimated to be about 1,840 ac-ft of which about 390 ac-ft would compensate for evaporation losses and 1,450 ac-ft for seepage losses (Stetson 1995b). When the Farnsworth Canal is not operational, reservoir pool levels would fall because of seepage and evaporation losses, but would remain high enough to maintain a year-round Tribal sport fishery.

3.1.6.4.1.2 River Reaches. Table 3.1-6 shows, by river reach and month, the difference (in cfs and in flow) expected under the Twin Pots Section 203 Alternative compared to baseline conditions.

Yellowstone River. With high mountain lakes' stabilization, flows originating in the upper Yellowstone River watershed (High Uintas Wilderness Area) would be uncontrolled and would follow natural runoff patterns, the same as described for the Proposed Action. However, unlike the Proposed Action, from about late July to late August there would be essentially no flow in the Yellowstone River downstream of the Yellowstone Feeder-Payne diversion (Reach Y-5), the same as at present. The river's flow would continue to be diverted into the Yellowstone Feeder and Payne Canals for irrigation use during this time. Except for some relatively minor accretion, the Yellowstone River would continue to be essentially dewatered from the Yellowstone Feeder-Payne diversion downstream to the confluence with the Lake Fork River (Reach Y-5) for about 1 month each year. There is no provision for bypass instream flows under this alternative.

Lake Fork River. With high mountain lakes' stabilization, flows originating in the upper Lake Fork River watershed (High Uintas Wilderness) down to Moon Lake Reservoir would be uncontrolled and follow natural runoff patterns. Because the lakes would generally be stabilized near natural levels, peak flows below the lakes would be similar to natural (pre-1900s) conditions (see Table 3.1-6).

Table 3.1-6

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Twin Pots Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Y-1¾ Yellowstone High Mountain Lakes Storage (ac-ft)													
Wet ^a	Baseline	772	1,187	1,602	2,017	2,467	3,001	3,773	3,994	3,994	2,034	74	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-772	-1,187	-1,602	-2,017	-2,467	-3,001	-3,773	-3,994	-3,994	-2,034	-74	0
Average	Baseline	594	891	1,188	1,485	1,782	2,198	2,792	3,861	3,994	2,034	74	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-594	-891	-1,188	-1,485	-1,782	-2,198	-2,792	-3,861	-3,994	-2,034	-74	0
Dry ^b	Baseline	416	594	772	970	1,148	1,445	1,861	2,573	3,464	1,504	0	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-416	-594	-772	-970	-1,148	-1,445	-1,861	-2,573	-3,464	-1,504	0	0
Y-2, Y-3, & Y-4¾ Yellowstone High Mountain Lakes to Yellowstone Feeder Diversion (cfs)													
Wet ^a	Baseline	134	86	67	56	50	51	61	295	818	491	237	157
	Alternative	137	89	70	59	53	54	65	302	827	481	220	148
	Difference	3	3	3	3	3	3	4	7	9	-10	-17	-9
Average	Baseline	90	68	56	49	45	47	70	284	482	217	141	111
	Alternative	93	71	59	52	48	50	74	290	484	207	126	102
	Difference	3	3	3	3	3	3	4	6	2	-10	-15	-9
Dry ^b	Baseline	61	49	42	40	37	38	74	162	181	106	82	60
	Alternative	64	52	45	43	40	41	77	167	186	97	70	50
	Difference	3	3	3	3	3	3	3	5	5	-9	-12	-10
Y-5¾ Yellowstone Feeder Diversion to Confluence (cfs)													
Wet ^a	Baseline	70	85	67	56	50	50	49	237	683	392	189	137
	Alternative	76	93	74	63	57	60	57	244	688	365	188	141
	Difference	6	8	7	7	7	10	8	7	5	-27	-1	4
Average	Baseline	23	63	55	49	45	46	56	225	381	150	91	85
	Alternative	28	70	60	54	50	54	61	235	387	121	91	86
	Difference	5	7	5	5	5	8	5	10	6	-29	0	1
Dry ^b	Baseline	3	32	37	40	37	37	60	125	123	70	70	51
	Alternative	5	38	42	43	40	43	61	130	122	57	75	52
	Difference	2	6	5	3	3	6	1	5	-1	-13	5	1

Table 3.1-6

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Twin Pots Section 203 Alternative

Reach	Month												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
LF-1--Lake Fork High Mountain Lakes Storage (ac-ft)													
Wet ^a	Baseline	356	593	830	1,067	1,304	1,660	2,075	385	4,859	2,483	107	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-356	-593	-830	-1,067	-1,304	-1,660	-2,075	-385	-4,859	-2,483	-107	0
Average	Baseline	297	475	653	831	1,009	1,306	1,662	3,444	891	1,889	0	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-297	-475	-653	-831	-1,009	-1,306	-1,662	-3,444	-891	-1,889	0	0
Dry ^b	Baseline	237	356	475	594	713	951	1,248	3,030	4,218	1,545	0	0
	Alternative	0	0	0	0	0	0	0	0	0	0	0	0
	Difference	-237	-356	-475	-594	-713	-951	-1,248	-3,030	-4,218	-1,545	0	0
LF-2³/₄Lake Fork High Mountain Lakes to Moon Lake (cfs)													
Wet ^a	Baseline	91	58	43	34	28	28	42	303	819	411	154	99
	Alternative	97	62	47	38	32	34	49	333	789	371	153	103
	Difference	6	4	4	4	4	6	7	30	-30	-40	-1	4
Average	Baseline	58	43	34	30	27	28	57	312	550	200	99	71
	Alternative	63	46	37	33	30	33	63	342	520	150	99	65
	Difference	5	3	3	3	3	5	6	30	-30	-50	0	-6
Dry ^b	Baseline	40	35	28	26	26	30	72	213	248	74	56	41
	Alternative	44	37	30	28	28	33	77	243	228	48	56	44
	Difference	4	2	2	2	2	3	5	30	-20	-26	0	3
LF-3³/₄Moon Lake to Farnsworth Diversion (cfs)													
Wet ^a	Baseline	1	0	0	0	7	8	47	229	644	439	267	165
	Alternative	1	0	10	12	9	8	75	245	621	451	253	137
	Difference	0	0	10	12	2	0	28	16	-23	12	-14	-28
Average	Baseline	4	3	2	2	2	2	46	226	458	393	261	107
	Alternative	4	3	3	3	3	3	77	247	399	411	245	109
	Difference	0	0	1	1	1	1	31	21	-59	18	-16	2
Dry ^b	Baseline	1	0	0	0	0	0	42	240	398	111	55	39
	Alternative	1	0	0	0	0	0	76	240	312	173	55	39
	Difference	0	0	0	0	0	0	34	0	-86	62	0	0

Table 3.1-6

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Twin Pots Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-4^{3/4}Farnsworth Diversion to Rowley Diversion (cfs)													
Wet ^a	Baseline	0	0	0	0	7	7	21	125	513	304	158	108
	Alternative	0	0	10	12	9	7	48	141	490	317	144	80
	Difference	0	0	10	12	2	0	27	16	-23	13	-14	-28
Average	Baseline	3	2	2	2	2	2	20	125	330	279	198	82
	Alternative	3	3	3	3	2	3	50	148	270	293	176	80
	Difference	0	1	1	1	0	1	30	23	-60	14	-22	-2
Dry ^b	Baseline	0	0	0	0	0	0	16	149	313	100	52	36
	Alternative	0	0	0	0	0	0	50	154	210	148	53	36
	Difference	0	0	0	0	0	0	34	5	-103	48	1	0
LF-Pipe^{3/4}Lake Fork Pipe to Yellowstone (cfs)													
Wet ^a	Baseline	0	0	0	0	0	0	0	0	0	0	0	0
	Alternative	0	0	0	0	0	0	30	50	0	50	50	30
	Difference	0	0	0	0	0	0	30	50	0	50	50	30
Average	Baseline	0	0	0	0	0	0	0	0	0	0	0	0
	Alternative	0	0	0	0	0	0	30	49	0	47	43	26
	Difference	0	0	0	0	0	0	30	49	0	47	43	26
Dry ^b	Baseline	0	0	0	0	0	0	0	0	0	0	0	0
	Alternative	0	0	0	0	0	0	30	50	0	28	25	12
	Difference	0	0	0	0	0	0	30	50	0	28	25	12
LF-5^{3/4}Rowley Diversion to Confluence (cfs)													
Wet ^a	Baseline	10	17	27	22	20	18	32	156	644	341	197	112
	Alternative	12	32	26	22	19	17	35	129	617	309	121	90
	Difference	2	15	-1	0	-1	-1	3	-27	-27	-32	-76	-22
Average	Baseline	14	14	14	14	14	15	33	173	404	307	246	101
	Alternative	14	15	15	15	15	15	38	147	334	263	177	84
	Difference	0	1	1	1	1	0	5	-26	-70	-44	-69	-17
Dry ^b	Baseline	10	10	10	10	10	10	25	173	343	209	97	58
	Alternative	10	10	10	10	10	10	33	135	264	188	64	47
	Difference	0	0	0	0	0	0	8	-38	-79	-21	-33	-11

Table 3.1-6

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Twin Pots Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-6¾ Confluence to "C" Canal Diversion (cfs)													
Wet ^a	Baseline	80	103	94	79	70	69	31	194	1,076	476	179	141
	Alternative	86	103	94	85	76	78	35	146	937	384	86	94
	Difference	6	0	0	6	6	9	4	-48	-139	-92	-93	-47
Average	Baseline	37	77	69	63	59	61	40	199	535	208	154	92
	Alternative	42	83	73	67	63	67	41	146	418	138	65	65
	Difference	5	6	4	4	4	6	1	-53	-117	-70	-89	-27
Dry ^b	Baseline	13	42	47	50	47	48	35	99	232	111	47	40
	Alternative	15	48	53	53	50	53	40	54	117	63	21	29
	Difference	2	6	6	3	3	5	5	-45	-115	-48	-26	-11
LF-7¾ "C" Canal Diversion to South Boneta Diversion (cfs)													
Wet ^a	Baseline	10	52	44	67	67	56	13	78	650	268	63	71
	Alternative	0	0	37	85	76	49	22	67	640	245	57	64
	Difference	-10	-52	-7	18	9	-7	9	-11	-10	-23	-6	-7
Average	Baseline	3	12	20	61	57	39	14	75	239	72	38	22
	Alternative	2	6	7	67	63	28	22	78	236	76	39	25
	Difference	-1	-6	-13	6	6	-11	8	3	-3	4	1	3
Dry ^b	Baseline	0	0	2	50	47	15	8	40	46	28	22	13
	Alternative	0	0	0	53	50	3	17	49	59	31	20	14
	Difference	0	0	-2	3	3	-12	9	9	13	3	-2	1
LF-8¾ South Boneta Diversion to Big Sand Wash Feeder Pipeline Diversion (cfs)													
Wet ^a	Baseline	10	59	63	79	70	56	12	95	758	287	71	84
	Alternative	0	0	37	85	76	49	21	64	636	241	55	62
	Difference	-10	-59	-26	6	6	-7	9	-31	-122	-46	-16	-22
Average	Baseline	3	14	23	63	59	41	15	92	287	71	38	24
	Alternative	2	6	7	67	63	28	22	76	232	73	38	24
	Difference	-1	-8	-16	4	4	-13	7	-16	-55	2	0	0
Dry ^b	Baseline	0	0	2	50	47	15	7	38	44	33	25	14
	Alternative	0	0	0	53	50	3	17	46	56	30	20	14
	Difference	0	0	-2	3	3	-12	10	8	12	-3	-5	0

Table 3.1-6

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Twin Pots Section 203 Alternative

Reach		Month											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LF-9^{3/4} Big Sand Wash Feeder Pipeline Diversion to Purdy Diversion (cfs)													
Wet ^a	Baseline	13	55	46	69	71	62	16	76	648	266	61	70
	Alternative	3	3	39	54	49	55	12	44	596	209	33	44
	Difference	-10	-52	-7	-15	-22	-7	-4	-32	-52	-57	-28	-26
Average	Baseline	6	15	23	63	61	45	18	73	237	70	36	22
	Alternative	4	9	9	18	18	34	13	55	201	49	18	13
	Difference	-2	-6	-14	-45	-43	-11	-5	-18	-36	-21	-18	-9
Dry ^b	Baseline	3	3	5	52	50	21	12	39	45	29	23	14
	Alternative	3	3	2	5	6	9	12	28	34	11	2	5
	Difference	0	0	-3	-47	-44	-12	0	-11	-11	-18	-21	-9
LF-10^{3/4} Purdy Ditch Diversion to Red Cap Diversion (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	14	86	747	276	62	80
	Alternative	3	3	39	54	49	55	10	37	583	198	29	40
	Difference	-10	-59	-26	-27	-24	-7	-4	-49	-164	-78	-33	-40
Average	Baseline	6	17	25	66	63	47	17	84	277	61	31	20
	Alternative	4	9	9	18	18	34	11	49	191	42	16	11
	Difference	-2	-8	-16	-48	-45	-13	-6	-35	-86	-19	-15	-9
Dry ^b	Baseline	3	3	5	52	50	21	9	29	35	30	24	13
	Alternative	3	3	2	5	6	9	10	23	28	9	2	4
	Difference	0	0	-3	-47	-44	-12	1	-6	-7	-21	-22	-9
LF-11^{3/4} Red Cap Diversion to Hamilton-Knudsen Diversion (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	7	59	713	240	33	65
	Alternative	3	3	39	54	49	55	3	12	548	164	6	27
	Difference	-10	-59	-26	-27	-24	-7	-4	-47	-165	-76	-27	-38
Average	Baseline	6	17	25	66	63	47	10	56	242	26	4	6
	Alternative	4	9	9	18	18	34	5	25	158	15	1	2
	Difference	-2	-8	-16	-48	-45	-13	-5	-31	-84	-11	-3	-4
Dry ^b	Baseline	3	3	5	52	50	21	2	2	2	1	0	0
	Alternative	3	3	2	5	6	9	3	1	1	0	0	0
	Difference	0	0	-3	-47	-44	-12	1	-1	-1	-1	0	0

Table 3.1-6

Comparison of Wet-, Average-, and Dry-Year Flows by River Reach in the Yellowstone (Y) and Lake Fork (LF) Rivers for the Twin Pots Section 203 Alternative

Reach	Month												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
LF-12^{3/4} Hamilton-Knudsen Diversion to Duchesne River (cfs)													
Wet ^a	Baseline	13	62	65	81	73	62	6	57	711	238	31	64
	Alternative	3	3	39	54	49	55	3	11	546	162	6	26
	Difference	-10	-59	-26	-27	-24	-7	-3	-46	-165	-76	-25	-38
Average	Baseline	6	17	25	66	63	47	9	55	240	24	2	6
	Alternative	4	9	9	18	18	34	4	24	156	14	0	2
	Difference	-2	-8	-16	-48	-45	-13	-5	-31	-84	-10	-2	-4
Dry ^b	Baseline	3	3	5	52	50	21	2	0	0	0	0	0
	Alternative	3	3	2	5	6	9	3	0	0	0	0	0
	Difference	0	0	-3	-47	-44	-12	1	0	0	0	0	0

^aWet years include 1941, 1944, 1965, 1983

^bDry years include 1934, 1977, 1988, 1989

Unlike the Proposed Action, there would be no releases of instream flows for fish from Moon Lake Reservoir that would remain in the Lake Fork River downstream to the Big Sand Wash Feeder Diversion Structure. Mid-fall through early spring flows downstream to the Yellowstone River confluence (Reaches LF-3 through LF-5) would therefore be similar to baseline flows.

From Moon Lake Dam to the Rowley Ditch diversion (Reaches LF-3 and LF-4), average flows would be 14 to 31 cfs (5 to 67 percent) higher in April, May, and July, and 16 to 60 cfs (6 to 18 percent) lower in June and August (see Table 3.1-6). From the Rowley Ditch diversion to the Lake Fork's confluence with the Yellowstone River (Reach LF-5), average flows would generally be lower in all months, most notably from May through September (17 to 70 cfs and 17 to 28 percent lower than baseline). This primarily reflects the diversion of up to 50 cfs of water during the irrigation season from the Lake Fork to the Yellowstone River, where it would then be diverted into the Yellowstone Feeder and Payne Canals. From the Yellowstone River confluence to the "C" Canal diversion (Reach LF-6), average flows would be 4 to 6 cfs (6 to 14 percent) higher from October through April, and 27 to 117 cfs (22 to 58 percent) lower from May through September.

From the "C" Canal diversion downstream to the Big Sand Wash Feeder Pipeline diversion, flows would generally be about the same or less than baseline (see Table 3.1-6). Average flows would range from 8 cfs (57 percent) higher than baseline during April to 55 cfs (19 percent) lower than baseline during June. From the Big Sand Wash Feeder Pipeline diversion to the river's confluence with the Duchesne River, average flows would be generally lower throughout the year, ranging from 2 cfs (100 percent) less to 86 cfs (31 percent) less than baseline during October and June, respectively.

Table 3.1-7 shows the ranked annual peak flows and percent change in flows estimated for the Twin Pots Section 203 Alternative. The 20- and 50-year ranked annual peak flow data illustrate the potential effect on peak flood discharges and fluvial processes. The 20- and 50-year peak flood discharges, which are much greater than the average monthly values previously discussed, would generally be unchanged or reduced up to about 200 cfs (14 percent) compared to baseline peak flood conditions. Peak flows would generally be less than described for the Proposed Action.

3.1.6.4.1.3 Irrigation Canals and Seepage. Project area-wide effects resulting from changes in spring and summer diversion patterns would be similar to those described for the Proposed Action. Late-season irrigation deliveries would be extended and irrigation diversions would better match crop consumptive use requirements. Crop production and crop consumptive use would increase, while indirect consumptive uses would decrease. Water leaving the Project Area would decrease by 3,004 ac-ft, as described in the following text.

The Twin Pots Alternative provides 6,500 ac-ft of replacement storage for high mountain lakes' water in the enlarged Big Sand Wash Reservoir, but this does not represent new water depletion. The remaining 5,500 ac-ft of storage in the enlarged Big Sand Wash Reservoir would be for new project water. This would consist of 3,000 ac-ft of storage for M&I water and 2,500 ac-ft of storage for irrigation water. Half of the 3,000 ac-ft of M&I water, or 1,500 ac-ft, is estimated to return to the system, representing a depletion of 1,500 ac-ft. The 2,500 ac-ft of storage for irrigation water is designated for exchange to the rehabilitated Twin Pots Dam and Reservoir and has been estimated to yield 1,600 ac-ft of water for this

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particular purpose; an estimated 6 percent or 96 ac-ft of this diverted water would return to the system as return flow. (The 6 percent estimate is the same as used in estimating baseline return flows for irrigation diversions.) The net depletion associated with irrigation diversions would be 1,600 ac-ft minus 96 ac-ft, or 1,504 ac-ft. The total net depletion under the Twin Pots Alternative would be 1,500 ac-ft associated with M&I water plus 1,504 ac-ft associated with irrigation water, or a total of 3,004 ac-ft.

3.1.6.4.2 Potential Operational Impacts on Groundwater Hydrology ~~Hydrology~~ in groundwater hydrology would be the same as for the Proposed Action, except as noted in the following text.

The Twin Pots Reservoir improvement would maintain a higher, more stable, shallow groundwater level adjacent to the reservoir. By maintaining the reservoir at full pool when the Farnsworth Canal is operating, water would saturate adjacent moraine materials and cause the water table to rise. Higher, more stable, shallow groundwater levels also would be maintained because groundwater drainage back into the reservoir from drawdown would be eliminated. During the nonirrigation season, when the Farnsworth Canal is not operating, reservoir pool levels would fall because of reservoir seepage and evaporation. However, adjacent shallow groundwater levels would be substantially higher than now because the reservoir pool would likely be full rather than empty at the end of the irrigation season (September), and adjacent moraine materials would remain saturated by seepage from the reservoir and snowmelt.

3.1.6.5 No Action Alternative

3.1.6.5.1 Trends ~~is~~ this project is not implemented, high mountain lake storage and river diversions would continue to be operated as in the past. No additional storage would be built, no stabilization of the high mountain lakes would be completed, no pipelines constructed, and no fish and wildlife features developed. The basin's water supply for M&I irrigation uses would continue to be limited, enhancement of wilderness recreation would not occur, and instream flows would not be provided.

Based on results from the Natural Resources Conservation Service (NRCS) Salinity Reduction Program, some conversion from flood irrigation to sprinkler irrigation is expected because of the need to improve water management and conservation practices. Pressure to use water as efficiently as possible would increase as water becomes increasingly expensive and valuable, and water control and measurement becomes increasingly important.

3.1.6.5.2 Future Conditions ~~The~~ the water resources system of high mountain lakes, rivers, reservoirs, canals, and the like, would remain essentially the same, with the percentage of sprinkler irrigation systems increasing. Conversion to sprinkler irrigation would lead to a decrease in deep percolation and surface runoff and a net reduction in the amount of water leaving the project area. The amount of low-quality recharge waters entering streams, surface runoff, and shallow groundwater would decline slightly at lower elevations in the project area. Overall, future water resource and hydrologic conditions in the project area would remain essentially the same as baseline conditions.

3.1.6.5.3 Consequences of Not Meeting Project Needs ~~Without~~ Without additional storage, crop yields would continue to be limited and water would continue to be overdiverted in spring to

compensate for the lack of water in late summer. This would cause excess surface runoff, deep percolation, and lower quality return flows entering the river system. The cause of these consequences would fall more heavily on secondary water right holders. The continued practice of “dry damming” and drying up some river reaches because of overdiversion would adversely affect other river resources.

3.1.7 Cumulative Impacts

There are no other projects known at this time that would cause cumulative impacts on water resources and hydrology in the Section 203 project area. Cumulative changes in salt loads and concentrations because of changes in the amount of water leaving the project area, and the cumulative effect downstream on the Colorado River system salinity control program, are assessed in Section 3.2, *Water Quality and Contaminants*.

3.2 Water Quality and Contaminants

3.2.1 Introduction

This section addresses potential changes to, and impacts on, surface water and groundwater quality and environmental contaminants associated with the project features of the Proposed Action and alternatives of the Section 203 Project. The discussion focuses on the affected (baseline) environment followed by a summary of potential direct, indirect, total, and/or cumulative impacts on water quality and environmental contaminants.

3.2.2 Issues Eliminated from Further Analysis

All water quality or contaminant issues identified during public scoping for the Upalco Unit DEIS that are relevant to the Section 203 Project were considered in this analysis. No issues were eliminated.

3.2.3 Issues Addressed in the Impact Analysis

Water quality and environmental contaminant issues and concerns identified during public scoping focused on potential changes in water quality and contaminant levels. Projected changes for the Section 203 Project were identified and assessed for their probable qualitative effect on bioaccumulation, risks to fish and wildlife, and beneficial use designations.

In the impact analysis, concentrations of contaminants in water are expressed as milligrams of contaminant per liter of water (mg/L), which is equivalent to parts per million (ppm). Concentrations of contaminants in biota, such as fish, invertebrates, aquatic plants, and bird eggs, are expressed as micrograms of contaminant per gram of tissue ($\mu\text{g/g}$), which also is equivalent to ppm.

3.2.4 Description of Area of Influence

The area of influence for water quality and contaminants is the same as described in Section 3.1, *Water Resources and Hydrology*.

3.2.5 Affected Environment

This section describes existing (baseline) surface and groundwater quality and environmental contaminant (trace element) conditions potentially affected by the Proposed Action and each of the action alternatives. The discussion includes a general description of the water quality/contaminant characteristics best addressed on an area-wide basis, and those that need to be addressed on a more localized basis.

3.2.5.1 Proposed Action Snake Fork Section 203

3.2.5.1.1 Surface Water Quality Surface water quality in the project area is characterized by excellent quality, high mountain source waters that gradually increase in constituent concentrations as they flow downstream to lower elevations. This degradation in water quality is the result of natural and human-induced non-point infusions of salt, sediment, and contaminants. Most constituents are contributed by non-point source inputs such as agricultural return flows. Water temperatures range from 0°C (32°F) at all locations in winter to between 18° and 26°C (64° to 78°F) in summer, depending on elevation.

In 1994, the Utah Department of Environmental Quality reclassified the waters of the state so as to protect the beneficial uses designated within each class against controllable pollution. Table 3.2-1 summarizes the water quality standards and numeric criteria established for each beneficial use classification, and Tables 3.2-2 and 3.2-3 present the water quality guidelines for irrigation use. Water classifications presented in this document are from the Utah DEQ, Division of Water Quality database on the Internet at <http://www.deq.state.ut.us>.

TABLE 3-2
Guidelines for Interpretation of Water Quality for Irrigation*

Potential Irrigation Problem		Degree of Restriction on Use		
Salinity	Units	None	Slight to Moderate	Severe
As EC	uS/cm	<700	700 to 3,000	>3,000
As TDS	mg/L	<450	450 to 2,000	>2,000
Infiltration (evaluated using SAR with EC)				
SAR		EC		
0 to 3	me/L	>700	700 to 200	<200
3 to 6	me/L	>1,200	1,200 to 300	<300
6 to 12	me/L	>1,900	1,900 to 500	<500
12 to 20	me/L	>2,900	2,900 to 1,300	<1,300
20 to 40	me/L	>5,000	5,000 to 2,900	<2,900
Specific Ion Toxicity				
Boron	mg/L	<0.7	0.7 to 3.0	>3.0

*Adapted from *Water Quality for Agriculture* (Ayers and Westcot 1989).

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3.2.5.1.1.1 High Mountain Lakes. Four high mountain lakes listed in Table 2.1-1 would be stabilized in the upper Lake Fork River watershed. The Utah Department of Environmental Quality (1994) has classified all four lakes as the following:

- Class 2B—protected for secondary contact recreation
- Class 3A—cold water fish/aquatic life
- Class 4—agricultural uses

In addition, Island Lake has been classified as Class 1C waters (protected for domestic use with treatment).

The Utah Department of Environmental Quality (1994) has classified seven of the nine lakes (except White Miller and Deer) proposed for stabilization in the upper Yellowstone River drainage as Class 2B, 3A, and 4 waters. These lakes are listed in Table 2.1-1.

The high mountain lakes can be characterized as clean, clear lakes supporting a cold water trout fishery. However, annual drawdowns ranging from 4 feet (Bluebell and White Miller) to 27 feet (East Timothy) may cause a temporary, seasonal degradation in water quality because of increased shoreline erosion; a stimulation of algal growth as a result of subsequent nutrient input from shoreline erosion; and the loss of shallow-water-attached aquatic plants that help stabilize the shoreline, take up nutrients, and provide fish habitat. Estimated water quality conditions (see Table 3.2-4) and discussions with the Utah Division of Water Quality indicate that all of the high mountain lakes meet the numeric criteria established for their beneficial use designation.

TABLE 3.2
Estimated Baseline Water Quality Conditions

Reservoir	Mid-summer Average Conditions			Suspended Sediment Concentrations		
	Chlorophyll (µg/L)	Water Clarity (Secchi depth) (ft)	Probability of Oxygen Depletion (%)	Inflow Average (mg/L)	Outflow	
					Low Range (mg/L)	High Range (mg/L)
High Mountain Lakes	0.28	10.9	16	1.5	0.045	0.15
Big Sand Wash	0.28	10.8	36	9.3	0.186	0.744
Twin Pots	0.26	9.2	12	9.3	0.093	0.465

3.2.5.1.1.2 Dams and Reservoirs. Historical water quality records and a eutrophication model were used to determine baseline water quality conditions and the quality of surface waters entering existing and proposed project area reservoirs. Table 3.2-5 summarizes the historical data as flow-weighted mean and maximum constituent concentrations. The water supply for the proposed enlarged Big Sand Wash Reservoir is represented by a blended water supply from the Lake Fork (below Moon Lake) and Yellowstone Rivers. The water supply for Twin Pots Reservoir, which would only be improved under the Twin Pots Section 203 Alternative, is represented by the “Lake Fork River below Moon Lake” data.

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Water quality records collected by the Utah Division of Water Quality (Utah Department of Environmental Quality 1996) indicate reservoirs in the project area (Big Sand Wash and Moon Lake) and surrounding area (Upper Stillwater) possess “very good” (Big Sand Wash and Moon Lake) to “excellent” (Upper Stillwater) water quality supportive of all beneficial uses. None of the reservoirs examined by the state exhibited water quality exceedances and the highest elevation lakes had the best water quality. The state sampling results are generally supportive of the baseline water quality conditions estimated for project area lakes and reservoirs (see Table 3.2-4).

Yellowstone River water quality is excellent. The water is clear, with low concentrations of total dissolved solids (TDS) and total suspended solids (TSS). Low salinity (measured as TDS), combined with a low sodium adsorption ratio (SAR), indicates generally excellent water quality (see Table 3.2-5).

The State of Utah has classified the Twin Pots and Big Sand Wash Reservoirs as the following:

- Class 1C—protected for domestic purposes with prior treatment
- Class 2B—secondary contact recreation
- Class 3A—cold water fish/aquatic life
- Class 4—agricultural uses

Water for Twin Pots Reservoir is supplied from the Lake Fork River below Moon Lake Dam via the Farnsworth Diversion. Water quality is generally excellent in this river reach as indicated by very low mean conductivity, TDS, and TSS levels (see Table 3.2-5).

Water for Big Sand Wash Reservoir is supplied from the Lake Fork River via the “C” Canal diversion located downstream from the confluence of the Lake Fork and Yellowstone Rivers. Using historical Lake Fork and Yellowstone River mean concentrations for nitrogen and phosphorus, eutrophication model results indicate a low potential for eutrophication and subsequent water quality problems (see Table 3.2-4).

3.2.5.1.1.3 River Reaches. The State of Utah has classified the entire Lake Fork–Yellowstone River system, from the confluence with the Duchesne River to headwaters, as Class 1C, 2B, 3A, and 4 waters, the same as noted for Big Sand Wash and Twin Pots Reservoirs. Moon Lake is classified for these uses as well as Class 2A (primary contact recreation).

Upper Lake Fork and Yellowstone River waters have similar quality. Both rivers and their tributary streams are cold and clear with low dissolved and particulate constituent concentrations. Mean TDS and TSS at upper elevation locations are less than 50 mg/L; and salinity, boron, and SAR levels are low (see Table 3.2-5).

Middle river reach waters range in quality from high-quality, upper-elevation waters to degraded, low-elevation waters. As water moves down through the basin and is used and reused for irrigation, it picks up increasing amounts of salt, sediment, and other constituents that return to the river as agricultural return flows.

The largest single source of agricultural return flow entering the Lake Fork River is Pigeon Water Creek. Pigeon Water Creek is more saline (mean TDS of 717 mg/L) than upper-elevation waters with increased hardness and alkalinity (see Table 3.2-5), but water quality

remains within the agricultural criteria set by the state. Mean and maximum TDS concentrations and electrical conductivity (EC) measurements indicate a slight to moderate restriction on use for irrigation.

Low-elevation waters are strongly affected by agricultural return flows. In addition to Pigeon Water Creek, other low-elevation samples representative of agricultural return flows and shallow groundwater conditions indicate: 1) a slight to severe restriction on use for irrigation because of high TDS and boron concentrations; 2) some maximum TDS and boron concentrations near Ioka and Roosevelt exceed the state agricultural criteria of 1,200 mg/L for TDS and 0.750 mg/L for boron; and 3) manganese concentrations near Ioka and Hancock Cove exceed the recommended maximum concentration in irrigation waters. Several low-elevation samples also exceeded the EPA chronic or acute freshwater criteria for mercury, silver, and/or lead.

3.2.5.1.1.4 Irrigation Canals and Seepage. Canal water quality is directly related to the quality of its source waters. For upper elevation diversions, surface water quality at canal and diversion rehabilitation sites is generally very high and essentially the same as upper Lake Fork and Yellowstone River waters. Diversions and canals downstream from the confluence of Pigeon Water Creek with the Lake Fork River have lower water quality because of the addition of agricultural return flows.

Most irrigation takes place on the bench and upland areas, which characterize the middle part of the project area. The process of canal seepage and shallow groundwater exchange results in water from upper canals moving into and degrading water in lower canals. In this general way, canal and irrigation systems affect water quality in lower-elevation streams, surface runoff/drains, and groundwater. As water moves to lower elevations through this interconnected system, its quality becomes degraded and similar to agricultural return flows, such as at Pigeon Water Creek.

3.2.5.1.2 Groundwater Quality. In 1991, the Utah Department of Environmental Quality established groundwater quality protection standards. Groundwaters are classified based on existing groundwater quality, including parameters such as TDS and primary maximum contaminant levels (MCLs). Contaminants include metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc), pesticides, and volatile organic chemicals. Although none of the Uinta Basin aquifers have been classified by the state, groundwater protection levels for unclassified groundwater areas are determined by existing groundwater quality.

Based on existing groundwater data, shallow aquifers in the project area likely fall into two categories:

- Class IA—pristine groundwater with TDS levels less than 500 mg/L and no contaminant concentrations that exceed primary MCLs
- Class II—drinking water quality groundwater with TDS levels between 500 and 3,000 mg/L and no contaminant concentrations that exceed primary MCLs

Groundwater quality is closely related to the quality of its source waters that provide recharge. As groundwater moves south, its quality is lowered because much of the recharge comes from lower quality canal seepage, agricultural return flows (including irrigation-deep

percolation), and river loss/percolation. Past and recent groundwater studies show TDS concentrations generally average from less than 500 mg/L in the upper and middle subunits to 2,071 mg/L in the lower subunit, with the increase in TDS readily apparent from north to south. TDS trends would likely be similar in the shallow and deep aquifers.

Groundwater quality in the regional, confined aquifer ranges from high to low. Quality is generally high in the upper (northern) part of the aquifer close to high-quality recharge areas, such as the Uinta Mountains, and becomes degraded as the water moves deeper and farther south (Hood and Fields 1978). Degradation occurs as groundwater passes through the Uinta and Duchesne Formations, which dissolve easily and contribute TDS to the groundwater passing through them. Thus, by the time groundwater discharges in the lower subunit, it is saline and contains high TDS concentrations. Groundwater quality in the regional aquifer, however, is not assessed further because it is protected from surface water influences (see discussions in *Water Resources and Hydrology*).

3.2.5.1.2.1 Upper Subunit. Shallow groundwater quality is high in the upper subunit because: 1) aquifer recharge is primarily from high-quality surface waters and snowmelt; 2) alluvial gravels that contain the aquifer have very low solubility and do not contribute TDS; and 3) the groundwater is just entering the system and has not dissolved soluble ions from the host bedrock. Shallow aquifers in the upper subunit likely would be classified as Class IA (pristine) waters.

3.2.5.1.2.2 Middle Subunit. Shallow groundwater quality becomes increasingly degraded, or higher in TDS, as it moves north to south through the middle subunit. This degradation occurs because: 1) canal seepage and irrigation-deep percolation leach dissolved solids out of soils and aquifer materials; 2) the alluvium contains a higher percentage of soluble bedrock materials; and 3) soils and alluvium become more saline because of increasingly poor drainage and more soluble bedrock materials.

Six trace element sampling sites (TE1 through TE6) located in the middle subunit indicate metal concentrations to be either not detectable or below primary MCLs. As shown in Table 3.2-6, TDS concentrations range between 172 and 769 mg/L, average 476 mg/L, and indicate a slight to moderate restriction on use for irrigation. All sample results above the detection limit for lead have concentrations higher than the EPA chronic freshwater criteria (0.0032 mg/L) and drinking water MCL (0.005 mg/L). Shallow aquifers in the middle subunit likely would be classified as Class IA (pristine) waters in the upper part of the subunit, and as Class II (drinking water quality) waters in the lower part of the subunit.

3.2.5.1.2.3 Lower Subunit. Most soils and some alluvial gravels in the lower subunit are derived from the Duchesne River and Uinta River Formations. These formations contain large amounts of soluble salts, which tend to dissolve as water moves through them. Saline soils, which are common in the lower part of the subunit in the land retirement areas, tend to further increase salinity loads in the shallow aquifer.

The shallow aquifer is partly recharged by the upward movement of groundwater from the confined, regional aquifer (Hood and Fields 1978). This upward-moving water accumulates dissolved solids as it flows through the Duchesne River and Uinta River Formations, contributing additional TDS loads to the shallow aquifer. Recharge from canal seepage,

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irrigation-deep percolation, and percolation of lower-quality surface waters also contribute to degraded groundwater quality in the lower subunit.

Four trace element sampling sites (TE7 through TE10) located in the lower subunit indicate metal concentrations to be either not detectable or below primary MCLs. As shown in Table 3.2-6, TDS concentrations range between 940 and 2,117 mg/L, average 1,618 mg/L, and indicate a slight to severe restriction on use for irrigation. All sample results above the detection limit for lead have concentrations higher than the EPA chronic freshwater criteria and drinking water MCL. Shallow aquifers in the lower subunit likely would be classified as Class II (drinking water quality) waters.

3.2.5.1.3 Environmental Contaminants. Following is a summary of the baseline findings contained in the Environmental Contaminants Technical Report (CH2M HILL/Horrocks 1996a). The report details existing contaminant (trace element) levels in the project area. Overall, the baseline contaminants data indicate that low-elevation areas within the project area are of greatest concern for contaminants exposure and related effects.

3.2.5.1.3.1 Contaminants in Surface Waters. Trace elements in project area surface waters are generally not detectable and below state and EPA water quality criteria. The major cations (calcium, magnesium, potassium, and sodium) have a broad range of concentrations throughout the area, but generally tend to increase from higher to lower elevations, reflecting a general increase in conductivity, salinity (TDS), and ionic enrichment at lower elevation sites. Total suspended sediment (TSS), nutrients (nitrogen and phosphorus), and radioactive elements also are higher at low-elevation sites.

Baseline trace element concentrations in the lower Lake Fork River near Myton are summarized as flow-weighted means in Table 3.2-7. For those trace elements with concentrations above the detection limit, only boron and manganese are noticeably higher and consistently exceed detection limits in lower-elevation locations. Selenium was not detected in surface water at any of the lower-elevation sites in the project area.

TABLE 3.2-7
Baseline Trace Element Concentrations for the Project Area Annual Average
Concentrations (mg/L)

Water Quality Constituent	Lower Lake Fork River
Arsenic	0.0039
Boron	0.418
Cadmium	<0.001
Chromium	<0.001
Copper	<0.010
Iron	0.019
Lead	<0.001
Manganese	0.083
Mercury	<0.0001

TABLE 3-2
Baseline Trace Element Concentrations for the Project Area Annual Average
Concentrations (mg/L)

Water Quality Constituent	Lower Lake Fork River
Selenium -D	<0.001
Selenium -T	<0.001
Zinc	<0.01
Gross Alpha*	0.0051

*In nanocuries per liter (nCi/L).

3.2.5.1.3.2 Contaminants in Fish. The National Contaminant Biomonitoring Program (NCBP) 85th percentile guidelines for freshwater fish are used to indicate elevated levels and exposure to environmental contaminants (Schmitt and Brumbaugh 1990). For the project area, some fish tissue concentrations exceeded the 85th percentile for arsenic, copper, mercury, selenium, and zinc.

Overall, trace element concentrations detected in fish tissue generally increased from fall to summer samples with the highest concentrations detected in low-elevation samples. Mean, low-elevation fish tissue concentrations for arsenic, boron, copper, mercury, and selenium were about 2, 3.6, 1.1, 1.3, and 1.4 times higher in summer than fall, respectively. Based on the baseline data gathered, the trace elements of greatest concern for fish bioaccumulation in the project area are copper, selenium, and zinc.

Mean selenium concentrations in fish obtained from high-elevation source waters decreased from fall to summer samples (3.2 µg/g to 2.2 µg/g) in contrast to low-elevation samples, which increased from about 3.6 µg/g to 5.0 µg/g, respectively. The highest concentration detected was 7.5 µg/g in Pigeon Water Creek. The NCBP 85th percentile for selenium (2.9 µg/g) was exceeded in 10 of 11 low-elevation fish samples. Predicted selenium effect levels (DOI 1993) for coldwater fish are: “no effect” (less than 2 µg/g), “level of concern” (between 2 and 4 µg/g), and “toxicity threshold” (greater than 4 µg/g). For warmwater fish, the “no effect,” “level of concern,” and “toxicity threshold” assessment levels are less than 3 µg/g, between 3 and 4 µg/g, and greater than 4 µg/g, respectively.

Organochlorine pesticide residues in fish were generally below detection limits. Pesticide residues slightly above the detection limit were found in two lower river samples, but at levels below biological effect levels. No other organochlorine pesticides were found above the detection limit.

3.2.5.1.3.3 Contaminants in Aquatic Invertebrates. Trace elements in aquatic invertebrates were analyzed to determine if birds are being exposed to elevated levels in their diet. Mixed aquatic invertebrate and insect samples throughout the project area showed both mean and maximum concentrations for arsenic, chromium, mercury, lead, and zinc in ranges considered normal or acceptable using dietary exposure criteria (Puls 1988). Levels detected were below the maximum tolerable levels identified by the National Academy of Sciences for bird diets (NAS 1980).

Invertebrate boron concentrations from the upper Lake Fork River (27 µg/g) and Pigeon Water Creek (34 µg/g) exceeded the bird dietary “acceptable” level of 13 µg/g. The mean boron concentration in low-elevation invertebrates was about 10 µg/g.

Invertebrate selenium concentrations from the Yellowstone River (2.8 µg/g) and Pigeon Water Creek (2.6 µg/g) exceeded the 2.0 µg/g maximum tolerable dietary level established by the NAS. The average selenium concentration in lower-elevation invertebrates was about 0.93 µg/g. Although selenium was not detected in bottom sediment or surface water samples, the presence of selenium in aquatic invertebrates (up to 2.8 µg/g) indicates that this trace element is bioaccumulated.

3.2.5.1.3.4 Contaminants in Aquatic Plants. Low-elevation aquatic plants show low to moderate levels of trace elements. With the exception of boron and selenium, plant tissue samples did not exhibit elevated contaminant levels. Boron levels were generally low, except for a single sample of pondweed collected from Pigeon Water Creek. This sample, containing 802 µg/g of boron, is significantly elevated when compared against the low-elevation average of 73 µg/g. Elevated fish and invertebrate boron levels at this location indicate local boron sources within the Pigeon Water Creek watershed.

Selenium was detected in pondweed samples from Midview Reservoir (3.6 µg/g) and the Duchesne River at Myton (2.3 µg/g). These concentrations are within the 2.0 to 4.0 µg/g dietary “level of concern” established for fish and wildlife (DOI 1993). The results are consistent with the basin-wide pattern of higher selenium levels being detected at lower elevation sampling sites.

3.2.5.1.3.5 Contaminants in Bird Eggs. Bird eggs collected from coot, western grebe, and killdeer nests at low-elevation sites showed that most trace elements were within normal concentration ranges. Mercury and selenium levels, however, were elevated in western grebe eggs when compared to other bird eggs sampled.

In freshwater marshes, the normal background mercury concentration in bird eggs is less than 1.0 µg/g. While the 1.5 µg/g level detected in western grebe samples from Midview Reservoir is marginally above the normal background level, it is about 1.4 to 21.4 times higher than other egg samples collected in the project area.

Selenium concentrations were generally below the less than 3 µg/g “no effect” level for waterbird eggs (DOI 1998). The only exception was western grebe eggs at Midview Reservoir, which ranged in concentration from 3.6 to 4.3 µg/g. Compared to an overall low-elevation average concentration of 2.2 µg/g for all species, the western grebe egg average of 4.07 µg/g is within the “level of concern” range for selenium toxicity (3 to 6 µg/g), is below the potential “toxicity threshold” of 6 µg/g, and indicates a moderate level of dietary exposure. The mean selenium concentration in western grebe eggs from nearby Stewart Lake, an area with documented selenium contamination problems, was 24.6 µg/g.

Because coot eggs at Midview Reservoir showed only background selenium levels (less than 2 µg/g), dietary exposure could occur outside the project study area during waterbird seasonal migrations. Differences between the bird species also may be caused by differences in diet, where coots eat vegetation and grebes eat fish. Overall, selenium concentrations in bird diets and eggs indicate a concern for potential selenium toxicity to fish and

invertebrate-eating aquatic birds if these concentrations increase to values indicating increased potential for toxicological effects.

Boron concentrations in project area bird eggs ranged from 0.58 to 5.8 µg/g, compared to a low-elevation average of 1.8 µg/g. In an extensive assessment of trace element toxicity in California's San Joaquin Valley, eggs averaging 3 to 13 µg/g of boron exhibited normal viability. Consequently, boron should not be a cause of concern in project area waterfowl.

3.2.5.2 Revised Section 203 Alternative

The affected environment and baseline conditions for the Revised Section 203 Alternative are the same as described for the Proposed Action, except no high mountain lakes would be stabilized.

3.2.5.3 Twin Pots Section 203 Alternative

The affected environment and baseline conditions for the Twin Pots Section 203 Alternative are the same as described for the Proposed Action, except as noted in the following text.

Twin Pots Reservoir would be improved under the Twin Pots Section 203 Alternative. The low influent nutrient loads entering Twin Pots via the Farnsworth Diversion from the Lake Fork River suggest that the reservoir has a low potential for eutrophication as indicated by correspondingly low values for chlorophyll, high water clarity, and a low probability for oxygen depletion (see Table 3.2-4).

3.2.6 Impact Analysis

This section identifies and describes the environmental impacts of the Section 203 Proposed Action and each action alternative on water quality and environmental contaminants.

Federal and state water quality standards and numeric criteria have been established to evaluate trace element (contaminant) concentrations in drinking water, agricultural water, and use for aquatic life (see Table 3.2-1). The assessment of contaminant concentrations in sediment and biota allows an impact evaluation that may not be apparent from the water quality data alone. However, specific trace element criteria have not been promulgated for bioaccumulation or sediments. Therefore, projected changes in contaminant concentrations were extrapolated to biota and compared against: 1) assessment guidelines for trace element and pesticide contaminant concentrations in fish (see Table 3.2-8); 2) assessment guidelines for trace element concentrations in bird diets (see Table 3.2-9); and 3) selenium effect levels for fish and wildlife (see Table 3.2-10). These assessments of potential toxicity to fish and wildlife provided the basis to evaluate whether beneficial uses relating to fish and wildlife would be impacted.

TABLE 3-2
Mean, Elevated (85th Percentile), and Maximum Trace Element and Pesticide Contaminant Concentrations in Fish
($\mu\text{g/g}$ dry weight)

Parameter	National Freshwater Fish Contaminant Biomonitoring Program		
	Geometric Mean	Elevated Levels (85th Percentile)	Maximum
Trace Metals			
Arsenic	0.56	1.08	6.00
Cadmium	0.12	0.20	0.88
Chromium	NE	NE	NE
Copper	2.60	4.00	92.40
Lead	0.44	0.88	19.52
Mercury	0.40	0.68	1.48
Selenium	1.68	2.92	9.20
Zinc	86.80	136.80	473.60
Organochlorine Pesticides			
4,4-DDE	0.76	NE	18.96

Sources: Schmitt and Brumbaugh (1990) for trace metals; Schmitt, Zajicek, and Peterman (1990) for pesticides.

Notes:

Average moisture content of fish was about 75 percent in these studies. Approximate dry weight concentrations were therefore derived from wet weight concentrations by multiplying by a factor of 4.

4,4-DDE = 4,4-Dichlorodiphenyldichloroethylene.

NE = Not established.

TABLE 3-3
Assessment Values for Trace Element Concentrations in Bird Diets ($\mu\text{g/g}$)

Element	Reference/Source				
	Eisler ^b Acceptable	Puls ^a			National Academy of Sciences ^c Maximum Tolerable Level
		Normal/ Adequate	High	Toxic	
Arsenic ^d	<100 ^e	100 ^e	NE	NE	100 ^e
Boron	<13 FW	NE	NE	NE	NE
Cadmium	<0.1 FW	<5	10 – 20	>20	0.5 ^f
Chromium	<10	5 - 20	NE	>300	1,000
Copper	NE	10 - 50	100 – 200	>200	300 ^d
Lead	<10	NA	25 ^g	NA	30 ^f

TABLE 3-9
Assessment Values for Trace Element Concentrations in Bird Diets (µg/g)

Element	Reference/Source				
	Eisler ^b Acceptable	Puls ^a			National Academy of Sciences ^c Maximum Tolerable Level
		Normal/ Adequate	High	Toxic	
Mercury	<0.1 FW	<0.1	1 – 50	5 - 100	2 ^f
Selenium	<6 ^h	0.3 - 1.1	3 – 5	>5	2
Zinc	<178	98 - 200	800 - 2,000	>2,000	1,000

Notes:

All values refer to dry weight concentrations unless otherwise noted as FW (fresh weight).

NE = Not established.

< = less than.

> = greater than.

^aPuls (1988); all values given as dry weight for poultry or waterfowl (when available).

^bEisler (1985a, 1985b, 1986, 1987, 1988a, 1988b, 1989, 1990, 1993).

^cNAS (1980); all values given as dry weight for poultry.

^dBased on Phillips (1990) and Stanley et al. (1994).

^eArsenic in organic form, which is less toxic than inorganic arsenic.

^fLevel based on human food residue considerations.

^gMaximum no-effect level for waterfowl.

^hBased on Ohlendorf, Hothem, and Welsh (1989), and DOI (1993).

TABLE3.210
Average Selenium Concentrations in Biota for the Section 203 Project Area Proposed Action and Alternatives
(µg/g dry weight)

Biota	U.S. DOI Toxicity Levels		Measured Baseline	Estimated		
	Level of Concern ^a	Toxicity Threshold ^a		Lake Fork Section 203	Revised Section 203	Twin Pots Section 203
Fish, fall	4-12	12	3.7	4.1	4.8	4.0
Fish, summer	4-12	12	5.0	5.6	6.5	5.4
Invertebrates	3-7	7	1.5	1.7	2.0	1.6
Plants	3-7	7	2.9	3.2	3.8	3.1
Bird eggs (all species)	6-10	10	2.2	2.5	2.9	2.4
Western grebe eggs	6-10	10	4.1	4.6	5.3	4.4

Bold = exceeds Level of Concern

^aUsing William Beckon, U.S. Fish and Wildlife Service (2000), Values.

Results of the Environmental Contaminants Study (CH2M HILL/Horrocks 1996a) were used to evaluate potential impacts on water quality and biota. Previous studies have shown selenium to be the most frequently elevated contaminant of concern. Therefore, the contaminants study focused on selenium, but also examined other trace elements and organochlorine contaminants.

3.2.6.1 Potential Impacts Eliminated from Further Analysis

Projected water quality conditions under the Proposed Action and each action alternative were compared to baseline conditions to identify the potential water quality effect, as well as determine whether the expected effect would be significant. Based on this analysis, many construction and operational impacts on surface water and groundwater quality were judged insignificant and therefore eliminated from further analysis. These potential impacts are summarized in the text that follows.

3.2.6.1.1 Potential Construction Impacts Eliminated from Further Analysis

construction-related impacts on surface and/or groundwater quality would include sediment from temporary soil disturbance, accidental releases of fuels or other liquids, and increased turbidity and sedimentation during instream activities, such as construction of diversion structures, cofferdams, and bank stabilization structures. Such impacts would have the potential to increase concentrations for parameters specified by the State of Utah, including turbidity, sedimentation, and other pollutants.

These potential impacts are expected to be temporary and minor as environmental protection requirements for the prevention of water pollution, erosion and sediment control, spill prevention and containment, and other measures would be implemented to avoid or reduce water quality impacts during construction (see the standard construction and operating requirements outlined in Appendix A of the Final EA). No significant or long-term impacts on surface or groundwater quality are expected.

Construction activities would be performed in accordance with the Non-Point Source Water Pollution Control Plan for Hydrologic Modifications in Utah (Robinson 1994). The plan specifies BMPs for non-point source water pollution control where there is potential for disturbing stream channels, riparian areas, and floodplains.

Any potential for adverse impacts resulting from an accidental release of petroleum products into surface water or groundwater would be reduced by adhering to spill containment and countermeasure requirements included in CUWCD's construction specifications and Spill Prevention, Containment, and Countermeasure (SPCC) Plan. Such specifications would include worker education, incidence reporting, and remediation provisions in the event of a spill.

To reduce adverse impacts on water quality, instream construction activities would be conducted during low-flow seasons to the extent practicable, and limited or avoided in riparian, stream, seep, and spring areas during periods of unstable soil and streambank conditions caused by high soil moisture, snowmelt runoff, or extended periods of rain.

Areas and periods for limited construction activities would be identified through consultation with soil, fish and wildlife, and water resource management agencies and would be included in CUWCD construction specifications. Contractors would be required

to monitor water quality during any construction activities that could impact surface water quality.

3.2.6.1.2 Potential Operational Impacts on Surface Water Quality Eliminated from Further Analysis. Under the Proposed Action and each alternative (except the No Action Alternative), some potential operational impacts on surface water quality were eliminated from further analysis—for reasons described in the following text.

3.2.6.1.2.1 High Mountain Lakes. With high mountain lakes stabilization in the upper Lake Fork and Yellowstone River watersheds, stabilized water surface elevations would be maintained year-round. Water quality impacts related to these stabilizations would be positive because existing, seasonal shoreline erosion and subsequent nutrient loading during drawdown would be eliminated (see Table 3.2-11). The degree of water quality improvement is expected to be proportional to the extent lake drawdown would be eliminated. Current drawdowns in the upper Yellowstone River watershed range from 4 feet (Bluebell and White Miller) to 27 feet (East Timothy) and from 11 feet (Brown Duck and Clements) to 18 feet (Kidney) in the upper Lake Fork River watershed. Stabilized water surface elevations would also encourage the growth of submerged aquatic plants around the lake perimeter, which would further stabilize lakeshore sediments and provide fish habitat.

Below the stabilized lakes, streamflows would exhibit normal, seasonal, high-mountain-stream hydrologic patterns. Stabilized lake outflows would be higher in fall, winter, and spring, and related increases in downstream turbidity (suspended sediments) would be similar to natural (pre-1900s) conditions.

All the high mountain lakes would continue to be characterized as clean, high-quality mountain lakes supporting a cold water (trout) fishery. Although specific water quality changes related to these stabilizations were not quantified, water quality impacts on upper-elevation waters resulting from lake stabilization would be positive. There would be no adverse impacts on lake or downstream water quality, and all water quality criteria and beneficial use designations would continue to be met.

3.2.6.1.2.2 Dams and Reservoirs. Projected water quality conditions for the enlarged Big Sand Wash Reservoir and the stabilized Twin Pots Reservoir would meet all applicable water quality criteria and beneficial use designations. Proposed reservoir operations are not expected to cause significant water quality impacts in the reservoirs or on downstream water quality.

Big Sand Wash Reservoir is an offstream storage facility located in the middle part of the project area. More than 90 percent of the influent suspended sediment load is expected to be trapped in the reservoir, and the potential for eutrophication should be slightly reduced by the enhanced depth of the enlarged reservoir (see Table 3.2-11). Although predicted over-winter dissolved oxygen levels in offstream reservoirs were not modeled, the conservation pool in the enlarged reservoir would continue to provide 1,200 ac-ft of storage and successful over-winter fish survival. Reservoir operations are not expected to cause significant water quality impacts in the reservoir or to reservoir release water quality.

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Reduced fluctuation of Twin Pots Reservoir is not expected to have any quantifiable effects on factors contributing to eutrophication (see Table 3.2-11). By utilizing reservoir storage primarily to support a year-round sport fishery, fish habitat, riparian communities, and recreational opportunities, reservoir pool levels would be maintained at higher levels than in the past. Consequently, current shoreline erosion and subsequent nutrient inputs caused by reservoir drawdown would be reduced and produce a net positive effect on reservoir water quality.

3.2.6.1.2.3 River Reaches. Projected water quality conditions in upper-elevation river reaches would be that of the existing upper rivers as modified by high mountain lakes' stabilization. As indicated previously, no adverse impacts on upper Lake Fork River or Yellowstone River water quality are expected from high mountain lakes' stabilization. Upper-elevation river water quality is expected to remain essentially the same as baseline conditions and would continue to meet all applicable water quality criteria and beneficial use designations.

Mid-section Lake Fork River water quality (upstream from Pigeon Water Creek) is not expected to experience water quality changes. Although water moving down through the project area becomes increasingly degraded by the non-point infusion of salts and other constituents entering the river, the blended upper-source waters would continue to maintain constituent concentrations below the numeric criteria established to protect designated beneficial uses, including cold water aquatic biota and agriculture. Changes in water quality would occur below Pigeon Water Creek following the addition of agricultural return flows into the lower Lake Fork River and are analyzed further (see Section 3.2.6.2.1).

3.2.6.1.2.4 Irrigation Canals and Seepage. Influent water quality at irrigation diversions would be that of blended, high-quality, upper-elevation source waters. Under the Proposed Action and each alternative—except the No Action Alternative—water use changes involving increased crop use and more even water use throughout the irrigation season, and improved water management where water delivery is matched to crop requirements, would cause a decrease in the amount of water channeled back to the river and leaving the unit as agricultural return flows. Because the mechanisms of water quality degradation through the irrigation and return flow system would not be altered, return flows from bench and upland agricultural areas are projected to be similar to baseline conditions.

Water use changes and improved water management would decrease agricultural return flows, a result of reduced runoff and irrigation-deep percolation. Subsequently, there would be less water moving salts and other constituents out of soils and shallow aquifers into the lower river system. Changes in salt loads and salt concentrations in water leaving the project area and downstream impacts on the Colorado River system are addressed in Section 3.2.6.2.1.

3.2.6.1.3 Potential Operational Impacts on Groundwater Quality Eliminated from Further Analysis. Under the Proposed Action and each alternative—except for the No Action Alternative—potential operational impacts on groundwater quality were eliminated from further analysis because the expected effects were not considered to be adverse—for reasons described in the following text.

Groundwater quality is closely related to the quality of its source waters that provide recharge. For those shallow aquifers adjacent to or near surface waters, changes in

groundwater quality would reflect expected changes in surface water quality. For those shallow aquifers located away from surface waters, such as beneath bench and upland agricultural areas, changes in groundwater quality would reflect expected changes in recharge waters originating from canal seepage and irrigation-deep percolation. These changes would be controlled by chemical interactions with local soil and shallow aquifer materials. Groundwater quality in shallow aquifers in the upper, middle, and lower subunits would be expected to be similar to baseline conditions in the Project Area.

Groundwater in the regional aquifer is deep circulating, recharged by precipitation in the upper watershed, confined by low-permeability strata, contains a very large volume of groundwater, and has an upward gradient in the lower unit. Therefore, any changes in surface water quality or groundwater quality in the shallow aquifers would not influence the quality of the regional aquifer.

No changes to groundwater quality are anticipated by enlarging and operating Big Sand Wash Reservoir. The reservoir is not located in a recharge area for the shallow aquifer, and reservoir water quality is expected to remain favorable for all beneficial use designations. Deeper groundwater is present in the Duchesne River Formation beneath the reservoir, but this groundwater is part of the regional aquifer, which is confined by low-permeability shale beds in this area.

3.2.6.1.4 Potential Operational Impacts on Environmental Contaminants Eliminated from Further Analysis. Bottom sediments were collected as part of the Environmental Contaminants Study (CH2M HILL/Horrocks 1996a). Concentrations of trace elements in bottom sediments showed considerable variability among stream and pond sites. However, none of the sediment samples exceeded sediment screening levels for toxic constituents, nor were sediments considered a mechanism for evaluating environmental effects.

Organochlorine analyses for sediment and biological samples were eliminated from further study because study results indicated that these contaminants were not accumulating at significant levels in project area fish populations.

3.2.6.2 Proposed Action Lake Fork Section 203

This section identifies and summarizes the operational impacts on surface water quality and environmental contaminants. The primary location for water quality and contaminant (trace element) assessment was the lower Lake Fork River near Myton, just upstream from its confluence with the Duchesne River.

An understanding of the concept of stream constituent loading is essential to an evaluation of surface water quality impacts. Constituent loads are estimated by multiplying constituent concentrations by streamflow. Thus, changes in load are influenced by changes in either concentration, flow, or both. Under the Proposed Action, lower Lake Fork River TDS concentrations are projected to increase in combination with a relatively greater decrease in project area outflow. The net result is a decrease in total salt load associated with an increase in concentration.

3.2.6.2.1 Potential Operational Impacts on Surface Water Quality. Changes in surface water quality were estimated based on current agricultural return flow quality, river quality, and relationships among river flow, EC, and TDS. TDS was the key water quality constituent

evaluated because of a clear trend toward increasing trace element concentrations with increasing TDS concentrations in surface waters, and because of the high level of concern for salinity (TDS) loads in the Colorado River system.

Under the Proposed Action, the mass balance analysis (which combines agricultural return flows with lower river flows) shows that mean annual TDS concentrations in the lower Lake Fork River would increase by 12 percent (71 mg/L); average annual flows leaving the unit (outflow) would be reduced by 12 percent (3,300 ac-ft); and the annual salt load in the lower Lake Fork River would decrease by 4 percent (900 tons) compared to baseline conditions (see Table 3.2-12). With a reduced salt load (900 tons per year) leaving the project area, the salt load is expected to decrease (0.1 percent) in the Colorado River at Imperial Dam.

TABLE 3.22
Flow and Salinity Impacts on the Colorado River for the Proposed Action

	Flow		TDS Concentration		Salt Mass (load)	
	(1,000 ac-ft/yr)	% change	(mg/L)	% change	(1,000 tons/yr)	% change
Colorado River ^a	7,271	NA	834	NA	8,253	NA
Lake Fork River near Myton						
Baseline	27.2	NA	584	NA	22.1	NA
Proposed Action	23.9	NA	655	NA	21.2	NA
Change (Baseline to Proposed Action)	-3.3	-12	71	12	-0.9	-4
Colorado River with Proposed Action ^b	7,268	-0.1	836	0.2	8,252	-0.1

NA = Not applicable.

^aAt Imperial Dam; 50-year modeled average.

^bNew values based on estimated impact on the Colorado River.

Water diverted for irrigation and which returns to the river system as runoff or deep percolation has a higher concentration of TDS than water that stays in the river. Under the Proposed Action, the salinity (TDS) concentration in water leaving the area would increase by 12 percent because more of the outflow would be lower-quality agricultural return flows rather than higher-quality river water. Salt loads would decline by 4 percent, however, because less water would be leaving the unit as runoff and irrigation-deep percolation.

The projected increase in the mean TDS concentration to 655 mg/L would be well below the state water quality criteria for agriculture (1,200 mg/L) (see Tables 3.2-1 and 3.2-2).

3.2.6.2.2 Potential Operational Impacts on Environmental Contaminants. Projected changes in surface water quality were used to estimate changes in environmental contaminant (trace element) constituent concentrations in the lower Lake Fork River. Projected changes in water quality and trace elements from implementing the Proposed Action were then compared to established water quality standards and numeric criteria. To assess probable qualitative impacts on bioaccumulation and risks to fish and wildlife, projected water quality changes were extrapolated to biota and compared against established assessment guidelines and effect levels (see Tables 3.2-8, 3.2-9, and 3.2-10). These assessments of

potential toxicity to fish and wildlife provided the basis to evaluate whether beneficial uses relating to fish and wildlife would be impaired.

3.2.6.2.2.1 Contaminants in Surface Waters. Trace elements and TDS were analyzed from the water quality samples collected as part of this study. The results incorporated a wide range of concentrations of all elements and indicated a clear trend toward increasing trace element concentrations with increasing TDS concentrations. Statistically significant positive trace element-TDS relationships were found for arsenic, boron, iron, manganese, and alpha radiation with nonsignificant but positive trends apparent for selenium and zinc (CH2MHILL/Horrocks 1996c). Because of these known relationships, and because no better or complex models were available, all trace element concentrations were assumed to vary positively with TDS for all water quality projections.

Under the Proposed Action, the projected 12 percent increase in the mean TDS concentration in the lower Lake Fork River is expected to result in a proportionate increase in mean concentrations of all dissolved ionic compounds, including selenium. Mean trace element concentrations for arsenic, boron, iron, manganese, and gross alpha radioactivity would increase by measurable amounts (see Table 3.2-13), but none of the mean trace element concentrations projected would exceed established water quality criteria (see Table 3.2-1). No estimates are available for mercury, selenium, and five other trace elements because mean values for baseline conditions were less than the detection limit.

TABLE3.213
Projected Trace Element Concentrations for the Proposed Action and Alternatives^a Annual Mean Concentrations (mg/L)

Water Quality Constituent	Lower Lake Fork River			
	Baseline	Proposed Action– Lake Fork Section 203	Revised Lake Fork Section 203	Twin Pots Section 203
TDS	584	655	767	630
Arsenic	0.004	0.004	0.005	0.004
Boron	0.418	0.469	0.549	0.451
Cadmium ^b	<0.001	<0.001	<0.001	<0.001
Chromium ^b	<0.001	<0.001	<0.001	<0.001
Copper ^b	<0.001	<0.001	<0.001	<0.001
Iron	0.019	0.021	0.025	0.020
Lead ^b	<0.001	<0.001	<0.001	<0.001
Manganese	0.083	0.093	0.109	0.090
Mercury ^b	<0.001	<0.001	<0.001	<0.001
Selenium -D ^b	<0.001	<0.001	<0.001	<0.001
Selenium -T ^b	<0.001	<0.001	<0.001	<0.001

TABLE 3.213

Projected Trace Element Concentrations for the Proposed Action and Alternatives^a Annual Mean Concentrations (mg/L)

Water Quality Constituent	Lower Lake Fork River			
	Baseline	Proposed Action– Lake Fork Section 203	Revised Lake Fork Section 203	Twin Pots Section 203
Zinc ^b	<0.001	<0.001	<0.001	<0.001
Gross Alpha ^c	0.005	0.006	0.007	0.005

^aBased on projected TDS concentrations.

^bLess than the detection limit for baseline; no change in concentration can be predicted.

^cIn nanocuries per liter (nCi/L).

Although mean trace element concentrations in the lower Lake Fork River are projected to increase above baseline conditions, changes in the frequency and magnitude of peak (maximum) concentrations were not modeled and are unknown. However, the projected 12 percent (71 mg/L) increase in the mean TDS concentration to 655 mg/L is expected to proportionately increase the number of agricultural water quality criteria exceedances for TDS and boron, as well as trace element contaminant effects in localized areas near the lower Lake Fork–Duchesne River.

The projected increase in mean TDS concentrations would affect those low-elevation river reaches and areas currently experiencing salinity (TDS) problems and/or trace element exceedances. In the project area, water quality effects would likely be limited to high TDS concentrations in the lowest river reaches, which include the Lake Fork River near Myton and the Duchesne River at Myton. Effects related to changes in boron concentrations are expected to be minimal and localized within the lower project area as well.

Predicted selenium concentrations in surface water were derived through an evaluation of the general relationship between selenium and TDS concentrations. On average, baseline and Proposed Action surface water selenium concentrations in the lower Lake Fork River are expected to remain near the limit of detection (< 0.001 mg/L).

3.2.6.2.2.2 Contaminants in Biota. Bioaccumulation and toxicity from selenium is of particular concern in the project area as selenium was shown to be accumulated to borderline toxic levels in some fish and bird samples in the lower basin (see Section 3.2.5.1.3). Under the Proposed Action, projected average selenium concentrations in fish tissues would be slightly above the “level of concern threshold” identified for fish and dietary criteria (see Table 3.2-10). However, the projected 12 percent increase in selenium levels is not expected to increase the general level of toxicity in resident fish and wildlife. The projected increase in mean tissue selenium concentrations does not represent a significant increase in the category of toxicity over current conditions (see Table 3.2-10) as confirmed by the contaminants criteria developed by Lemly and Smith (1987) and Maier and Knight (1994).

Projected selenium levels in fish-eating western grebe eggs (4.6 µg/g) would remain below the currently measured “level of concern” range of 6 to 10 µg/g. Projected selenium levels in

aquatic plants (3.2 µg/g) would slightly exceed the 3 to 7 µg/g dietary “level of concern” range established for fish and wildlife.

Average copper (3.8 and 4.5 µg/g) and zinc (193 and 135 µg/g) concentrations in fall and summer fish tissues would remain at or near elevated levels (above the 85th percentiles of 4.0 and 136.8 µg/g, respectively). The projected 12 percent increase in tissue concentrations for these two trace elements, however, would not result in a significant increase in toxicological effects.

The bird eggs sampled as part of the baseline survey were collected from nesting waterfowl in May and June. Selenium bioaccumulation is very rapid in nesting birds and the exposure within 2 weeks prior to laying eggs is most important in determining toxicological effects (Heinz 1993, Ohlendorf 1996). The increased TDS and trace element exposure projected for the Proposed Action and alternatives would occur as a result of agricultural practices and is expected to occur gradually over the irrigation season, which is after most waterfowl nesting. When the irrigation season ends and winter flows dilute local waters, summer-time levels of selenium bioaccumulation would fall again. For this reason, the estimated project-related egg selenium increases (see Table 3.2-10) are extremely conservative for waterfowl reproduction. It is likely that the timing of waterfowl nesting would partially mitigate for reproductive effects. Actual dietary and egg selenium levels for assessing impacts to reproducing waterfowl will probably be lower than the estimates shown in Table 3.2-10. The estimated selenium levels may be more representative for conditions later in the irrigation season, such as in August and/or September, after the period of egg laying.

There is already some level of beneficial use impairment in project area resident fish and wildlife populations because of the presence of trace elements at levels considered borderline toxicity. Implementation of the Proposed Action is not expected to change this level of fish and wildlife toxicity or cause an additional impairment of beneficial uses relative to fish and wildlife because no significant toxicological changes from baseline are expected.

3.2.6.3 Revised Section 203 Alternative

This section identifies and summarizes the operational impacts on surface water quality and environmental contaminants under the Revised Section 203 Alternative.

3.2.6.3.1 Potential Operational Impacts on Surface Water Quality

Quality of the project features included in the Revised Section 203 Alternative would change annual and seasonal flow and diversion patterns in a manner very similar to the Proposed Action. Overall, water leaving the project area (outflow) would decrease by 8,359 ac-ft because there would be less water in the river system. This is a result of increased diversion requirements and less agricultural return flows resulting from increased crop consumptive use and improved irrigation efficiencies.

These changes are expected to increase the mean salinity concentration in the lower Lake Fork River near Myton, but decrease the annual salt load contributed to the Colorado River. The mass balance analysis (which combines agricultural return flows with lower river flows) shows that mean annual TDS concentrations in the lower Lake Fork River would increase by 31 percent (183 mg/L); average annual flows leaving the unit (outflow) would

be reduced by 31 percent (8,400 ac-ft); and the annual salt load in the lower Lake Fork River would decrease by 12 percent (2,600 tons), compared to baseline conditions (see Table 3.2-14). With a reduced salt load (2,600 tons per year) leaving the project area, the salt load is expected to decrease (0.1 percent) in the Colorado River at Imperial Dam.

TABLE 3-24
Flow and Salinity Impacts on the Colorado River for the Revised Section 203 Alternative

	Flow		TDS Concentration		Salt Mass (load)	
	(1,000 ac-ft/yr)	% Change	(mg/L)	% Change	(1,000 tons/yr)	% Change
Colorado River ^a	7,271	NA	834	NA	8,253	NA
Lake Fork River near Myton						
Baseline	27.2	NA	584	NA	22.1	NA
Revised Section 203	18.8	NA	767	NA	19.5	NA
Change (Baseline to Revised Section 203)	-8.4	-31	183	31	-2.6	-12
Colorado River with Revised Section 203 ^b	7,263	-0.1	837	0.2	8,250	-0.1

NA = Not applicable.

^aAt Imperial Dam; 50-year modeled average.

^bNew values based on estimated impact on the Colorado River.

Water diverted for irrigation and which returns to the river system as runoff or deep percolation has a higher concentration of TDS than water that stays in the river. Under the Revised Section 203 Alternative, the salinity (TDS) concentration in water leaving the unit would increase by 31 percent because more of the outflow would be lower-quality agricultural return flows rather than higher-quality river water. Salt loads would decline by 12 percent, however, because less water would be leaving the unit as runoff and irrigation-deep percolation.

The projected increase in the mean TDS concentration to 787 mg/L would be well below the state water quality criteria for agriculture (1,200 mg/L) (see Tables 3.2-1 and 3.2-2).

3.2.6.3.2 Potential Operational Impacts on Environmental Contaminants
 TDS concentration in the lower Lake Fork River is expected to increase about 31 percent under the Revised Section 203 Alternative versus 12 percent under the Proposed Action. Consequently, the projected increase in trace element concentrations in lower Lake Fork River water quality and area biota under this alternative would be somewhat greater than the levels projected for the Proposed Action. Impacts related to these increased contaminant levels would be similar to those described for the Proposed Action.

3.2.6.4 Twin Pots Section 203 Alternative

This section identifies and summarizes the operational impacts on surface water quality and environmental contaminants under the Twin Pots Section 203 Alternative.

3.2.6.4.1 Potential Operational Impacts on Surface Water Quality of the project features included in the Twin Pots Section 203 Alternative would change annual and seasonal flow and diversion patterns. Overall, water leaving the project area would decrease by 3,004 ac-ft because there would be less water in the river system. This is a result of increased diversion requirements and less agricultural return flows resulting from increased crop consumptive use and improved irrigation efficiencies.

These changes are expected to increase the mean salinity concentration in the lower Lake Fork River near Myton, but decrease the annual salt load contributed to the Colorado River. Under the Twin Pots Section 203 Alternative, the mass balance analysis (which combines agricultural return flows with lower river flows) shows that mean annual TDS concentrations in the lower Lake Fork River would increase by 8 percent (46 mg/L); average annual flows leaving the unit (outflow) would be reduced by 12 percent (3,300 ac-ft); and the annual salt load in the lower Lake Fork River would decrease by 8 percent (1,700 tons), compared to baseline conditions (see Table 3.2-15).

TABLE 3.25
Flow and Salinity Impacts on the Colorado River for the Twin Pots Section 203 Alternative

	Flow		TDS Concentration		Salt Mass (load)	
	(1,000 ac-ft/yr)	% Change	(mg/L)	% Change	(1,000 tons/yr)	% Change
Colorado River ^a	7,271	NA	834	NA	8,253	NA
Lake Fork River near Myton						
Baseline	27.2	NA	584	NA	22.1	NA
Twin Pots Section 203	23.9	NA	630	NA	20.4	NA
Change (baseline to Twin Pots Section 203)	-3.3	-12	46	8	-1.7	-8
Colorado River with Twin Pots Section 203 ^b	7,268	-0.1	836	0.2	8,251	-0.1

NA = Not applicable.

^aAt Imperial Dam; 50-year modeled average.

^bNew values based on estimated impact on the Colorado River.

With a reduced salt load (1,700 tons per year) leaving the Upalco Unit, the salt load is expected to decrease (0.1 percent) in the Colorado River at Imperial Dam.

Water diverted for irrigation and which returns to the river system as runoff or deep percolation has a higher concentration of TDS than water that stays in the river. The salinity (TDS) concentration in water leaving the unit would increase by 8 percent because more of the outflow would be lower-quality agricultural return flows. Salt loads would decline by 8 percent, however, because less water would be leaving the unit as runoff and irrigation-deep percolation.

The projected increase in the mean TDS concentration to 630 mg/L would be below the state water quality criteria for agriculture (1,200 mg/L) (see Tables 3.2-1 and 3.2-2).

3.2.6.4.2 Potential Operational Impacts on Environmental Contaminants. Projected changes in water quality and trace elements from implementing the Twin Pots Section 203 Alternative were estimated and compared to established water quality criteria, assessment guidelines, and effect levels. Toxicity assessments provided the basis to evaluate whether beneficial uses relating to fish and wildlife would be impaired.

3.2.6.4.2.1 Contaminants in Surface Waters. Under the Twin Pots Section 203 Alternative, mean trace element concentrations for arsenic, boron, iron, manganese, and gross alpha radioactivity would increase slightly (see Table 3.2-13). Except for boron, none of the mean trace element concentrations projected would exceed established water quality criteria (see Table 3.2-1).

Although mean trace element concentrations in the lower Lake Fork River are projected to increase above baseline conditions, changes in the frequency and magnitude of peak (maximum) concentrations were not modeled and are unknown. However, the projected 8 percent (46 mg/L) increase in the mean TDS concentration to 630 mg/L is expected to proportionately increase mean concentrations of all dissolved ionic constituents, including selenium. Consequently, the number of agricultural water quality exceedances for TDS and boron, and trace element contaminant effects in localized areas near the lower Lake Fork–Duchesne River are expected to increase. Water quality impacts would likely be limited to these low-elevation river reaches and areas currently experiencing high TDS concentrations and/or trace element exceedances.

3.2.6.4.2.2 Contaminants in Biota. Under the Twin Pots Section 203 Alternative, projected average selenium concentrations in fish tissues would remain below the toxicity threshold identified for fish and dietary criteria (see Table 3.2-10).

Projected selenium levels in fish and plants would exceed the “level of concern threshold” of 4 and 3 $\mu\text{g/g}$, respectively.

Average copper levels (4.4 $\mu\text{g/g}$) in summer fish tissues and zinc levels (186 $\mu\text{g/g}$) in fall fish tissues would remain at elevated levels (above the 85th percentiles of 4.0 and 136.8 $\mu\text{g/g}$, respectively).

There is already some level of beneficial use impairment in project area resident fish and wildlife populations because of the presence of trace elements at levels considered borderline toxicity. Implementation of the Twin Pots Section 203 Alternative would cause a slight additional impairment of beneficial uses relative to fish and wildlife because of expected toxicological changes from baseline.

3.2.6.5 No Action Alternative

3.2.6.5.1 Trends. Expected water resource trends if the project is not implemented are described in Section 3.1, *Water Resources and Hydrology*. No trends have been identified with respect to contamination by potentially toxic trace elements.

3.2.6.5.2 Future Conditions. The water resources system of high mountain lakes, rivers, reservoirs, canals, etc., and future water quality conditions associated with the continued use of this water supply and delivery system would remain essentially the same as baseline conditions. However, the gradual conversion from flood to sprinkler irrigation under the

NRCS Salinity Reduction Program would lead to a decrease in irrigation-deep percolation and surface runoff (agricultural return flows) because of improved irrigation efficiencies. The USBR Salinity Reduction Program, which addresses conveyance facility losses, also would increase deep percolation losses.

If there is no change in irrigation diversions (169,000 ac-ft/yr) and the trend of reduced irrigation and conveyance losses from improved irrigation efficiencies continues, agricultural return flows entering the lower Lake Fork River would be reduced. Consequently, both the annual amount of water leaving the project area (outflow) and the annual salt load in the lower river would be reduced. The salinity (TDS) concentration in water leaving the project area also would decline because a smaller percentage of the outflow would be low-quality agricultural return flows. This assumes TDS concentration in agricultural return flows to the river would be essentially unchanged from present values. With a reduced salt load leaving the project area, salinity is expected to decrease in the Colorado River at Imperial Dam.

3.2.6.5.3 Consequences of Not Meeting Project Needs The consequences of not meeting project needs are described in Section 3.1, *Water Resources and Hydrology*.

3.2.7 Cumulative Impacts

The Colorado River system salinity control program is the only other project identified that could potentially result in cumulative impacts when combined with the Section 203 Project. To assess this potential, the amount of water and salt leaving the Section 203 project area under the Proposed Action and each action alternative was compared to baseline conditions. This cumulative change in flows, salt (TDS) concentrations, and salt loads leaving the Lake Fork River determines the cumulative effect downstream on the Colorado River system salinity control program. These effects were discussed in Sections 3.2.6.2, 3.2.6.3, and 3.2.6.4.

3.3 Aquatic Resources

3.3.1 Introduction

This analysis assesses potential impacts on aquatic resources resulting from the construction, operation, and maintenance of project features associated with the Proposed Action and alternatives of the Section 203 Project. Instream habitat assessments are based on modeled hydrological conditions expected with the Section 203 Proposed Action and alternatives.

3.3.2 Issues Eliminated from Further Analysis

All issues identified during public scoping for the Upalco Unit Draft EIS that are relevant to the Section 203 Project were considered.

3.3.3 Issues Addressed in the Impact Analysis

Issues addressed include high mountain lakes' stabilization; conservation pools and fish-rearing potential in the enlarged storage reservoir; instream flows and habitat for fish; channel-shaping flows; and fish passage.

3.3.4 Description of Area of Influence

The area of influence, shown on Map 1.4-1 in Chapter 1 of the Final EA, includes the Section 203 project area in northeastern Utah. Immediate areas of influence within the project area include the project feature sites for the Proposed Action and alternatives, which are shown on Maps 2.2-1, 2.3-1, and 2.4-1 in Chapter 2 of the Final EA.

3.3.5 Affected Environment

3.3.5.1 Proposed Action Lake Fork Section 203

3.3.5.1.1 High Mountain Lakes. The four high mountain lakes proposed for stabilization in the upper Lake Fork River drainage all support fish populations. Brook trout (*Salvelinus fontinalis*) are present in all but Clements Lake, while cutthroat trout (*Oncorhynchus clarki*) are present in all four lakes. Fishing pressure is heavy on Brown Duck Lake and moderate on Clements, Island, and Kidney Lakes (Wildlife Resources 1981, 1986).

Water levels and aquatic habitat in the four lakes decline during summer and early fall as water is released to meet downstream demands. As examples, lake surface area can decline from 79 to 12 acres in Clements Lake and from 190 to 168 acres in Kidney Lake. Depending on the lake, water levels can fluctuate between about 7 feet and 17 feet. Flows to outlet streams and their aquatic habitat are reduced or eliminated from late fall through late spring as water entering the lakes is stored for the following year.

Recreational fisheries in the nine high mountain lakes proposed for stabilization in the upper Yellowstone River drainage are exclusively for brook trout and/or cutthroat trout. Brook trout are present in each lake, while cutthroat trout are present in Deer, Bluebell, East Timothy, Five Point, and Superior Lakes. Fishing pressure at most lakes is light to moderate (Wildlife Resources 1981, 1986).

Water levels and aquatic habitat in all but Farmers, White Miller, and Water Lily Lakes, which are stable, decline during summer and early fall as water is released to meet downstream demands. Depending on the lake, water levels can fluctuate between about 5 feet and 27 feet. Lake surface area can generally decline about 50 percent during drawdowns. As the lakes begin to refill in late fall and water is stored for the following year, flows to outlet streams and their aquatic habitat are reduced or eliminated until late spring.

3.3.5.1.2 Dams and Reservoirs. The offstream Big Sand Wash Reservoir, which would be enlarged 12,100 ac-ft under the Proposed Action, supports a popular recreational fishery for trout, bass, and sunfish. It has a conservation pool of 1,200 ac-ft of water that the State of Utah purchased to enhance reservoir fisheries habitat.

3.3.5.1.3 River Corridors

3.3.5.1.3.1 Flow Regime. Two primary factors limiting fish populations in the Lake Fork and Yellowstone Rivers are instream habitat during low-flow growth periods, which is best represented by September flows, and instream habitat during low-flow winter months. Estimated September and winter flows under baseline conditions in river reaches where instream fish habitat was evaluated are compared against projected flows under the Proposed Action and alternatives in Section 3.3.6.

3.3.5.1.3.2 Water Temperature. Maximum daily water temperatures at project area gaging stations during early August range from 58°F just downstream from Moon Lake Dam to 83°F near the confluence of the Lake Fork and Duchesne Rivers. This temperature regime supports the observed longitudinal distribution of fish species in project area streams based on their temperature tolerances (Bell 1991; Eaton et al. 1995).

Maximum temperatures in the upper Lake Fork (58°F) and upper Yellowstone (66°F) Rivers are within optimal rearing temperatures of 54 to 66°F for rainbow trout (*Oncorhynchus mykiss*) and 39 to 70°F for brown trout (*Salmo trutta*). They are well below upper tolerance temperatures for brook trout and cutthroat trout (72°F), which are present in upper river reaches. At the Lake Fork–Yellowstone River confluence, water temperatures are too warm for brook trout. Further downstream at the “C” Canal diversion near Altamont, temperatures approach the upper tolerance limit (75°F) for rainbow and brown trout.

Temperatures of 78 to 83°F at the most downstream Lake Fork River stations exceed upper tolerance rearing temperatures of 72 to 75°F for all trout species observed in the project area, and upper lethal temperatures for brook trout (77°F) and cutthroat trout (73°F). Only one brown trout was collected near one of the more downstream stations (in study reach LF-C2), and no trout were collected below this point. Maximum temperatures in the lower Lake Fork River exceed 78°F and are more suited to carp (*Cyprinus carpio*), sunfish, and, to some extent, suckers, which are the predominant fish observed in the lower river.

3.3.5.1.3.3 Habitat. Fisheries habitat in each study reach shown on Map 3.3-1 is briefly summarized below. Further detail is presented in CH2M HILL/Horrocks (1996b).

Upper Lake Fork River (Reach LF-A). This reach extends 3.4 miles from the Farnsworth Canal diversion to the Ashley National Forest–Tribal boundary. Fisheries habitat is generally very good. It is characterized by an abundance of large, deep pools, cool temperatures, clear water, clean substrates, and extensive food-producing areas (clean cobbles in riffles).

Middle Lake Fork River (Reach LF-B). This reach extends 7.4 miles from the Forest–Tribal boundary downstream to the Yellowstone River confluence. Fisheries habitat is generally poor because of the severe lack of pools. Spawning habitat is available, but fry rearing habitat is lacking except in pocket water. Low-flow conditions, also a problem, create glides where pools might otherwise have existed.

Middle Lake Fork River (Reach LF-C). This reach extends 17.0 miles from the Yellowstone River confluence to the Red Cap Canal diversion. Overall, trout habitat is fair. Primary limiting factors are the lack of pools and spawning areas and the absence of instream cover. The conspicuous absence of small cottonwoods suggests cattle prevent their recurrence.

Lower Lake Fork River (Reach LF-D). This reach extends 11.1 miles from the Red Cap Canal diversion downstream to the Duchesne River confluence at Myton. Overall, fisheries habitat is good for carp, but poor to nonexistent for trout. Limiting factors for trout include high water temperatures, poor water quality, lack of spawning and food-producing areas, and lack of instream cover other than water turbidity. Water quality problems (primarily the result of silty irrigation return flows) are the principal cause of poor trout habitat, although sparse riparian vegetation also is a factor.

Map3.31 (11x17 black and white)
(page 1 of 2)

Map 3.3 (11x17 black and white)
(page 2 of 2)

Upper Yellowstone River (Reach YL-A). This reach extends 7.8 miles from the confluence with Swift Creek downstream to the Forest/Tribal boundary. Fisheries habitat is generally fair, with side channels probably providing very important spawning and early rearing/refuge areas. Limiting factors include a lack of pools and overhead cover; relatively steep channel gradient, which limits the amount of holding water in riffles and rapids; and flood flows, which sweep away most large woody debris and scour a wide channel.

Lower Yellowstone River (Reach YL-B). This reach extends 10.2 miles from the Forest-Tribal boundary downstream to the Lake Fork River confluence. Overall, fisheries habitat is fair. There are adequate spawning areas, and food production potential is very high. However, the few pools present are shallow and have limited overhead cover. Channel exposure also is a major problem and would benefit from encroachment by riparian vegetation and cottonwood stand regrowth.

3.3.5.1.3.4 Benthic Invertebrates. Macroinvertebrate community structure and taxa observed in the Lake Fork River changed longitudinally along the river. Study results indicate cool, running water/erosional habitat in the three upstream study reaches (LF-A, LF-B, LF-C1). This is reflected in the dominant faunal groups collected (Trichoptera or caddisflies, and Ephemeroptera or mayflies) and the relatively high abundance of common net spinners (caddisfly Family Hydropsychidae) and spiny crawlers (mayfly Family Ephemerellidae), which are generally found in faster-moving, clear, cool water.

Study results in the two most downstream reaches (LF-C2, LF-D) of the Lake Fork River indicate warm, running water/depositional habitat. Dominant faunal groups in these reaches included Coleoptera (aquatic beetles) and Diptera (midges). The dominant riffle beetle (Family Elmidae) in Reach LF-C2 is often associated with warmer, slow-moving water, which is consistent with the very low summer flows in this reach because of upstream irrigation diversions. Diversity and evenness, or the distribution of organisms among taxa, also were lower in the two downstream reaches than upstream. In general, diversity values between 1 and 3 represent slightly degraded conditions, such as in Reaches LF-A, LF-C2, and LF-D, while values greater than 3 represent clean water, such as in Reaches LF-B and LF-C1 (Wilhm and Dorris 1968).

Macroinvertebrate community structure in the Yellowstone River varied considerably among the three study reaches. However, study results indicate cool, running water/erosional habitat, even in Reach YL-B2 in the lower Yellowstone, which is dewatered in late summer. Ephemeroptera or Trichoptera was the dominant faunal group in each reach. Taxa diversity, number of taxa, and evenness decreased in a downstream direction, while total density increased. Diversity indices generally indicate clean water in Reach YL-A and slightly degraded conditions in Reaches YL-B1 and YL-B2.

3.3.5.1.3.5 Fish Populations. Fish population studies were conducted in eight reaches of the Lake Fork and Yellowstone Rivers (see Map 3.3-1). Table 3.3-1 lists collected fish species, and Figure 3.3-1 depicts trout density and relative abundance in each river reach. Study results are summarized in the text that follows.

Figure 3.3 (page 1 of 1) (black and white)

TABLE 3-3
Distribution of Fish Species Collected in the Lake Fork (LF) and Yellowstone (YL) Rivers

Species	Study Reach/Station							
	LF-A	LF-B	LF-C1	LF-C2	LF-D	YL-A	YL-B1	YL-B2
Brook trout	●	●				●	●	
Brown trout	●	●	●	●		●	●	●
Rainbow, cutthroat, and/or hybrids	●	●	●			●	●	●
Mountain whitefish			● ^a			●		●
Sculpin <i>spp.</i>	●	●	●				●	●
Mountain sucker	●		●			●	●	●
Flannelmouth sucker			●					
White sucker			●	●	●			
Carp					●			
Speckled dace	●	●	●					●
Minnow <i>spp.</i> ^b					●			
Green sunfish					●			

^aCollected in an off-channel seep fed by an irrigation canal.

^bProbably speckled dace.

Upper Lake Fork River (Reach LF-A). Collected fish species included brook, brown, and hybrid rainbow/cutthroat trout; mountain sucker (*Catostomus platyrhynchus*); sculpin (*Cottus spp.*); and speckled dace (*Rhinichthys osculus*). The total trout population estimate was 648 fish per mile of main stem river. Of this total, brook trout were most abundant (43 percent), followed by rainbow/cutthroat trout (39 percent) and brown trout (18 percent). Collected trout were 38 to 500 millimeters (mm) long and averaged 233 mm.

Middle Lake Fork River (Reach LF-B). Brook, brown, and rainbow/cutthroat trout; sculpin; and speckled dace were collected in this reach. The total trout population estimate was 930 fish per mile of main stem river. Brown trout were most abundant (63 percent), followed by rainbow/cutthroat trout (36 percent) and brook trout (1 percent). The trout were 65 to 370 mm long and averaged 235 mm.

Middle Lake Fork River (Reach LF-C: Stations LF-C1 and LF-C2). The first sampling station (LF-C1) in this reach is approximately 1 mile upstream from the “C” Canal diversion near Altonah, and the second (LF-C2) is approximately 2 miles downstream from this diversion. At the first station, brown and rainbow/cutthroat trout, sculpin, speckled dace, flannelmouth sucker (*Catostomus latipinnis*), white sucker (*Catostomus commersoni*), and mountain sucker were collected. The total trout population estimate was 108 fish per mile of main stem river, with about three times as many brown trout (83 per mile) as rainbow/cutthroat trout (25 per mile). The trout were 80 to 423 mm long and averaged 215 mm.

The only trout species collected at the second station (LF-C2) was a single brown trout 320 mm long. Estimated population size was eight brown trout per mile of main stem river.

Lower Lake Fork River (Reach LF-D). Carp, minnows (probably speckled dace), green sunfish (*Lepomis cyanellus*), and white sucker were the only fish species collected in this reach. Population estimates were 2,377 carp and 29 white sucker per mile of main stem river.

Upper Yellowstone River (Reach YL-A). Wildlife Resources sampled fish populations near the Bridge Campground and east of the Yellowstone Ranch in September 1990. Mountain whitefish, mountain sucker, and brook, brown, rainbow, and cutthroat trout were collected. The total trout population estimate was 631 fish per mile of main stem river. Weighted average lengths of trout were 215 mm near the campground and 193 mm east of the ranch.

Lower Yellowstone River (Reach YL-B: Stations YL-B1 and YL-B2). The first sampling station (YL-B1) in this reach is approximately 1.1 miles upstream from the Yellowstone Feeder Canal diversion. Sculpin, mountain sucker, and brook, brown, rainbow, and cutthroat trout were collected at this station. The total trout population estimate was 388 fish per mile of main stem river. Rainbow and cutthroat trout were most abundant (65 percent), followed by brown trout (29 percent) and brook trout (6 percent). The trout were 55 to 330 mm long and averaged 191 mm.

The second station (YL-B2) is downstream from the Yellowstone Feeder Canal diversion and approximately 0.3 mile upstream from the confluence with the Lake Fork River. Brown and cutthroat trout, sculpin, speckled dace, mountain sucker, and one mountain whitefish were collected. The total trout population estimate was 91 fish (70 brown trout, 21 cutthroat trout) per mile of main stem river. The trout were 80 to 495 mm long and averaged 238 mm.

Overview. Estimated numbers and distribution of trout species change longitudinally in the Lake Fork and Yellowstone Rivers. Total trout population estimates for the Lake Fork River range from more than 900 fish per mile in the upper reaches (in Reach LF-B upstream of the confluence with the Yellowstone River), to none in the lower river in Reach LF-D downstream from the Red Cap Canal (see Map 3.3-1). Total trout population estimates for the Yellowstone River range from over 600 fish per mile in the upper reach to less than 100 fish per mile in the most downstream reach. In general, trout species composition shifts from rainbow/cutthroat hybrids and brook trout in upper reaches of both rivers to brown trout in lower reaches.

The two most apparent factors causing downstream changes in trout numbers and species composition are river flow and water temperature. In the Lake Fork River system, flows generally decrease proceeding downstream because of diversions. This decrease appears most responsible for the downstream decrease in trout numbers and is reflected in population estimates for study sites upstream and downstream of major canal diversions. In the Lake Fork River, for example, the population estimate for trout upstream of the "C" Canal diversion (Station LF-C1) was approximately 100 fish per mile compared to less than 10 fish per mile downstream of this diversion (Station LF-C2) (see Figure 3.3-1). The "C" Canal is one of the largest diversions on the river and takes most of the water from the middle Lake Fork River during summer. In the Yellowstone River, population estimates were nearly 400 trout per mile upstream of the Yellowstone Feeder Canal (Station YL-B1)

and less than 100 trout per mile downstream of this diversion (Station YL-B2) (see Figure 3.3-1). The Yellowstone Feeder Canal is the largest irrigation diversion on the river. From about late July to late August each year, there is essentially no flow in the Yellowstone River downstream of this diversion, except for some relatively minor accretion, because of water being diverted for irrigation use. Temperatures below this diversion and the “C” Canal diversion appear to be tolerable for trout as indicated by their presence; therefore, the decrease in habitat resulting from decreased flows appears to be the factor most limiting trout numbers.

The downstream increase in river water temperatures during summer (maximum temperatures of 78°F to 83°F) appears to be the factor that most controls trout species composition. Increasing downstream water temperatures in the Lake Fork River are primarily a result of flow reduction because of irrigation withdrawals, as well as decreasing elevation and associated warmer ambient air temperatures at these lower elevations. In addition, stream channels in the lower river reaches are generally wider, and have a lower gradient and less riparian shading. These factors also contribute to the substantial downstream increase in water temperatures.

Brook trout and cutthroat trout have the narrowest optimal temperature range and lowest temperature tolerance of trout species collected during the study. It is not surprising that either of these species or rainbow/cutthroat hybrids are only found in upper reaches of both rivers where temperatures are lowest. In downstream reaches, trout species composition shifts toward rainbow and brown trout, which tolerate warmer water temperatures than brook and cutthroat trout. In the more downstream reaches of both rivers, almost all trout collected were brown trout. No trout were collected in the most downstream reach of the Lake Fork River because of poor water quality resulting from high temperature and heavy sediment load, both attributable to decreased river flows and irrigation return flows.

3.3.5.1.4 Diversion Structures. Table 3.3-2 lists fish passage conditions at the 13 canal diversions in the Section 203 project area—11 on the Lake Fork River and 2 on the Yellowstone River. Five of these diversions are temporary structures. They are typically bulldozed river-rock sills just downstream from the canal intake that usually remain intact until the next high-flow event and possibly until next year’s peak runoff. This type of structure usually creates a very short rapids/cascade, which is not inherently a barrier to fish passage except at extremely low flow. As these structures deteriorate, they become riffle-like in nature, making them less of a barrier, even at low flow.

TABLE 3-2
Existing Conditions of Project Area Diversion Structures

	Dam Type	Existing Fish Passage
Lake Fork River		
Farnsworth	P	No
Rowley	T	Yes
U.S. Lake Fork	P	No
Boneta	None	Yes

TABLE 3-2
Existing Conditions of Project Area Diversion Structures

	Dam Type	Existing Fish Passage
Dry Gulch No. 1	T	Yes
“C” Canal	P	No
South Boneta	T	Yes
Purdy	P	Yes
Uteland	None	Yes
Red Cap	P	No
Hamilton-Knudsen	T	Yes
Yellowstone River		
Crystal Ranch	T	Yes
Yellowstone–Payne	P	No

P = Permanent structure; usually concrete.

T = Temporary; bulldozed rubble.

There are six permanent diversion structures in the project area (see Table 3.3-2). These are typically low concrete structures that extend across the entire channel. Five of these—the Farnsworth, U.S. Lake Fork, “C”, Red Cap, and Yellowstone Feeder–Payne Canal diversions—are impassable to upstream migrating fish. Only the Purdy Canal diversion, the sixth permanent structure, is believed to allow fish passage in its present configuration. Under the Proposed Action, fish passage would be provided at the proposed Big Sand Wash Feeder Diversion Structure.

There are two other permanent blocks to upstream fish passage in the Upalco Unit: Moon Lake Dam on the Lake Fork River and the Yellowstone Hydroelectric Diversion Dam on the Yellowstone River. Neither dam has a fish ladder. Off-channel dams, such as Big Sand Wash Dam, do not impede fish passage in main stem rivers.

3.3.5.1.5 Fish and Wildlife Mitigation and Enhancement. Fish and wildlife features that would affect aquatic resources under the Proposed Action were referred to previously in discussions of diversion structures (fish passage) and stabilization of high mountain lakes (fish and wildlife/wilderness benefits). In addition, instream flows for fish would be provided to enhance habitat in the Lake Fork River between Moon Lake Reservoir and the Big Sand Wash Feeder Diversion Structure during late summer, fall, and winter, and bypass instream flows past the Yellowstone–Feeder–Payne and “C” Canal Diversion Structures would be provided.

3.3.5.2 Revised Section 203 Alternative

Affected aquatic resources would be the same as for the Proposed Action except that no high mountain lakes would be stabilized and there would be no provision for instream flows for fish.

3.3.5.3 Twin Pots Section 203 Alternative

Affected aquatic resources would be the same as the for the Proposed Action except as described in the following text. There would be no provision for instream flows for fish under this alternative.

3.3.5.3.1 High Mountain Lakes. Aquatic resources at the high mountain lakes are the same as described for the Proposed Action.

3.3.5.3.2 Dams and Reservoirs. Aquatic resources in Big Sand Wash Reservoir, which would be enlarged 12,100 ac-ft under this alternative, are the same as described for the Proposed Action.

3.3.5.3.3 River Corridors. Aquatic resources in reaches of the Yellowstone and Lake Fork Rivers that would potentially be affected by the Twin Pots Section 203 Alternative were described under the Proposed Action.

3.3.5.3.4 Diversion Structures. Facilities for fish passage would be provided at the proposed Big Sand Wash Feeder Pipeline and Lake Fork–Yellowstone Pipeline diversions. Both of these proposed diversions are in river reaches used by trout.

3.3.5.3.5 Fish and Wildlife Mitigation and Enhancement. In addition to fish passage and high mountain lakes' stabilization, Twin Pots Reservoir would be improved. Proposed water management activities at Twin Pots Reservoir would provide year-round fish habitat and would improve the fisheries potential of this reservoir, which supports rainbow, brook, and cutthroat trout, mountain whitefish, and mountain sucker. Reservoir habitat is now degraded because of widely fluctuating water levels (FWS 1985).

3.3.6 Impact Analysis

3.3.6.1 Proposed Action Lake Fork Section 203

3.3.6.1.1 High Mountain Lakes. Lakes would be stabilized at levels zero to 5 feet above their original "natural" level and their outflows restored to natural conditions, which would benefit aquatic resources in a number of ways. It would eliminate the exposure and desiccation during drawdown of aquatic insects that are primary food sources for trout; provide good, shallow-water cover for trout by inundating a band of rocks near the original shoreline of most lakes; increase the size of the shallow euphotic zone, aquatic productivity, and, potentially, fish growth; and prevent the potential for winter fish kills by maintaining maximum water depths greater than 15 feet. In addition, restoring lake outlet streams to their original "natural" hydrologic condition would increase fall and winter base flows and May through June peak runoff flows; improve stream fish-rearing and food-production potential; and prevent the potential dewatering and freezing of brook trout eggs that incubate in stream gravels over winter.

3.3.6.1.2 Dams and Reservoirs

3.3.6.1.2.1 Conservation Pool. The conservation pool in the enlarged Big Sand Wash Reservoir would continue to provide 1,200 ac-ft of storage and successful over-winter fish survival.

3.3.6.1.2.2 Fish-Rearing Potential. Big Sand Wash Reservoir should continue to support a recreational fishery for trout, bass, and sunfish.

3.3.6.1.3 River Corridors

3.3.6.1.3.1 Instream Flows

Rearing Flows (September). Late summer baseflows are very important for supporting fish populations in project area rivers. One of the primary factors limiting fish populations in the Lake Fork–Yellowstone River system is instream habitat during low-flow periods. Therefore, the instream flow habitat analysis focused on predicted flow changes during September (lowest growing season flow month) as affected by the proposed project. Baseline and predicted September flows for the Proposed Action and alternatives are compared for a normal water year (50 percent flow exceedance) in Table 3.3-3, and for a dry water year (90 percent flow exceedance) in Table 3.3-4.

Presently, effective trout habitat only exists in the Lake Fork River downstream to the “C” Canal diversion because of frequent dewatering below that point. With the Proposed Action, instream flows for fish would extend downstream to the proposed Big Sand Wash Feeder Diversion Structure, which would be 4 miles downstream of the “C” Canal diversion. Fish production in reaches downstream of the proposed pipeline diversion is presently severely limited by poor water quality in these lower stream reaches. The Proposed Action also would provide bypass instream flows past the Yellowstone Feeder–Payne Diversion in the Yellowstone River and past the “C” Canal Diversion in the Lake Fork River.

One important difference for the Proposed Action compared to baseline conditions is that rearing flows would be enhanced for 4 miles below the “C” Canal diversion (see Tables 3.3-3 and 3.3-4). The downstream end of this 4-mile reach corresponds to the location of the proposed Big Sand Wash Feeder Diversion Structure; this reach is essentially considered “new and improved” habitat because of the increased flows for fish that would remain in this 4-mile reach of river. Even though baseline conditions show some flow in this reach under both 50 percent and 90 percent exceedance conditions, the data show numerous occurrences of zero flow and unsuitable water temperatures, which for all practical purposes, do not provide effective trout habitat. Another important difference for the Proposed Action compared to baseline conditions is that rearing flows would be somewhat higher in the upper Lake Fork River during a dry water year.

Winter Flows. Winter flows also are important in sustaining fish populations, particularly by providing enough flow to cover refuge areas where trout reside during winter. Trout seek refuge in crevices among boulders in deep pools or congregate amid heavy accumulations of brush and other woody debris in pools with lower water velocities (Bjornn 1971; Campbell and Neuner 1985; Hillman, Griffith, and Platts 1987). Such refuge areas are somewhat limited in the Lake Fork and Yellowstone Rivers. Because of this, the instream flow habitat analysis also focused on predicted flow changes during winter (analyzing the lowest monthly flow for the period November through March) as affected by the proposed project. Baseline and predicted winter flows for the Proposed Action and alternatives are compared for a normal water year (50 percent flow exceedance) in Table 3.3-5, and for a dry water year (90 percent flow exceedance) in Table 3.3-6.

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Table 3.3 (page 1 of 1)

As noted for rearing flows, an important difference during winter for the Proposed Action compared to baseline conditions is the additional instream flows for fish that would be provided below the “C” Canal diversion downstream to the proposed Big Sand Wash Feeder Pipeline diversion. These additional winter flows are reflected in Tables 3.3-5 and 3.3-6.

A second very important flow difference that would only occur under the Proposed Action, and which is the source of instream fish flows below the “C” Canal diversion, would be the release of instream flows for fish from Moon Lake Reservoir to the Lake Fork River from August through April. Instream flows and release criteria, which were described in Chapter 2, Section 2.2.2.6.2, *Instream Flows* of the Final EA, are summarized in Table 3.3-7. Presently, no water is released from Moon Lake Reservoir from mid-October through mid-April. As a result, river reaches below the dam are either dewatered or experience substantive flow reductions from mid-fall through early spring. Data for the Proposed Action in Tables 3.3-3 through 3.3-6 reflect these additional fish flows.

TABLE 3-3

Instream Flows in the Lake Fork River between Moon Lake Reservoir and the Big Sand Wash Feeder Diversion Structure

Month	Water Year* (Number of Years)	Instream Flow (cfs)
October 1 through April 30	Wet (36 out of 100 years)	10.5
	Average (42 out of 100 years)	7.0
	Dry (22 out of 100 years)	3.5
May 1 through July 31	All years	Normal irrigation releases
August 1 through September 30	Wet (36 out of 100 years)	11
	Average (42 out of 100 years)	11
	Dry (22 out of 100 years)	6

*Water year defined based on anticipated active storage in Moon Lake Reservoir on October 1, as follows:

- Wet: more than 15,000 ac-ft
- Average: between 4,500 and 15,000 ac-ft
- Dry: less than 4,500 ac-ft

A third important flow difference that would only occur under the Proposed Action is the use of water discharging from the stabilized high mountain lakes to provide bypass instream flows past the Yellowstone Feeder–Payne and “C” Canal diversions. These instream flow bypass criteria were also described in Chapter 2, Section 2.2.2.6.2, *Instream Flows* of the Final EA, and would consist of 3 cfs October through June, 2.5 cfs in July, and 2 cfs in August and September. Presently, there is essentially no flow in the Yellowstone River below the Yellowstone Feeder diversion from about late July to late August. This condition would be remedied by stipulated bypass flows under the Proposed Action.

3.3.6.1.3.2 Rearing Habitat (September)–Normal Water Year (50 Percent Flow Exceedance)

Trout Fry. The Proposed Action would result in about a 28 percent increase in total instream trout fry habitat in the Lake Fork River and a 3 percent increase in the Yellowstone River compared to baseline conditions (see Table 3.3-8). Increases in fry habitat would occur where flows differ from baseline, with the greatest increases occurring below the “C” Canal. As stated previously, the Proposed Action would provide substantial flow increases for fish below the “C” Canal for about 4 miles. Given the baseline conditions of low flow, this essentially represents the creation of “new and improved” trout habitat. Substantial increases in fry habitat would also occur in the Lake Fork River immediately above the “C” Canal. This increase, however, would result from reduced project flows compared to baseline conditions because fry prefer shallow, quiet water.

Juvenile Trout. The Proposed Action would result in an increase in total instream juvenile trout habitat of about 8 percent in the Lake Fork–Yellowstone system compared to baseline conditions (see Table 3.3-8). As noted for fry, most of this increase would reflect the “new” habitat created below the “C” Canal. Habitat also would increase somewhat in the Lake Fork River immediately above the “C” Canal. The analysis for this reach of river shows juvenile habitat decreasing at flows above 40 cfs. Therefore, reduced flow would actually result in increased juvenile habitat.

TABLE 3-8
Percent Change in Rearing (September) Instream Trout Habitat (Weighted Usable Area) by Lifestage from Baseline Conditions in the Lake Fork–Yellowstone River System for the Proposed Action

Flow Exceedance Level and River	Trout Lifestage					
	Fry		Juvenile		Adult	
50 Percent (Average)						
Lake Fork River	+28	(1,454,549)	+12	(375,527)	+9	(314,464)
Yellowstone River	+3	(104,821)	+<1	(7,985)	<-1	(-6,804)
Total	+17	(1,559,370)	+8	(383,512)	+6	(307,660)
90 Percent (Dry)						
Lake Fork River	+41	(1,972,726)	+74	(1,103,688)	+82	(1,095,258)
Yellowstone River	+1	(24,976)	-2	(-34,242)	-3	(-53,431)
Total	+23	(1,997,702)	+34	(1,069,446)	+32	(1,041,827)

Note: Numbers in parentheses show change in total usable habitat area (in square feet).

The only river reach where juvenile habitat would decrease would be in the Lake Fork River from the Tribal boundary to the confluence with the Yellowstone River. The analysis for this reach of river shows juvenile trout habitat increasing as flows increase over the entire modeled flow range. Therefore, the predicted reduction in flow in this reach under the Proposed Action would result in about 4 percent less juvenile habitat than under baseline conditions.

Adult Trout. Total instream adult trout habitat would increase about 6 percent in the Lake Fork–Yellowstone system under the Proposed Action compared to baseline conditions (see Table 3.3-8). The gains and losses in adult habitat also would occur in the same locations as described for juveniles. New habitat would be created below the “C” Canal, representing the most significant gain, and there would be a small increase in habitat immediately above the “C” Canal. Losses in adult habitat totaling about 6 percent would occur in the Lake Fork River above the confluence with the Yellowstone River as a result of decreased project flows.

3.3.6.1.3.3 Rearing Habitat (September)–Dry Water Year (90 Percent Flow Exceedance)

Trout Fry. Instream trout fry habitat would increase by about 41 percent in the Lake Fork River and 1 percent in the Yellowstone River under the Proposed Action in a dry water year (see Table 3.3-8). Increases would primarily occur below the confluence with the Yellowstone River. Much of this habitat increase would be a result of the new habitat below the “C” Canal, but habitat also would increase substantially upstream because of the improved flow regime for fish compared to baseline.

Juvenile Trout. Instream juvenile habitat in the Lake Fork–Yellowstone River system would increase by about 34 percent during a dry water year (see Table 3.3-8). Much of the habitat increase would occur below the “C” Canal, and in the Lake Fork River upstream of the confluence with the Yellowstone River.

Adult Trout. Instream adult trout habitat in the Lake Fork–Yellowstone River system would increase by about 32 percent during a dry water year (see Table 3.3-8). All of the increases in adult habitat would occur below the “C” Canal in the newly created habitat, and in the Lake Fork River upstream of the confluence with the Yellowstone River because of increased flows. A slight reduction in habitat would occur immediately above the “C” Canal because of a slight decrease in flows compared to baseline conditions.

3.3.6.1.3.4 Winter Trout Habitat

Normal Water Year (50 Percent Flow Exceedance). Winter trout habitat in the Lake Fork River during a normal water year would increase about 32 percent compared to baseline conditions (see Table 3.3-9). Much of the increase would occur because of new habitat created below the “C” Canal where, presently, there is essentially no over-wintering habitat for trout. Creation of additional over-wintering habitat between Moon Lake Dam and the confluence with the Yellowstone River also would be significant. Habitat would decrease slightly immediately above the “C” Canal because of increased flows and unsuitable water velocities for over-wintering trout. There would be a slight increase in the Yellowstone River because of outflows from stabilized high mountain lakes.

TABLE 3-9
 Percent Change in Winter Instream Trout Habitat (Weighted Usable Area) from Baseline Conditions in the Lake Fork–
 Yellowstone River System for the Proposed Action and Alternatives

Flow Exceedance Level and River	Proposed Action–Lake Fork Section 203		Revised Section 203	Twin Pots Section 203	
50 Percent (Average)					
Lake Fork River	+32	(29,763)		+3	(2,457)
Yellowstone River	<u>+1</u>	<u>(908)</u>	No Change	<u>+1</u>	<u>(681)</u>
Total	+19	(30,671)		+2	(3,138)
90 Percent (Dry)					
Lake Fork River	+14	(13,427)		+3	(2,996)
Yellowstone River	<u>+10</u>	<u>(5,400)</u>	No Change	<u>+9</u>	<u>(5,065)</u>
Total	+12	(18,827)		+5	(8,061)

Note: Numbers in parentheses show change in total usable habitat area (in square feet).

Dry Water Year (90 Percent Flow Exceedance). During a dry water year, overall winter trout habitat in the Lake Fork River would increase by about 14 percent compared to baseline conditions (see Table 3.3-9). The newly created habitat in the Lake Fork River below the “C” Canal and upstream of the confluence with the Yellowstone River would more than offset slight losses incurred elsewhere in the Lake Fork River during winter in a dry water year. Habitat immediately above the “C” Canal would be reduced by about 11 percent because of increased winter flows, which would create unsuitable water velocities for over-wintering. Habitat in the Yellowstone River would increase by about 10 percent during winter.

3.3.6.1.3.5 Trout Habitat Summary. Under the Proposed Action, total instream trout habitat in September (rearing season) would increase for all lifestages in the Lake Fork River compared to baseline conditions. Nearly all of the increases would result from new habitat created below the “C” Canal. Availability of suitable rearing habitat during dry years is most important to the long-term sustained viability of fish populations. Drought conditions can severely reduce trout populations, and recovery of the populations with more favorable flow conditions can take several years. This concept, referred to as biological bottlenecking, is important when interpreting results of instream flow habitat modeling. In general, changes in habitat in a dry year would best represent potential long-term impacts that the Proposed Action would have on fish populations in the rivers. Therefore, because conditions during a dry year are considered significant in maintaining a viable trout population, the Proposed Action should alleviate some of the biological bottlenecking attributable to summer low-flow periods presently occurring under baseline conditions. Depending on lifestage, trout habitat in the Lake Fork during September would increase 41 to 82 percent in a dry water year and 9 to 28 percent in an average water year.

Changes in the amount of habitat in the lower Yellowstone River during September would be minor, but beneficial to sensitive, smaller-sized trout during dry and average water years. The bypass instream flows during this general time of year would assure cover

downstream of the Yellowstone Feeder diversion at a time when this reach may otherwise be largely dewatered. Overall benefits to the Lake Fork–Yellowstone system in September would vary, depending on lifestage, from trout habitat increases of 23 to 34 percent in dry water year to 6 to 17 percent in an average water year.

Total instream trout habitat also would increase in the Lake Fork River during the winter, primarily for the following three reasons:

- Increased winter flows in the Lake Fork River downstream to Moon Lake Reservoir because of natural and higher discharges from stabilized high mountain lakes
- The release of instream flows for fish from Moon Lake Reservoir to the Lake Fork during the winter would benefit about 12 miles of river downstream to the confluence with the Yellowstone River, which are presently dewatered or have very low flows
- Increased winter flows in the 4-mile reach of the Lake Fork between the “C” Canal diversion and the proposed Big Sand Wash Feeder Diversion Structure where winter baseline flows are presently quite low

Winter habitat in the Lake Fork River would increase by 32 percent in an average water year and by 14 percent in a dry water year. Four miles of “new and improved” trout habitat created between the “C” Canal and proposed Big Sand Wash Feeder Pipeline diversions would be important because there is essentially no over-wintering trout habitat in this reach at present. Further upstream, creation of additional winter trout habitat in the 12-mile reach of the Lake Fork River between Moon Lake Dam and the Yellowstone River confluence also would be significant. The limited amount of winter habitat presently found in this 12-mile reach likely represents a biological bottleneck to the population. Similarly, enhancing winter flows and aquatic habitat through the provision of instream flows could potentially enhance the trout population. In addition, providing year-round flows to the 2-mile river reach immediately downstream of Moon Lake Dam that is now dewatered from late fall through early spring would increase aquatic insect productivity and enhance the food supply for the downstream fish population. Upstream of Moon Lake Reservoir, increased river flows during winter of about 3 cfs (10 percent more than baseline) because of high mountain lakes’ stabilization could potentially provide about 10 percent more over-wintering habitat for trout. Observations on the upper Lake Fork indicate a direct correlation between streamflow and winter habitat.

Bypass instream flows of 3 cfs during the winter past the Yellowstone Feeder Diversion also would assure over-winter habitat for trout in the lower Yellowstone River. Like the Lake Fork, increased winter flows because of high mountain lakes stabilization would benefit the trout fishery throughout the Yellowstone during winter of dry and average water years.

Habitat increases described previously would more than offset some projected slight winter habitat reduction in a 4-mile reach of the Lake Fork River between its confluence with the Yellowstone River and the “C” Canal diversion. This projected decrease in habitat would actually result from increased flows and, therefore, increased water velocities that would provide slightly less suitable habitat for over-wintering fish than at present. Fish occurring in this reach could disperse upstream to use increased winter habitat in the Lake Fork and the Yellowstone upstream of the Yellowstone–Lake Fork confluence. Fish occurring

downstream of the “C” Canal diversion would use “new” habitat that would extend downriver to the Big Sand Wash Feeder Diversion Structure.

3.3.6.1.3.6 Channel-Shaping Flows. The magnitude of the channel-shaping, 2-year high-flow event in the Lake Fork River would range from the same to 4 percent less than baseline upstream of the confluence with the Yellowstone River, 15 percent less than baseline downstream to the “C” Canal, and 31 percent less than baseline between the “C” Canal and the proposed Big Sand Wash Feeder diversions where new habitat would be created. The timing, duration, and rate of flow change surrounding the peak would essentially follow the natural regime. In addition, channel maintenance floods frequently occur every 2 to 3 years and the existing 2-year flood would return every 2 to about 2.7 years, depending on river reach, upstream of the Big Sand Wash Feeder Diversion Structure. Thus, no adverse impact on fisheries or other aquatic resources is anticipated.

3.3.6.1.4 Diversion Structure. The new Big Sand Wash Feeder Diversion Structure would be designed to provide passage for juvenile and adult fish throughout the year, as well as unimpeded bedload movement.

3.3.6.1.5 Fish and Wildlife Mitigation and Enhancement Benefits. Benefits associated with providing fish passage at the Big Sand Wash Feeder Diversion Structure, stabilizing high mountain lakes, and providing instream flows for fish, were described in the preceding text.

3.3.6.1.6 Total Impacts. Assessing total impacts of the Proposed Action on fisheries resources requires understanding how the various project components would combine to affect fish in the watershed. Three largely separate fisheries would be affected by the project: high mountain lake, offstream reservoir, and stream fisheries. The hydrologic connection among the three is the change in river flows that would occur with high mountain lakes’ stabilization, release of instream flows for fish from Moon Lake Reservoir and bypass flows past the Yellowstone Feeder and “C” Canal diversions, and streamflow diversions for reservoir operation.

Changes to high mountain lakes’ fish populations likely would be positive. These lakes currently support good trout populations, comparable to other natural lakes in the High Uintas Wilderness and would continue to do so. Probably the greatest fisheries benefit associated with lake stabilization would be improved aesthetics as the presently dewatered zone around each lake becomes revegetated. Their more natural visual appearance would enhance the attractiveness of these lakes to recreational anglers, providing a higher-quality fishing experience consistent with the purposes of the High Uintas Wilderness.

The enlarged Big Sand Wash Reservoir would continue to provide a 1,200-ac-ft conservation pool for fish and successful over-winter fish survival. Wildlife Resources would continue to stock the reservoir at rates appropriate for the size of the reservoir.

Stream fisheries (primarily trout) would be enhanced by the following project features:

- Instream flows for fish would be released from Moon Lake Reservoir from August through April and would remain in the Lake Fork River downstream to the Big Sand Wash Feeder Diversion Structure.

- An overall increase in “effective stream habitat” would eliminate some of the flow-related “biological bottlenecks” that likely now limit fish populations during the growing season and during the winter.
- An overall increase in “effective stream habitat” would provide additional overwintering habitat for trout upstream and downstream of Moon Lake Dam.
- Bypass instream flows past the Yellowstone Feeder and “C” Canal diversions would provide additional overwintering habitat in the Yellowstone and Lake Fork Rivers and habitat during periods when some reaches of these two rivers are sometimes dewatered.
- Upstream fish passage facilities would be constructed at the new Big Sand Wash Feeder Diversion Structure.
- Four miles of “new and improved” trout habitat would occur in the Lake Fork River below the “C” Canal diversion.
- Twelve miles of winter trout habitat would be enhanced in the Lake Fork River between Moon Lake Dam and the confluence with the Yellowstone River.

Trout populations in project-area streams are quite limited now, even in upper reaches that have not been substantially affected by land use activities. Relatively low nutrient levels, exceedingly high runoff flows because of the south-facing watersheds, and channel geomorphic conditions (lack of pools) combine to provide natural conditions poorly suited to support large trout populations. In the context of potential project-related impacts, it is important to recognize that project-area streams are not now, nor could they become in the future, high-yield fish producers. There would continue to be degradation of riparian vegetation from grazing and maintenance of existing water diversion structures under the Proposed Action.

Major benefits to the stream fisheries under the Proposed Action would include provisions for instream flows in the Lake Fork River downstream of Moon Lake Dam to the proposed Big Sand Wash Feeder Diversion Structure, an overall increase in “effective stream habitat” in the Lake Fork River for all lifestages of trout during average and dry water years of the growing and winter seasons, instream bypass flows in the Yellowstone River past the Yellowstone Feeder diversion that would benefit trout during low-flow periods and over winter, and the provision of fish passage facilities at the Big Sand Wash Feeder Diversion Structure that would allow trout to disperse upstream and downstream.

3.3.6.2 Revised Section 203 Alternative

3.3.6.2. Dams and Reservoirs The conservation pool and fish-rearing potential of the enlarged Big Sand Wash Reservoir would be the same as described for the Proposed Action.

3.3.6.2.2 River Corridors

3.3.6.2.2.1 Instream Flows

Rearing Flows (September). The proposed September flow regimes during average and dry water years are compared against baseline flows in Tables 3.3-3 and 3.3-4, and are similar to but slightly less than those described for the Proposed Action.

Winter Flows. Proposed winter flows during average and dry water years would be the same as baseline flows (see Tables 3.3-5 and 3.3-6). There would be no releases of instream flows for fish from Moon Lake Reservoir to the Lake Fork River as described for the Proposed Action.

3.3.6.2.2.2 Rearing Habitat (September). September flows under the Revised Section 203 Alternative would be similar to those for the Proposed Action under both the 50 percent and 90 percent exceedance conditions (see Tables 3.3-3 and 3.3-4). Therefore, overall changes in rearing trout habitat in the Lake Fork River from baseline conditions for all lifestages also would be similar, ranging from 7 to 30 percent in a normal water year and from 41 to 77 percent in a dry water year (see Table 3.3-10). Yellowstone River flows would not be affected by this alternative.

TABLE 3.30
Percent Change in Rearing (September) Instream Trout Habitat (Weighted Usable Area) by Lifestage from Baseline Conditions in the Lake Fork River for the Revised Section 203 Alternative

Flow Exceedance Level and River	Trout Lifestage					
	Fry		Juvenile		Adult	
50 Percent (Normal)						
Lake Fork River	+30	(1,578,367)	+11	(357,749)	+7	(234,411)
90 Percent (Dry)						
Lake Fork River	+41	(1,941,748)	+70	(1,049,323)	+77	(1,024,588)

Note: Numbers in parentheses show change in total usable habitat area (in square feet).

3.3.6.2.2.3 Winter Habitat

Normal Water Year (50 Percent Flow Exceedance). Winter flows and habitat under the Revised Section 203 Alternative would be essentially the same as baseline flows and habitat under 50 percent exceedance conditions (see Tables 3.3-5 and 3.3-9).

Dry Water Year (90 Percent Flow Exceedance). Winter flows and habitat during dry water year conditions for the Revised Section 203 Alternative would be essentially the same as baseline flows and habitat (see Tables 3.3-6 and 3.3-9).

3.3.6.2.2.4 Trout Habitat Summary. Changes in rearing habitat for all lifestages under average and dry water year flow conditions would be similar to those described for the Proposed Action, except that the 13 high mountain lakes would not be stabilized and there would be no provisions for instream flows in the Lake Fork River or bypass flows in the Yellowstone River. Winter habitat under average and dry water year flow conditions also would be essentially the same as baseline conditions.

3.3.6.2.2.5 Channel-Shaping Flows. Channel-shaping flows would be similar to those described for the Proposed Action. No adverse impacts on channel conditions, fisheries, or other aquatic resources are anticipated.

3.3.6.2.3 Diversion Structure The same new diversion structure with provision for fish passage would be constructed as under the Proposed Action.

3.3.6.2.4 Fish and Wildlife Mitigation and Enhancement Potential fisheries benefits associated with this feature would be the same as described for the Proposed Action, except there would be no high mountain lakes' stabilization and no provision for instream or bypass fish flows.

3.3.6.2.5 Total Impacts Total impacts of the Revised Section 203 Alternative on fisheries resources would be similar to those described for the Proposed Action, except that the 13 high mountain lakes in the Lake Fork and Yellowstone River drainages would not be stabilized and there would be no provisions for instream flows in the Lake Fork River or bypass flows in the Yellowstone River. Also, there would be no gains in over-wintering habitat because no instream flows for fish would be provided.

3.3.6.3 Twin Pots Section 203 Alternative

3.3.6.3.1 High Mountain Lakes Potential benefits to aquatic resources in the 13 high mountain lakes that would be stabilized and in their outlet streams would be the same as described for the Proposed Action.

3.3.6.3.2 Dams and Reservoirs The conservation pool and fish-rearing potential of the enlarged Big Sand Wash Reservoir would be the same as described for the Proposed Action.

3.3.6.3.3 River Corridors

3.3.6.3.3.1 Instream Flows

Rearing Flows (September). The greatest flow changes under the Twin Pots Section 203 Alternative would be substantially decreased rearing flows in many reaches of the Lake Fork River downstream of Moon Lake Reservoir during average water years (see Tables 3.3-3 and 3.3-4). Flows in the Yellowstone River would be similar to baseline flows, although not identical because of stabilizing nine high mountain lakes in this drainage. The Yellowstone River downstream of the Yellowstone Feeder-Payne diversion would continue to be dewatered annually from about late July to late August, the same as at present, since there would be no stipulation to provide instream bypass flows. This late-summer occurrence would continue to adversely affect fish populations in the lower Yellowstone River, regardless of projected habitat changes during September (the month of analysis) when flows are again left in the river.

Winter Flows. Proposed winter flows under the Twin Pots Section 203 Alternative would be about the same (Lake Fork River) or slightly greater (Yellowstone River) than baseline flows.

3.3.6.3.3.2 Rearing Habitat (September)-Normal Water Year (50 Percent Flow Exceedance)

Trout Fry. Under average water year flow conditions, the Twin Pots Section 203 Alternative would result in flows lower than baseline in many reaches of the Lake Fork River and essentially the same flows in the Yellowstone River. This reduction in flow would result in an overall increase in fry habitat of about 17 percent (see Table 3.3-11). Most habitat gains would result from the new and improved habitat below the "C" Canal, although substantial

gains also would be realized immediately above the “C” Canal where flows would be reduced by about 20 percent.

TABLE 3-31
Percent Change in Rearing (September) Instream Trout Habitat (Weighted Usable Area) by Lifestage from Baseline Conditions in the Lake Fork–Yellowstone River System for the Twin Pots Section 203 Alternative^a

Flow Exceedance Level and River	Trout Lifestage					
		Fry		Juvenile		Adult
50 Percent (Average)						
Lake Fork River	+30	(1,555,985)	+4	(128,989)	-2	(-68,034)
Yellowstone River ^b	+1	(56,864)	+<1	(4,975)	-<1	(-3,822)
Total	+17	(1,612,849)	+3	(133,964)	-1	(-71,856)
90 Percent (Dry)						
Lake Fork River	+27	(1,273,415)	+25	(379,071)	+14	(187,664)
Yellowstone River ^b	<1	(17,584)	-1	(-19,014)	-2	(-30,222)
Total	+15	(1,290,999)	+11	(360,057)	+5	(157,442)

^aNumbers in parentheses show change in total usable habitat area (in square feet).

^bThe Yellowstone River downstream of the Yellowstone Feeder–Payne diversion would continue to be dewatered from late July to late August immediately preceding the September period of analysis, and except for accretion, would provide essentially no fish habitat during late summer.

Juvenile Trout. Overall juvenile rearing habitat would increase by about 3 percent under the Twin Pots Section 203 Alternative (see Table 3.3-11). Most notably, juvenile habitat would benefit from the newly created and improved habitat below the “C” Canal.

Adult Trout. Total adult trout habitat would decrease about 1 percent compared to baseline conditions in an average water year under the Twin Pots Section 203 Alternative (see Table 3.3-11). Habitat gains below the “C” Canal would not offset habitat losses in the Lake Fork River between Moon Lake Dam and the confluence with the Yellowstone River.

3.3.6.3.3.3 Rearing Habitat (September)—Dry Water Year (90 Percent Flow Exceedance). Overall habitat increases in the Lake Fork–Yellowstone River system during dry water year conditions would vary from 5 to 15 percent during the rearing season, depending on lifestage (see Table 3.3-11). Gains in new habitat downstream of the “C” Canal would more than offset habitat reductions just upstream of the “C” Canal that would result from reduced flow compared to baseline conditions. Overall habitat gains in the Lake Fork River for fry, juveniles, and adults would typically be much less than those for the Proposed Action.

3.3.6.3.3.4 Winter Habitat. Winter flows in the Lake Fork River downstream of Moon Lake under the Twin Pots Section 203 Alternative would be essentially the same as baseline under both the 50 percent and 90 percent exceedance conditions (see Tables 3.3-5 and 3.3-6). The exceptions would be during dry and average water years when flow from the Yellowstone

River into the Lake Fork River would be greater than baseline because of high mountain lakes stabilization. Therefore, winter trout habitat would be slightly greater than baseline conditions (see Table 3.3-9). In the Yellowstone River and in the Lake Fork River upstream of Moon Lake Reservoir, there would be increases in winter habitat of approximately 5 to 10 percent because of high mountain lakes' stabilization and natural and higher winter discharges to streams. The overall combined increase in winter trout habitat in the Lake Fork–Yellowstone river system would be approximately 2 percent in an average water year and 5 percent in a dry water year.

3.3.6.3.3.5 Trout Habitat Summary. The Twin Pots Section 203 Alternative would result in overall gains in trout rearing habitat under average and dry water year flow conditions except for adults in an average year. Habitat gains would be much less than for the Proposed Action, especially in a dry water year.

Winter habitat in the Lake Fork River would be comparable to or slightly greater than baseline conditions. Slight increases in winter habitat in the Yellowstone River and the Lake Fork River would reflect stabilization of high mountain lakes and slightly increased winter flows.

3.3.6.3.3.6 Channel-Shaping Flows. Channel-shaping flows generally would be slightly smaller in volume and have slightly longer return intervals than was described for the Proposed Action. The return interval for a 2-year flood event would be 2.9 years between the “C” Canal and proposed Big Sand Wash Feeder diversions.

3.3.6.3.4 Diversion Structures. The nature of potential fish passage benefits at diversion structures would be the same as described for the Proposed Action. The new Big Sand Wash Feeder Pipeline and Lake Fork–Yellowstone Pipeline diversions on the Lake Fork River would have fish passage facilities.

3.3.6.3.5 Fish and Wildlife Mitigation and Enhancement Benefits. In addition to fish passage provisions and benefits from stabilizing 13 high mountain lakes, the third fish and wildlife feature related to aquatic resources that would be implemented under this alternative is the Twin Pots Reservoir Improvement. Reduction of water level fluctuation in Twin Pots Reservoir would increase food production because of a larger euphotic zone, promote nearshore vegetation, and improve over-winter fish survival. A conservation pool would be maintained to provide year-round fish habitat.

3.3.6.3.6 Total Impacts. Total impacts associated with the Twin Pots Section 203 Alternative would include the following:

- Improved high mountain lakes' (13 lakes) and Twin Pots Reservoir fish populations and a higher-quality fishing experience because of lake and reservoir stabilization
- Continuation of the recreational fishery at the enlarged Big Sand Wash Reservoir
- Elimination of some fisheries-limiting “biological bottlenecks” on the Lake Fork River during dry water year conditions of the rearing season
- Construction of upstream fish passage facilities at two new diversions

- Creation of 4 miles of “new and improved” trout habitat below the “C” Canal diversion on the Lake Fork River
- Creation of some additional over-wintering habitat in the Lake Fork River upstream of Moon Lake Reservoir and in the Yellowstone River.
- Continued degradation of riparian vegetation from grazing and maintenance of existing diversion structures.

Unavoidable adverse impacts would include an overall reduction in the Lake Fork–Yellowstone River system of adult trout “effective stream habitat” during the rearing season of average water years.

3.3.6.4 No Action Alternative

3.3.6.4.1 Trends Fish populations in the Section 203 project area appear to have developed in response to degraded instream and riparian habitat, mostly in the mid to lower reaches, as well as frequent high-flow and low-flow events. Densities of trout appear low in many river reaches, fish are generally small, and spawning success appears limited. Warm water temperatures and poor water quality in the lower Lake Fork River limit fish populations to only those species, such as carp and suckers, that can tolerate these conditions. This fishery would most likely continue to exist in its present state.

3.3.6.4.2 Future Conditions If the Proposed Action or any of the alternatives are not implemented, instream habitat and fish resources would remain essentially unchanged. The following conditions, and their consequences on fish resources, would continue to persist:

- Degradation and destruction of riparian vegetation as a result of grazing and water diversion structure maintenance
- Continuation of severe low flows during late summer, particularly during dry years
- Continuation of severe low flows during winter in portions of the river system

3.3.6.4.3 Consequences of Not Meeting Project Needs Purpose and needs of the project are primarily related to meeting irrigation demands. Therefore, there would be no effects on aquatic resources from not meeting project needs.

3.3.7 Cumulative Impacts

Changes in streamflows for the Section 203 Project Proposed Action and alternatives would cumulatively affect flows in the Duchesne River. These flows, and those farther downstream in the Green River, are of concern for several federally listed fish species. Potential impacts on these species are discussed in Section 3.7, *Threatened and Endangered Species*, of the Final EA.

3.4 Wetland and Riparian Resources

3.4.1 Introduction

The wetland and riparian resources analysis addresses known and estimated direct, indirect, total, and cumulative potential impacts resulting from the construction, operation, and maintenance of project features associated with the Proposed Action and alternatives of the Section 203 project area. Wetland creation mitigation and enhancement strategies that would avoid net impacts also are identified.

3.4.2 Issues Eliminated from Further Analysis

All wetland and riparian resource issues identified during public scoping for the Upalco Unit DEIS that are relevant to the Section 203 Project were considered in this analysis. However, some aspects of this project would not significantly affect these resources. These impacts would generally result in a temporary loss of habitat that would subsequently be replaced naturally or through implementation of mitigation measures. Thus, in the long term, there would be no net loss of these resources. In these instances, analysis is limited to a brief description of existing conditions, and resources are not addressed in the impact analysis.

Of particular importance in this regard is the stabilization of high mountain lakes. Lake stabilization would change pool levels and result in a temporary loss of existing resources along lake shorelines. Subsequent to stabilization, however, natural replacement of more persistent wetlands is expected to occur along the new lake margins. Replacement is anticipated to result in no net loss of area, function, or value for this resource because soils have not been eroded from the drawdown areas and stable water levels would promote growth of wetland and riparian species. The Uinta Basin Replacement Project (UBRP) *Wetland/Riparian Resource Technical Report* (CH2M HILL/Horrocks 1996c) discusses these effects in detail.

3.4.3 Issues Addressed in the Impact Analysis

Issues identified during public scoping for the UBRP are addressed in the impact analysis. These issues have been combined into four major subject areas that include the following:

1. All impacts on wetland and riparian communities must be accounted for.
2. Impacts on wetland and riparian communities should be avoided where possible because of the difficulty and very high costs of replacing these resources.
3. All impacts on wetland and riparian communities must be mitigated in-kind and as close to the impact site as possible.
4. Mitigating impacts by restoring degraded wetland and riparian communities would require very large areas but has proven to be much more successful than creating new wetlands.

Sources of temporary or permanent impacts on existing wetland and riparian resources predicted to occur from the project, and which would be mitigated, are addressed in the impact analysis and include the following:

- Construction of new diversion structures would fill wetlands.
- Enlargement of Big Sand Wash Reservoir would submerge existing wetland and riparian habitat.
- Construction of pipelines and haul roads would fill or excavate existing wetlands. In most cases, this would result in temporary impacts until these resources are re-established in place.

3.4.4 Description of Area of Influence

The area of influence is shown on Map 1.4-1 in Chapter 1 of the Final EA and is located in northeastern Utah. Within the project area, immediate areas of influence include the project feature sites for the Proposed Action and alternatives, which are shown on Maps 2.2-1, 2.3-1, and 2.4-1 in Chapter 2 of the Final EA.

3.4.5 Affected Environment

Wetland and riparian cover types in the project area include emergent wetlands, wet meadows, and shrub and forested riparian communities. Each of these types performs or provides specifically different functions and values depending on their size, position within the landscape, location relative to other habitats, and other factors. The composition of these cover types is discussed in the UBRP *Wetland/Riparian Resource Technical Report* (CH2MHILL/Horrocks 1996c).

This section summarizes the types and amounts of wetland and riparian resources that would be affected by the Proposed Action and alternatives. Resources that would be unaffected or only temporarily affected are not discussed further in this document.

3.4.5.1 Proposed Action Lake Fork Section 203

Wetland and riparian resources potentially affected by project features of the Proposed Action are listed in Tables 3.4-1 and 3.4-2.

3.4.5.1.1 High Mountain Lakes Thirteen high mountain lakes would be stabilized as part of the Proposed Action. Wet meadow wetlands, emergent wetlands, and shrub riparian habitat grow along the margins of some of these lakes (see Table 3.4-1).

3.4.5.1.2 Dams and Reservoirs Wetland and riparian communities in the vicinity of the Big Sand Wash Reservoir enlargement site are primarily shrub riparian communities (see Table 3.4-1). Emergent and wet meadow wetlands also are found around the Reservoir.

3.4.5.1.3 River Corridor Wetland and riparian cover types are present within the floodway of the Lake Fork River downstream of the proposed Big Sand Wash Feeder Pipeline diversion site (see Table 3.4-2). Most of this cover occurs at lower elevations and along low stream gradients. Approximately 3,560 acres of wetland and riparian cover types were identified along the Lake Fork River corridor.

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TABLE 3-2
River Corridor Wetland and Riparian Cover Types (in acres)

Reach	Reach Description	Emergent Wetlands	Wet Meadow	Shrub Riparian	Forested Riparian
III	Lake Fork River (Big Sand Wash Feeder Pipeline Site to the Duchesne River)	20	1,290	1,480	770

3.4.5.1.4 Diversion Structure. Shrub riparian and forested riparian cover types occur near the proposed diversion structure site. Because the precise location of the diversion structure is not known at this time, exact acres of potentially affected resources could not be determined.

3.4.5.1.5 Pipeline. Forested riparian, shrub riparian, wet meadow, and emergent wetland communities occur along the proposed Big Sand Wash Feeder Pipeline route and the proposed Big Sand Wash–Roosevelt Pipeline route.

3.4.5.1.6 Fish and Wildlife Mitigation and Enhancement. Wetland and riparian resources would not be affected by development of fish and wildlife features. By definition, wetland creation and enhancement will occur within or near existing wetland and riparian communities along the Lake Fork River or alternatively along the Duchesne River corridor, as described in Chapter 2 of the Final EA and in Appendix A, *Wetland/Riparian Creation*, in this Final Technical Memorandum.

3.4.5.2 Revised Section 203 Alternative

Tables 3.4-2 and 3.4-3 summarize the wetland and riparian resources potentially affected by this alternative. Resources affected at reservoir, pipeline routes, diversion structures, and fish and wildlife mitigation and enhancement sites are identical to those described for the Proposed Action. No high mountain lakes would be stabilized under this alternative.

3.4.5.3 Twin Pots Section 203 Alternative

Tables 3.4-2 and 3.4-4 summarize wetland and riparian resources potentially affected by this alternative. Enlargement of Big Sand Wash Reservoir would affect emergent wetland, wet meadow, and shrub riparian habitat on non-Tribal lands.

3.4.5.3.1 High Mountain Lakes. Affected wetland and riparian resources were discussed in Section 3.4.5.1.1 (see Table 3.4-4).

3.4.5.3.2 River Corridor. Cover types in the Lake Fork River corridor downstream of the Big Sand Wash Feeder Pipeline diversion site are identified in Table 3.4-2. River corridor cover types were discussed under the Proposed Action.

3.4.5.3.3 Diversion Structure. Wetland and riparian resources affected by diversion structures are the same as for the Proposed Action except that a new diversion, the Lake Fork–Yellowstone, is covered under this alternative (see Table 3.4-4).

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3.4.5.3.4 Pipeline This alternative includes construction of a third pipeline, the Lake Fork–Yellowstone Pipeline, which would pass through wet meadow and woody riparian systems, primarily on Tribal land.

3.4.5.3.5 Fish and Wildlife Mitigation and Enhancement Wetland and wildlife features are the same as for the Proposed Action, except as discussed below. While no detailed wetland and riparian resource survey was conducted at the Twin Pots Reservoir Improvement area, approximately 0.5 acre of small clumps of willows and cottonwood along with scattered colonies of emergent sedges and rushes grow along the high water line of the reservoir.

3.4.6 Impact Analysis

3.4.6.1 Impact Analysis Methods

Impacts on wetland and riparian resources were determined by evaluating the area of each wetland or riparian type to be impacted by a particular project feature. Impacts at diversion structures were not calculated, as the final location for each structure has not been identified. If permanent impacts occur at these features, wetlands/riparian mapping of the affected areas will be conducted and a mitigation plan developed in consultation with resource and regulatory agencies prior to any construction activity.

3.4.6.2 Potential Impacts Eliminated From Further Analysis

Tables 3.4-1, 3.4-3, and 3.4-4 include project feature sites where wetland and riparian areas are not present. Wetland resources would not be impacted by the Proposed Action or alternatives at these sites and they have been eliminated from further analysis. Of particular importance in this regard is the stabilization of high mountain lakes. Lake stabilization would change pool levels and result in a temporary loss of existing resources along lake shorelines. Subsequent to stabilization, however, natural replacement of more persistent wetlands is expected to occur along the new lake margins. Replacement is anticipated to result in no net loss of area, function, or value for this resource because soils have not been eroded from the drawdown areas and stable water levels would promote growth of wetland and riparian species. Because of this, high mountain lakes have been similarly eliminated from further analysis.

3.4.6.3 Proposed Action Lake Fork Section 203

3.4.6.3.1 Dams and Reservoirs Dams and reservoirs affect wetland and riparian resources through habitat inundation and dam construction. A total of 31 acres of shrub riparian, emergent, and wet meadow communities (see Table 3.4-1) would be impacted by Big Sand Wash Reservoir enlargement.

3.4.6.3.2 River Corridor Table 3.4-5 lists baseline flows and expected flows under the Proposed Action for representative stations on the Lake Fork River downstream of the confluence with the Yellowstone River. Return periods for the 2- and 5-year spring peak flow events are expected to be longer (about 20 to 40 percent) than currently experienced (see Table 3.4-5). The return period for the 10- and 20-year peak flow events would be up to twice as long as currently experienced. This may result in a reduction in the rate of seed germination and seedling establishment and survival for cottonwoods during a given year and also in a longer time period between years when successful establishment occurs in

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those reaches. Return spring flow flood frequency between the “C” Canal and Big Sand Wash diversions would be longer with the project (see Table 3.4-5). If great enough, the expected long-term impact of a reduced rate and frequency of cottonwood germination and survival may be a gradual decline in the extent of cottonwood forest. However, given the expected level of reduction for the proposed project, impacts should be negligible. For example, the magnitude of the 5-, 10-, and 20-year flow events would be 4 to 13 percent less than what is currently experienced. In addition, channel maintenance floods frequently occur every 2 to 3 years and the existing 2-year flood would return every 2.4 to 2.7 years with the project (see Table 3.4-5). There would be no effect on channel maintenance flows with the project.

Lake Fork River flow patterns (50 percent exceedance values) would vary as a result of the Proposed Action (see Table 3.4-5). Between the Yellowstone River confluence and the “C” Canal, flows would increase over baseline 2 to 11 cfs (6 to 100 percent) from October through March. Flows 5 to 128 cfs (7 to 69 percent) lower than baseline would occur from May through September. The same sort of effects as discussed previously for peak flows also may affect maintenance conditions in the Lake Fork between the confluence with the Yellowstone and the “C” Canal during summer. Flows would be 2 to 31 cfs (up to 57 percent) above baseline throughout the year (except in March and August) between the “C” Canal and Big Sand Wash Feeder diversions, including rewatering the channel with instream fish flows of 7 cfs from October through December when the channel has been historically dry. There would be little or no change in median flows below the Big Sand Wash diversion to the Duchesne River during much of the year. However, winter flows from January through March would be considerably lower (50 to 60 cfs) as water is diverted to fill the enlarged Big Sand Wash Reservoir, while flows in June and July would be higher (12 to 15 cfs) than baseline.

There would be little impact on riparian or wetland resources along the Lake Fork River, given the magnitude of growing season flows and minimal change in peak flows. However, groundwater recharge during the winter would be less in the lower reaches of the Lake Fork River. Section 3.2.4.1 of the Final EA discussed why no potential adverse effects on groundwater recharge are expected from this minor winter reduction.

3.4.6.3.3 Diversion Structure. Because the precise location and design of the new diversion structure is not known at this time, the impacts of this structure on resources cannot be quantified. Best management practices (BMPs) would be employed during construction and operation of the dam to avoid and minimize impacts on wetland and riparian resources (see Appendix A of the Final EA).

3.4.6.3.4 Pipelines. There would be a temporary loss of forested riparian, shrub riparian, wet meadow, and emergent wetland habitat from construction of the Big Sand Wash Feeder and Big Sand Wash–Roosevelt Pipelines (see Table 3.4-1). The exact locations of the pipeline centerlines have not been sufficiently delineated to quantify the exact amount of each type. However, this habitat would be replaced following construction, including restoration of pre-construction contours and vegetation communities. Following identification and staking of the pipeline centerlines, exact acreage of temporary impacts by plant community type will be determined. Periodic maintenance of the pipelines may result in additional

temporary impacts on resources during the lifetime of the facilities. Operation of the pipelines is not expected to impact wetland resources.

3.4.6.3.5 Fish and Wildlife Mitigation and Enhancement. There would be no impacts on wetland and riparian resources from implementing fish and wildlife features. Instream flows between Moon Lake Reservoir and the Big Sand Wash Feeder Diversion Structure may benefit these resources during some winter months when baseline river flows are very low or lacking. The same is true for the bypass instream flows on the Yellowstone River. However, mitigation is being proposed because of the effects of other project features and also to achieve the goal of no net loss of wetland and riparian habitat as a result of project implementation. As discussed in Chapter 2 of the Final EA, wetland and riparian habitat would be created along the Lake Fork River or at an alternative site in the Duchesne River corridor as part of the Proposed Action. Approximately 50 acres of wetland/riparian habitat will be developed to offset the loss of wetland/riparian habitat at Big Sand Wash Reservoir and any other potential project-related losses. This will result in no net loss of wetland/riparian habitat through implementation of the Proposed Action. Appendix A, *Wetland/Riparian Creation*, describes the plan for wetland riparian creation in detail.

All wetland/riparian development will be implemented through coordination as described in Chapter 2 of the Final EA. Other mitigation considerations include the following:

- Unavoidable loss of wetland and riparian resources from reservoir construction would be offset through wetland and riparian development as previously discussed.
- Impacts on resources from diversion structure construction would be quantified during dam design. Mitigation would primarily occur through minimization of impacts. BMPs would be employed throughout construction. Habitat would be developed onsite and in-kind with locally available native stock to replace wetland or riparian habitat unavoidably lost.
- Temporary impacts from construction of two pipelines would be mitigated through re-establishment of wetland and riparian vegetation along the pipeline trenches and along temporary construction access roads. Permanent maintenance roads would not be reclaimed. Liners would be used within pipeline trenches to minimize potential surface or subsurface drainage of wetland and riparian sites by the pipelines. Native species would be used to revegetate these areas.

3.4.6.3.6 Total Impacts. The Proposed Action would permanently affect 31 acres of wetland and riparian resources (see Table 3.4-1). Diversion structure construction could result in some wetland and riparian losses, but would not exceed 1 acre. Mitigation measures covering 50 acres are expected to substantially offset all these losses. Other potential, currently unquantifiable impacts could occur because of changes in downstream river discharge.

3.4.6.3.7 Unavoidable Adverse Impacts. Unavoidable adverse impacts on wetland and riparian resources resulting from the Proposed Action would be mitigated as described above.

3.4.6.3.8 Cumulative Impacts. There would be no cumulative impacts on wetland and riparian resources under the Proposed Action.

3.4.6.4 Revised Section 203 Alternative

Impacts and mitigation for wetland and riparian resources under this alternative would be similar to the Proposed Action, with the exception of high mountain lakes, which would not be stabilized. Flow changes from baseline also would generally be similar to or slightly less than described for the Proposed Action. As a result, no additional impacts are expected, although portions of the river channel would continue to be dry from October through December, as they have been historically (see Table 3.4-5).

3.4.6.5 Twin Pots Section 203 Alternative

All of the impacts and mitigation described for the Proposed Action also apply to this alternative. Lake Fork River peak flows would be slightly smaller and return intervals longer, and monthly growing season flows would be usually less upstream of the Big Sand Wash Feeder Diversion Structure than described for the Proposed Action. Other impacts unique to the Twin Pots Section 203 Alternative include construction of the new Lake Fork–Yellowstone Pipeline diversion; temporary loss of 31 acres of wet meadow, shrub riparian, and forested riparian habitat from construction of the Lake Fork–Yellowstone Pipeline; and loss of 0.5 acre of wetland upon stabilization of Twin Pots Reservoir, where the stabilized water levels would benefit submerged and emergent wetland vegetation. These additional impacts are noted in Table 3.4-4 and would be mitigated in the same manner as described for the Proposed Action.

3.4.6.6 No Action Alternative

If no action is taken, present trends affecting wetland and riparian resources in the project area would continue into the future. Irrigation water diversion from the Lake Fork and Yellowstone Rivers would continue, with diversions highest during peak flows in early summer. Peak and monthly flows would remain unchanged from the present. Wetland and riparian resources within reservoir fill areas and borrow areas would not be lost. Storage and regulation of irrigation water releases would not change. As a result, high groundwater tables, seeps, and irrigation return flows would likely continue to support these resources.

Improved water use efficiency would likely occur over time in some areas, resulting in closer regulation of water application and a reduction in runoff. Without mitigation, this could result in a decline in wetland and riparian habitat supported by irrigation runoff and return flow over the long term.

3.5 Wildlife Resources

3.5.1 Introduction

The wildlife resources analysis addresses potential impacts on wildlife habitat and species resulting from the construction, operation, and maintenance of project features associated with the Proposed Action and alternatives of the Section 203 Project. The analysis focuses on direct, indirect, total, and cumulative potential impacts on wildlife habitat and certain species, including big game, sage grouse, and raptors. Threatened, endangered, candidate, and FS-sensitive wildlife species are addressed in Section 3.7, *Threatened and Endangered Species*, of the Final EA.

3.5.2 Issues Eliminated from Further Analysis

All wildlife resource issues identified during public scoping for the Upalco Unit DEIS that are relevant to the Section 203 Project were considered in this analysis.

3.5.3 Issues Addressed in the Impact Analysis

Potential impacts on wildlife resources that may occur as a result of implementing the Section 203 Project Proposed Action or alternatives are addressed in the impact analysis and include the following:

- Loss of wetland, riparian, and upland wildlife habitat
- Loss of critical and normal big game winter range
- Impacts on certain raptors
- Impacts on sage grouse breeding complexes

3.5.4 Description of Area of Influence

The area of influence, shown on Map 1.4-1 in Chapter 1 of the Final EA, is located in northeastern Utah. Within the project area, immediate areas of influence include the project feature sites for the Proposed Action and alternatives, which are shown on Maps 2.2-1, 2.3-1, and 2.4-1 in Chapter 2 of the Final EA.

3.5.5 Affected Environment

Wildlife habitat cover types in the project area were described in detail in the UBRP *Wetland/Riparian Resource Technical Report* (CH2M HILL/Horrocks 1996c), the UBRP *Wildlife Resources Technical Report* (CH2M HILL/Horrocks 1996d), and by North State Resources (1996), along with the protocols used for mapping cover types. Protocols developed by Cowardin et al. (1979) for wetland and riparian communities that rely on canopy coverage of the tallest vegetation as well as tree and shrub height were used for cover type mapping. These cover type designations were used for the analysis and for all mapping. Cover types present in the area of project features include conifer (pure and mixed stands), mixed conifer/deciduous (conifer and either aspen or cottonwood), upland aspen, Russian olive, forested riparian, shrub riparian, emergent wetland, wet meadow, open water, beaver pond complex (mix of open water and shrub and forest riparian), sagebrush/grass (including all upland shrub and grass types), juniper, irrigated lands (irrigated croplands and pasture with minor inclusions of farmsteads and outbuildings), and bare ground.

Information also is presented on big game winter and spring distribution and cover type use, sage grouse habitat and breeding complex distribution, and raptor wintering and nesting near the reservoir site and at other project feature sites where data are available.

3.5.5.1 Proposed Action Snake Fork Section 203

3.5.5.1.1 High Mountain Lakes Wetland cover types at the high mountain lakes include wet meadow, emergent wetlands, and shrub riparian habitat as described in this chapter in Section 3.4, *Wetland and Riparian Resources*. Wildlife use of these areas is probably relatively low because of the generally small vegetation patch size and high elevation of the sites. However, wildlife use would be relatively high compared to that of high elevation upland cover types. For most wildlife, the season of use is the snow-free period, which generally

extends from June or early July to September or October. Some of the more common wildlife that use these cover types include a few species of passerine birds that breed or forage in shrub riparian communities; a few species of small mammals; and a few moose (*Alces alces*) that feed on shrubs or aquatic plants during summer and early fall. These findings are based on consultation with Forest Service and Utah Division of Wildlife Resources' biologists during preparation of the Upalco Unit DEIS, and on results of site visits to the high mountain lakes by wildlife biologists.

3.5.5.1.2 Dams and Reservoirs

3.5.5.1.2.1 Wildlife Habitat. Table 3.5-1 shows the acreage of each vegetation cover type at the Big Sand Wash Dam and Reservoir site.

TABLE 3.5

Acreage of Affected Cover Types for Big Sand Wash Dam and Reservoir Expansion for the Proposed Action–Lake Fork Section 203, Revised Section 203 Alternative, and Twin Pots Section 203 Alternative

Cover Type	Acres Permanently Impacted	Acres Temporarily Impacted
Conifer	0	0
Deciduous/conifer mix	0	0
Upland aspen	0	0
Forest riparian	0	0
Shrub riparian	20	0
Emergent wetland	7	0
Wet meadow	4	0
Open water	0	0
Beaver pond	0	0
Irrigated	11	0
Sagebrush/grass	309	22
Juniper	43	5
Bare ground	1	7
Russian olive	0	0
Total	395	34

Notes: Cover type area was calculated to the nearest 0.1 acre by the Geographic Information System. All numbers were raised to the next whole number on this table.

3.5.5.1.2.2 Big Game. Big game distribution in the vicinity of Big Sand Wash Dam and Reservoir was determined through the use of aerial surveys during two winters. The results of the aerial surveys are summarized in the text that follows.

The Utah Division of Wildlife Resources (Wildlife Resources) classifies and has mapped mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and moose for winter, summer, and year-long range. The classification system uses a rating of the relative importance of areas

for these species. Relative importance ratings, as defined by Wildlife Resources, include the following categories:

- Critical—sensitive use areas that, because of limited abundance and/or unique qualities, constitute irreplaceable, critical requirements for high-interest wildlife
- High-value—intensive use areas that, because of relatively wide distribution, do not constitute critical areas but are highly important to high-interest wildlife
- Substantial-value—existence areas used regularly by high-interest wildlife, but at moderate levels with little or no concentrated use by these species
- Limited—occasional use areas that either are sparsely populated or show sporadic use by high-interest wildlife

The Big Sand Wash Reservoir enlargement site is classified by Wildlife Resources as high-value, year-long range for mule deer. Deer were observed most frequently in juniper and sagebrush/grass cover types in the area during both winters. Smaller numbers of deer also were seen near the reservoir during spring green-up surveys.

No elk were located during aerial surveys, although some elk are present in the general area and are managed to keep numbers within tolerable limits because of crop and pasture damage they are capable of causing. As part of this management, these elk provide good hunting opportunities on a landowner-permission basis.

3.5.5.1.2.3 Sage Grouse. The proposed Big Sand Wash Reservoir enlargement area does not contain lands classified as sage grouse (*Centrocercus urophasianus*) habitat. No leks (the centers of sage grouse breeding complexes) were located during aerial surveys and none are known to exist within 4 miles of this site.

3.5.5.1.2.4 Raptors. Raptor observations near Big Sand Wash Reservoir included a winter sighting of a rough-legged hawk (*Buteo lagopus*), a red-tailed hawk (*Buteo jamaicensis*), and a northern harrier (*Circus cyaneus*). Other raptor species expected in the reservoir area include short-eared owl (*Asio flammeus*), American kestrel (*Falco sparverius*), golden eagle (*Aquila chrysaetos*), barn owl (*Tyto alba*), screech owl (*Otus kennicottii*), and, during migration and winter, sharp-shinned and Cooper's hawks (*Accipiter striatus* and *A. cooperii*, respectively).

3.5.5.1.3 River Corridors. River corridors or floodplains support extensive wetland and riparian communities intermixed with uplands. Big game use of river corridors varies considerably from year to year depending on the depth of mountain snows, with more animals using river corridors during heavy snow years (CH2M HILL/Horrocks 1996d). Many raptors use river corridors during the winter. Common species observed in project area river corridors include red-tailed and rough-legged hawks, golden eagles, northern goshawks (*Accipiter gentilis*), and bald eagles (*Haliaeetus leucocephalus*). Most birds were perched in cottonwood trees, which also contained many large stick nests.

Wildlife and wildlife habitat (wetland and riparian communities) along river corridors below the proposed Big Sand Wash Feeder Diversion Structure may be affected by the Proposed Action and alternatives. The affected environment along river corridors includes wetland and riparian communities located on broad floodplains. This analysis was presented in the section on *Wetland and Riparian Resources*. The extent and condition of these

communities vary considerably depending on the width of the floodplain, hydrologic conditions, the extent of human disturbance such as water diversion and channelization, and grazing intensity.

3.5.5.1.4 Diversion Structures. Because diversion structure sites include riparian communities and wet meadows, some of the more common wildlife species in these areas would include red-tailed hawks; great-horned owls (*Bubo virginianus*); various songbirds including warblers, flycatchers, and sparrows; killdeer (*Charadrius viciferus*); common snipe (*Gallinago gallinago*); several amphibians; and a variety of small mammals, including bats. Wildlife use of these areas also would vary considerably depending on the levels of human disturbance and the type, amount, and condition of habitat present at the diversion and in the surrounding area.

3.5.5.1.5 Pipelines

3.5.5.1.5.1 Wildlife Habitat. Sagebrush/grass, shrub riparian, agricultural, and juniper are the four primary plant communities that would be crossed by the pipelines.

3.5.5.1.5.2 Big Game. The Big Sand Wash Feeder Pipeline and Big Sand Wash–Roosevelt Pipeline would be constructed through land classified as high-value, or substantial, year-long range for mule deer, but unclassified for elk or moose. Mule deer use riparian areas for escape cover and fawning (Wildlife Resources 1978).

3.5.5.1.5.3 Raptors. Raptor species expected to use pipeline routes depend on the type and size of cover present. Large trees are probably the single most important habitat feature for raptors because they can support many species of nesting raptors and also provide perches from which to hunt over surrounding open cover types. Large trees are occasionally used by golden eagles as perches. Rough-legged hawks are relatively abundant in the project area during winter and use trees overlooking open fields, meadows, and sagebrush/grass communities for perches from which to hunt. Larger forest/shrub stands also may be used by species such as long-eared owls (*Asio otus*). Northern harriers and short-eared owls use open fields, meadows, and sagebrush/grass communities for foraging and nesting.

3.5.5.1.6 Fish and Wildlife Mitigation and Enhancement. Proposed fish and wildlife features include providing fish passage at a new diversion structure, creating wetland/riparian habitat along the Lake Fork River or at an alternative location in the Duchesne River corridor, providing instream flows for fish in the Lake Fork River between Moon Lake Reservoir and the Big Sand Wash Feeder Diversion Structure from late summer through winter, and providing bypass instream flows past the Yellowstone Feeder and “C” Canal diversions. Terrestrial wildlife habitats at these features are discussed in the subsections on *River Corridors* and *Diversion Structures*.

3.5.5.2 Revised Section 203 Alternative

Wildlife resources for the Revised Section 203 Alternative are the same as described for the Proposed Action, with the exception that no high mountain lakes would be stabilized.

3.5.5.3 Twin Pots Section 203 Alternative

Wildlife habitat types and wildlife use at project feature sites would include those described for the Proposed Action plus those descriptions in the following text.

3.5.5.3.1 High Mountain Lakes Wildlife habitat at the 13 high mountain lakes would be the same as described for the Proposed Action.

3.5.5.3.2 Diversion Structure Wildlife habitat at the Lake Fork–Yellowstone Diversion Structure is the same as described for diversions under the Proposed Action.

3.5.5.3.3 Pipelines The Twin Pots Section 203 Alternative includes the Big Sand Wash Feeder and Big Sand Wash–Roosevelt Pipelines, the same as described under the Proposed Action, plus the Lake Fork–Yellowstone Pipeline. General wildlife habitat value of wetland and riparian cover types along pipelines was discussed in the section for the Proposed Action.

The proposed Lake Fork–Yellowstone Pipeline would pass through critical mule deer and elk winter range. Raptor species expected to use this pipeline route would be the same as described for pipelines under the Proposed Action, and would depend on specific cover types and size of the cover type blocks present.

The Lake Fork–Yellowstone Pipeline route is within about 0.75 mile of two sage grouse leks, the centers of sage grouse breeding complexes, and is entirely within land classified as year-long sage grouse range.

3.5.5.3.4 Fish and Wildlife Mitigation and Enhancement The affected environment would be the same as described previously, except for the addition of the Twin Pots Reservoir Improvement. Approximately 0.5 acre of small clumps of willows and cottonwoods are found along the high water line of the reservoir. Sedges and rushes are lightly scattered throughout the areas between the high and low water lines. Wet meadow, emergent, and shrub riparian communities are distributed along the outlet stream below the reservoir. Upland habitat includes sagebrush/grass vegetation communities.

3.5.6 Impact Analysis

Environmental consequences of the Proposed Action and alternatives are described for each main project feature for which impacts are expected. Three terrestrial biological resource areas required special efforts beyond a general wildlife habitat analysis. These include big game winter and spring range, sage grouse breeding complexes, and raptor nesting. The following discussions of project impacts related to reservoirs and mitigation for those impacts focus on the results of the wildlife habitat impact analysis, as well as these three resource areas.

Mitigation measures focus on avoiding impacts through restrictions on construction periods; rerouting project features such as pipelines; avoiding sensitive habitats for roads or soil disposal; minimizing impacts through field surveys to locate species of interest; working around occupied sites and restricting clearing of sensitive vegetation; and minimizing the duration of impacts through careful and timely reclamation of native plant communities.

3.5.6.1 Potential Impacts Eliminated from Further Analysis

Potential impacts that were determined to not be significant were eliminated from further analysis. Also, some project features would have no impacts regardless of the alternative. These features are indicated briefly below and are not described further for any of the alternatives.

3.5.6.1.1 High Mountain Lakes. Potential impacts on wetland and riparian cover types resulting from high mountain lakes' stabilization are described in the *Wetland and Riparian Resources* section. Generally, areas of these cover types lost from stabilizing water levels below present levels are expected to be replaced by the same cover types that would develop at suitable water depths and soil moisture conditions around the new lakeshore.

The current wetland and riparian vegetation around high mountain lakes has developed in the presence of extensive annual growing season drawdowns, which typically limit the extent of these vegetation types. Field inspection of the high mountain lakes indicates that soils have generally not eroded from the current drawdown zones. Over the long term, the same wetland and riparian cover types as those present today are expected to develop, because soils are present to support these cover types and water levels would not fluctuate as in the past. Stable water levels are expected to allow at least as much wetland and riparian vegetation to develop as is present today. Littoral zone vegetation is currently limited by the fact that this zone is exposed and dried out every year during the summer irrigation drawdown. This annual drawdown would no longer occur following lake stabilization. Therefore, littoral zone vegetation would be expected to develop to its full potential under stable water conditions. This would result in a more extensive and fully developed littoral zone plant community than is currently present at high mountain lakes.

Stable water conditions may result in a small net overall increase in the extent of wetland and riparian vegetation over a period of 2 to 3 years for the littoral zone and 5 to 25 years for riparian communities. Wildlife habitat values would decline initially during this period of adjustment, but would be expected to return to at least pre-stabilization levels in 5 to 25 years.

3.5.6.1.2 Dams and Reservoirs

3.5.6.1.2.1 Migration and Local Movement. Studies in the project area by Wildlife Resources (1978) indicate that Big Sand Wash Reservoir is not located along migration routes. Therefore, the proposed reservoir expansion would not significantly interfere with seasonal mule deer migration patterns.

3.5.6.1.2.2 Construction Disturbance. During the enlargement of Big Sand Wash Dam, big game would be displaced from the immediate areas near construction sites. A slight increase in deer/vehicle collisions, resulting in some mortality, would also be expected because of increased traffic levels. These impacts are not considered significant.

3.5.6.1.2.3 Sage Grouse. No impacts on sage grouse breeding complexes would be expected to result from expansion of Big Sand Wash Reservoir.

3.5.6.1.2.4 Raptors. Raptor foraging and potential nest sites within the expanded dam and reservoir area would be lost. Red-tailed hawks, American kestrels, and great horned owls are the most common raptors in the area and potentially would be most affected by habitat loss. However, no large stick nests were found within the reservoir expansion area during field surveys so no currently known nests would be impacted. Raptors also would be temporarily displaced from near construction areas. These impacts are not considered significant.

3.5.6.1.3 River Corridors. Improved growing season flows or no change in flows below the “C” Canal diversion would result in no significant impacts on wetland or riparian communities under the Proposed Action or alternatives and are discussed in the *Wetland and Riparian Resources* section. Certain monthly flows would decrease above the “C” Canal diversion, but not to an extent expected to result in significant impacts. Peak flow return periods would generally increase for the 2-, 5-, 10-, and 20-year events (see Table 3.4-5). However, the return period would either not increase substantially or the magnitude of the flow event would be similar enough to baseline conditions such that no significant impacts are expected.

3.5.6.1.4 Pipelines

3.5.6.1.4.1 Big Game. Potential impacts from pipeline construction on big game include permanent and temporary habitat loss, disturbance on critical winter range during construction, and disturbance during annual maintenance activities. Impacts on critical winter range would be minimized by avoiding critical periods during construction. Temporary loss of forest and shrub riparian communities would impact mule deer fawning during the recovery period. Temporary, though long-term, riparian habitat loss within right-of-ways would persist 10 to 25 years as revegetation proceeds. Increased human presence associated with pipeline maintenance activities in riparian areas would decrease their value as fawning areas if disturbance occurred during the fawning period. None of these impacts is considered significant.

3.5.6.1.4.2 Raptors. Some potential loss of actual or potential raptor nest trees and some nest abandonment could occur during pipeline construction through riparian areas and juniper communities. Nest abandonment resulting from construction and periodic disturbance during maintenance activities would occur occasionally. However, the primary species that would be affected (red-tailed hawks, great horned owls, and American kestrels) are not as sensitive to nest abandonment as are some other species such as ferruginous hawks. None of these impacts are considered significant. The DOI and CUWCD will conduct raptor surveys, if deemed appropriate, using FWS-approved procedures prior to construction to avoid adverse impacts.

3.5.6.1.4.3 Sage Grouse. New pipeline segments located more than 2 miles from sage grouse leks would not result in any significant impacts on sage grouse.

3.5.6.1.5 Fish and Wildlife Mitigation and Enhancement. Fish and wildlife mitigation and enhancement would not result in significant impacts on wildlife and wildlife habitat. Impacts would include habitat loss for a variety of species and displacement during conversion of upland habitats to wetland/riparian habitats at the wetland/riparian creation site on the Lake Fork River, or possibly at an alternative site in the Duchesne River corridor.

3.5.6.1.6 Habitat Fragmentation. Each project feature would create openings or gaps in the plant communities present in the landscape matrix, thereby temporarily disturbing wildlife habitat. However, because the areas affected would be very small relative to the size of the Uinta Basin, the matrix in which these gaps would occur would remain essentially unchanged by project features relative to the remaining matrix of habitats within the project area. On a landscape scale, neither the total nor the cumulative impacts of the Proposed

Action and alternatives would constitute what is typically defined by Noss and Cooperrider (1994) as habitat fragmentation. Therefore, habitat fragmentation is not discussed further.

3.5.6.2 Proposed Action Lake Fork Section 203

3.5.6.2.1 Dams and Reservoirs

3.5.6.2.1.1 Wildlife Habitat. Implementation of the Proposed Action would result in the loss of 429 acres of habitat at the Big Sand Wash Reservoir site (see Table 3.5-1). Sagebrush/grass cover types would be most affected by project development, while open water areas would increase at the reservoir site. Also, 31 acres of wetland and riparian communities would be lost.

3.5.6.2.1.2 Big Game. There would be a loss of high-value, year-round deer range at Big Sand Wash Reservoir, but the impact would not be significant because of the abundance of this same type of habitat in adjacent areas.

3.5.6.2.2 River Corridors. As discussed in Section 3.4, *Wetland and Riparian Resources*, there would be no significant impacts on wildlife habitat in the river corridors from implementation of the Proposed Action. Instream flows from late fall through early spring between Moon Lake Reservoir and the proposed Big Sand Wash Feeder Diversion Structure may benefit wildlife in those river reaches that presently exhibit little or no flow during this time of year. Wildlife also may benefit from the bypass instream flows past the Yellowstone Feeder and “C” Canal diversions at those times of year when some river reaches have little or no flow.

3.5.6.2.3 Diversion Structures. Impacts at the diversion structure site would be limited to immediate areas around the structure and access road, and would probably amount to less than 2 acres. Potential wetland impacts and mitigation measures were discussed in the *Wetland and Riparian Resources* section. Construction impacts would be temporary, although replacement of trees would require many years. Areas occupied by the new diversion structure and permanent access road would be permanently lost. Mitigation of both temporary and permanent impacts on wildlife habitat would occur at the site of the impact, regardless of ownership.

3.5.6.2.4 Pipelines. The exact locations of the Big Sand Wash Feeder Pipeline and Big Sand Wash–Roosevelt Pipeline centerlines have not been sufficiently delineated to quantify the exact amount of each cover type that would be affected. Most impacts would be temporary, and therefore not significant. However, permanent impacts on wildlife habitat would occur where permanent facilities, such as access roads along the pipelines, are constructed. All impacts on plant communities would be mitigated in place or at the mitigation site. Specific measures that would be undertaken to avoid or reduce potential impacts on wildlife habitat, big game, and raptors are described in Section 3.5.6.2.7, and include such things as restrictions on construction periods, road closures, and reclamation activities.

Direct habitat losses in construction right-of-ways beyond access roads would not be permanent. About 75 percent of the acres impacted by pipeline construction would not be permanently impacted. The duration of these temporary impacts would vary, depending on the cover type affected. Complete reclamation of upland cover types and replacement of lost wildlife habitat values would require 10 to 20 years, while wet meadows would recover in

3 to 5 years. Full recovery of plant communities and wildlife habitat values in riparian areas would take 10 to 15 years for shrub communities and 10 to 25 years for forest communities. All wildlife species that use affected areas would be impacted by habitat loss and by periodic disturbance resulting from pipeline maintenance activities. Field surveys, construction timing restrictions, and careful reclamation would be followed to avoid and reduce potential impacts.

3.5.6.2.5 Fish and Wildlife Mitigation and Enhancement. Creation of up to 50 acres of wetland and riparian habitat along the Lake Fork River or at an alternative mitigation site in the Duchesne River corridor would benefit many upland and wetland dependant wildlife species. As a result of this action, deer fawning habitat would be created in riparian areas, as would nesting habitat for a variety of passerine birds and waterfowl. Small mammal cover would increase, as would cover for amphibians and reptiles.

3.5.6.2.6 Total Impacts. Total impacts of project features on wildlife habitat under the Proposed Action would be no greater than impacts already described.

3.5.6.2.7 Mitigation. Mitigation measures described in the following text are intended to reduce or avoid impacts or to mitigate for impacts that cannot be avoided.

3.5.6.2.7.1 Wildlife Habitat Mitigation Strategies. Mitigation strategies intended to avoid or minimize impacts on wildlife or habitat, shorten the duration of land-disturbing impacts, or compensate for impacts that cannot be avoided are included in Appendix A. Appendix A includes discussions of wildlife habitat mitigation strategies; habitat improvement and development methods; operation and maintenance activities; monitoring and reporting requirements; and contingency plans for wildlife habitat.

3.5.6.2.7.2 Mitigation Measures to Avoid or Minimize Impacts on Big Game and Raptors. Several measures would be implemented during pipeline construction. These measures include field surveys, restrictions on construction and maintenance periods, impact avoidance features, access road closures, and reclamation activities. They would be implemented on a selective basis in or near sensitive habitats as determined by the project biologist in consultation with FWS and Utah Division of Wildlife Resources. Detailed descriptions of these mitigation measures are included in Appendix A of the Final EA and Appendix A of this document.

3.5.6.2.7.3 Specific Mitigation Measures for the Proposed Action. Measures intended to mitigate for impacts on wildlife habitat that cannot be avoided would be implemented at the mitigation site either along the Lake Fork River or in the Duchesne River corridor. Mitigation measures described above would be implemented during pipeline construction and maintenance to avoid or minimize impacts on big game and raptors. No sage grouse surveys would be conducted along the proposed Big Sand Wash Feeder or Big Sand Wash–Roosevelt Pipelines because there is no suitable or classified habitat along the routes. Similar mitigation measures would be implemented at the new diversion structure.

3.5.6.2.8 Unavoidable Adverse Impacts. Pipeline construction could result in some loss of raptor nest trees, although as discussed in Section 3.5.6.1.4.2, this impact is not considered to be significant.

3.5.6.2.9 Cumulative Impacts Additional irrigation water would be diverted from the Lake Fork River with implementation of the Section 203 Proposed Action, resulting in a cumulative impact on river flows. As discussed earlier, flows in the river with the project are not expected to significantly impact wildlife resources along the Lake Fork River.

3.5.6.3 Revised Section 203 Alternative

Impacts and mitigation would essentially be the same as described for the Proposed Action except that no high mountain lakes would be stabilized.

3.5.6.4 Twin Pots Section 203 Alternative

Impacts and mitigation would essentially be the same as for the Proposed Action except as described in the following text.

3.5.6.4.1 Diversion Structures Impacts at the two diversion structures under this alternative would be limited to the immediate areas around the structures and site access roads, estimated to be less than 2 acres per site, including wetland and riparian communities. The types of impacts, avoidance measures, and mitigation at these diversion structures would be the same as the diversion under the Proposed Action.

3.5.6.4.2 Pipelines In addition to the Big Sand Wash Feeder Pipeline and the Big Sand Wash–Roosevelt Pipeline, the Lake Fork–Yellowstone Pipeline would be constructed under the Twin Pots Section 203 Alternative. The general types of impacts and mitigation described for pipelines under the Proposed Action would be the same, including the permanent loss of wildlife habitat in areas occupied by access roads along pipeline routes.

The Lake Fork–Yellowstone Pipeline would be constructed entirely within classified year-long sage grouse range. This pipeline has the potential of impacting two sage grouse breeding complexes within about 0.75 mile of the proposed route. This proximity suggests there is a relatively high likelihood of an impact on one or both of these breeding complexes from pipeline construction, maintenance activities, and new public access along the maintenance road. Potential impacts could include loss of nesting areas or possible abandonment of a breeding complex, a significant impact. The exact location of the breeding complexes relative to the surveyed pipeline route would be determined and the pipeline route adjusted, to the extent practicable, while still meeting water delivery requirements, to reduce potential impacts on sage grouse. Mitigation measures described in Appendix A of the Final EA and Appendix B of this document would be implemented to avoid the impact or reduce its severity or duration.

3.5.6.4.3 Fish and Wildlife Mitigation and Enhancement The other fish and wildlife feature that would be implemented is the Twin Pots Reservoir Improvement (4.3 acres impacted).

3.5.6.4.4 Mitigation Mitigation measures would be the same as for the Proposed Action.

3.5.6.4.5 Unavoidable Adverse Impacts Two sage grouse breeding complexes could be impacted by construction of the Lake Fork–Yellowstone Pipeline, maintenance activities along the pipeline, and the new public access provided by the pipeline maintenance road.

3.5.6.4.6 Cumulative Impacts Cumulative impacts would be the same as for the Proposed Action.

3.5.6.5 No Action Alternative

3.5.6.5.1 Trends Wildlife populations and wildlife use of particular sites vary over time because of natural or human-caused changes in habitat conditions; plant community succession; human management of wildlife populations; and human population increases, activity patterns, and associated disturbance levels. In the Uinta Basin, two known population trends are: 1) sage grouse are generally declining in numbers throughout the basin; and 2) moose and elk numbers are generally increasing slowly along the south slope of the Uinta Mountains.

Habitat-related trends that affect wildlife within the Uinta Basin and along the south slope of the Uinta Mountains include the following:

- The extent of juniper forest is expanding slowly.
- Climax conifer species are invading some mature aspen stands.
- Human activities, such as oil and gas exploration/extraction and road construction, continue to impact relatively small, but increasing, areas of primarily sagebrush/grass and juniper.
- Range conditions and riparian plant communities on Forest Service lands are fairly stable.
- Wetland and riparian communities located on river floodplains are periodically changed by large runoff events but over the long term are fairly stable on a river basin scale, barring human disturbance.

3.5.6.5.2 Future Conditions The analysis of impacts and evaluation of mitigation strategies for the UBRP Habitat Evaluation Program (HEP) study projected future conditions for a variety of subject areas that affect the value of wildlife habitat. These are discussed in the *UBRP Wildlife Resources Technical Report* (CH2M HILL/Horrocks 1996d). The general conclusion of the HEP study regarding future conditions relative to wildlife habitat was that on a scale encompassing the Uinta Basin, current wildlife habitat values are expected to remain relatively unchanged over the life of the project.

3.5.6.5.3 Consequences of Not Meeting Project Needs If the potential impacts attributed to the Proposed Action or alternatives would occur if the No Action Alternative were selected. Improvement of habitat values on mitigation sites also would not occur. However, these improvements would not be necessary because there would be no need to compensate for project impacts on wildlife and wildlife habitat.

3.6 Cultural Resources

3.6.1 Introduction

This analysis addresses potential impacts on cultural and paleontological resources resulting from the construction, operation, and maintenance of project features associated with the Proposed Action and alternatives of the Section 203 Project. An intensive Class III survey of all features within the selected alternative, followed by approved mitigation of specific historic properties, as necessary, must be completed prior to construction. A

Class III survey was completed for the Proposed Action during the 2000-2001 field seasons—the results and analysis of which are provided in this document.

3.6.2 Issues Eliminated from Further Analysis

No cultural resource issues identified during public scoping for the Upalco Unit DEIS that are relevant to this Final EA were eliminated from analysis. However, certain project features could potentially affect some aspects of the paleontological or cultural resources of concern, but they would not result in significant impacts. These particular areas of no impact or low probability of impact are described in detail in the *UBRP Cultural Resources Technical Report* (Sagebrush Archaeological Consultants 1996). They are listed in the following text and are not discussed further in this document:

River Corridors—Cultural and paleontological resources in river corridors within the project area would not be affected by project operation because the range of future river flows and the potential for channel scour and possible channel movement would be similar to existing conditions.

3.6.3 Issues Addressed in the Impact Analysis

The following issues are addressed:

1. Determine the extent and type of cultural resources in the project area.
2. Estimate the probability of significant resources occurring within the area of, and potentially being impacted by, proposed project features.
3. Locate and record any potentially impacted prehistoric and historic sites and determine their eligibility to the National Register of Historic Places (NRHP), using the NRHP, as defined in 36 CFR 60.4, as a guideline.
4. Locate ethnographic, traditional, and religious use areas and determine their eligibility to the NRHP, using the following as guidelines: National Historic Register Bulletin 38; the American Indian Religious Freedom Act, PL 95-341; and, the Native American Graves Protection and Repatriation Act of 1990, PL-101-601.
5. Record the extent and significance of paleontological resources in the project area and determine their potential for being impacted by the proposed project features.

3.6.4 Description of Area of Influence

The area of influence, shown on Map 1.4-1 in Chapter 1 of the Final EA, includes the Section 203 project area in northeastern Utah. Immediate areas of influence include the project feature sites for the Proposed Action and alternatives, which are shown on Maps 2.2-1, 2.3-1, and 2.4-1 in Chapter 2 of the Final EA.

3.6.5 Affected Environment

The Uinta Mountains and Uinta Basin are the result of processes occurring for more than 2 billion years. The fossil record of the Uinta Mountains and Uinta Basin extends from Precambrian (Middle Proterozoic) time to Quaternary time, which is a period of about 1 billion years. The rock record of this area extends back another 1.5 billion years.

The prehistory of the project area is complex and poorly understood because of the area's location near the contact zone of the Great Basin, Colorado Plateau, and Northern Plains cultures. The prehistory of the Uinta Basin is a meld of these traditions, which has resulted in the identification of many enigmatic archaeological sites. Despite this mix of archaeological traits, the general model of prehistory for the eastern Great Basin and Northern Colorado Plateau is believed to be most prominent in the Uinta Basin and was therefore followed in this study. The series of cultural changes in these areas is classified into five general chronological periods as defined by Jennings (1986). These periods include Paleo-Indian, Desert Archaic, Formative, Post-Formative, and Contact. Within each of these major periods are a number of separate phases. Marked by a distinct lifeway, each period or phase is characterized by associated significant traits, characteristics, and artifacts.

The prospect of profitable fur trapping in the Uinta Basin provided the initial attraction for non-Indians. However, the presence of the Ute Tribe and the discovery and development of minerals and petroleum resources provided the impetus for European–American activity in the area. In this analysis, the area's history was divided into eight distinct periods associated with significant developments since the arrival of European–Americans. These periods include: Exploration, Trapping, and Trading (1776-1852); Early Settlement (1853-1861); Reservation (1862-1868); Secondary Settlement and Early Irrigation (1869-1885); Mineral Development (1886-1904); Land Rush and Water Development (1905-1927); Drought, Depression, and World War II (1928-1945); and Post-War (1946-Present).

Thirty-one cultural resource inventories were completed in the broad Uinta Basin area between 1973 and 1997. Table 3.6-1 lists those inventories together with recorded cultural resources sites. In addition, file searches were conducted at the State Historic Preservation Office (SHPO) in Salt Lake City during July and August, 2000. Class III intensive-level cultural resource inventories were conducted for the Proposed Action project area during the 2000-2001 field seasons. No currently-listed NRHP sites were located in the vicinity of the Section 203 project area. However, 27 of the 40 cultural resources sites found during the recent Class III inventory were determined eligible to the NRHP. Cultural resource sites associated with the proposed Section 203 project features are discussed in the following text and in Appendix B, *Cultural Resources File Search*.

3.6.5.1 Proposed Action Lake Fork Section 203

3.6.5.1.1 High Mountain Lakes Thirteen high mountain lakes—four in the Yellowstone drainage, five in the Swift Creek drainage, and four in the Lake Fork drainage—would be stabilized under the Proposed Action. All 13 of the dam features at the lakes that would be stabilized have been previously documented on Historic American Building Survey/ Historic American Engineering Record (HABS/HAER) cards for the U.S. Bureau of Reclamation (USBR) (Fraser and Jurale 1985). Though this form of mitigative documentation was considered adequate at the time it was done, it is no longer considered acceptable by the National Park Service. To properly document cultural resources at the reservoirs to current standards for both archaeological and historic resources, each dam feature needed to be reevaluated for significance and cultural resource inventories of each reservoir shoreline had to be carried out. Previous surveys by the U.S. Forest Service (FS) at nearby high mountain lakes indicate a potential for finding prehistoric sites around these lakes. Previous recordation for the USBR (Fraser and Jurale 1985) of Clements Lake Dam, Kidney Lake Dam, Island Lake Dam, Water Lily Lake Dam, and Farmers Lake Tunnel recommended

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these facilities eligible to the NRHP. Dam recordation and survey has been completed at all 13 high mountain lakes. This action has resulted in identification, recordation, and evaluation of 13 prehistoric sites and 13 historic dams and associated features.

The scarcity of fossils in Precambrian rocks from the Uinta Group gives the lakes low potential for the presence of paleontological material. However, there is a slight possibility of finding Pleistocene fossils in these areas.

3.6.5.1.2 Dams and Reservoirs There is potential for finding prehistoric sites at the Big Sand Wash Reservoir enlargement site, though none were found in a previous survey of a portion of the reservoir. The proposed Big Sand Wash Reservoir enlargement site contains Holocene paleontological resources and perhaps Pleistocene fossils.

3.6.5.1.3 Diversion Structures Low potential exists for historic or prehistoric resources at the Big Sand Wash Feeder Diversion Structure site. There is a slight possibility of encountering Pleistocene fossils in glacial tills and Eocene vertebrates in the Duchesne River Formation.

3.6.5.1.4 Pipelines Four historic properties and three prehistoric archaeological sites have been previously found within 1 mile of the proposed Big Sand Wash Feeder Pipeline corridor. One historic property was determined eligible for the NRHP. There is a slight possibility of encountering Pleistocene fossils in glacial tills along the pipeline corridor and Eocene vertebrates in the Duchesne River Formation. No cultural or paleontological resources are known to exist within the Big Sand Wash–Roosevelt Pipeline corridor.

3.6.5.1.5 Fish and Wildlife Mitigation and Enhancement There are no known prehistoric or historic sites recorded within a 1-mile radius of the proposed wetland/riparian creation site. Nearby ethnographic resources used by Ute Indian Tribe members include fish from the Lake Fork River.

3.6.5.2 Revised Section 203 Alternative

Prehistoric, historic, ethnographic, and paleontological resources at proposed project feature sites would be the same as described for the Proposed Action, except there would be no stabilization of the 13 high mountain lakes.

3.6.5.3 Twin Pots Section 203 Alternative

Prehistoric, historic, ethnographic, and paleontological resources at proposed project feature sites would be the same as described for the Proposed Action, except as noted in the following text.

3.6.5.3.1 High Mountain Lakes Thirteen high mountain lakes—four in the Yellowstone drainage, five in the Swift Creek drainage, and four in the Lake Fork drainage—would be stabilized under the Twin Pots Section 203 Alternative, the same as for the Proposed Action.

3.6.5.3.2 Diversion Structures There is probably low potential for historic and prehistoric sites at the diversion structure sites in the project area. There is a slight possibility of encountering Pleistocene fossils in glacial tills and Eocene vertebrates in the Duchesne River Formation.

3.6.5.3.3 Pipelines Previously, three archaeological sites, one prehistoric lithic scatter (42Dc843), one historic road segment (42Dc844), and one historic gravel/dump (42Dc605)

were identified near the proposed Lake Fork–Yellowstone Pipeline area. There are 11 historic irrigation canal features located within 1 mile of the proposed routes of the Lake Fork–Yellowstone Pipeline, Big Sand Wash Feeder Pipeline, and Big Sand Wash–Roosevelt Pipeline. Eight of these canals have been recommended eligible for the NRHP. There is a slight possibility of encountering Pleistocene fossils in glacial tills along the Lake Fork–Yellowstone Pipeline corridor and Eocene vertebrates in the Duchesne River Formation.

3.6.5.3.4 Fish and Wildlife Mitigation and Enhancement Twin Pots Dam was recommended eligible for the NRHP during previous recordation for the USBR, and has been documented on a HABS/HAER card (Fraser and Jurale 1985). There is potential for finding both prehistoric and historic sites at Twin Pots Reservoir. One non-significant prehistoric site (42Dc227), and three non-significant historic sites have been identified within 1 mile of the proposed activity area. Ethnographic resources used by Ute Indian Tribe members include berries from the Twin Pots area. Twin Pots Reservoir is in an area of Pleistocene deposits of glacial till. There is a slight possibility of finding Pleistocene fossils in the glacial tills.

3.6.6 Impact Analysis

Potential impacts on cultural and paleontological resources from construction and operation of the Proposed Action or alternatives are now largely known from Class III intensive level inventories carried out during the 2000 and 2001 field seasons. A total of 40 cultural resources sites were found during the inventories of the project features within the Proposed Action. Of the total, 27 sites were determined eligible to the NRHP based upon age and integrity and one or more NRHP criteria. No paleontological localities were identified during these inventories.

Determination of effects on eligible cultural resources is guided by federal implementing regulation 36 CFR 800, which states that cultural resource assessments of federal “undertakings” on eligible properties should result in one of three determinations:

1. No effect
2. No adverse effect—one or more historic properties will be affected but the historic qualities making them significant will not be harmed
3. Adverse effect—the undertakings will cause harm to one or more historic properties

These guidelines are used to determine effects and possible effects on eligible cultural resources associated with the Proposed Action and alternatives. Impacts on historic and prehistoric sites not eligible for the NRHP are not considered an effect on cultural resources.

Potential impacts on paleontological resources from construction and operation of the Proposed Action and alternatives are addressed using the following guidelines: impacts are considered significant if project implementation results in adverse effects on Type 1 or 2 paleontologically sensitive geological formations, or in adverse effects on Class 1, 2, or 3 paleontologically sensitive fossil localities.

Adverse effects to prehistoric and historic cultural resources and on paleontological resources would be dealt with through implementation of mitigation measures discussed in the text that follows.

3.6.6.1 Proposed Action Lake Fork Section 203

3.6.6.1.1 High Mountain Lakes. A cultural and paleontological survey has been completed for 13 high mountain lakes. These include: four lakes located in the Lake Fork Drainage, including Kidney, Island, Clements, and Brown Duck; four lakes located in the Yellowstone Drainage, including Five Points, Superior, Drift, and Bluebell; and five lakes located in the Swift Creek Drainage including Farmers, East Timothy, White Miller, Deer, and Water Lily. A total of 26 cultural resource sites were recorded and evaluated during these inventories. These sites include 13 historic dams and associated features constructed at each of the lakes, and 13 prehistoric campsites located on the margins of the lakes, below the high-water line. All 13 historic dam sites were determined eligible to the NRHP and six of the prehistoric campsites (42Dc1340, 42Dc1341, 42Dc1342, 42Dc1344, ET-1, and ET-2) were determined eligible to the NRHP. The six eligible prehistoric campsites represent variably sized scatters of chipped stone and chipped stone tools dating, perhaps, as old as 6,000 to 8,000 years. They have good potential for cultural depth beneath the surface scatter of artifacts.

Lowering of lake levels will not directly affect eligible sites on the lake margins or beneath the current lake levels, but it will facilitate the erosion of the denuded shoreline (through wind, water, and wave action) and increase the risk of vandalism of sites because of increased visibility. Wave action could adversely affect sites that exist along the original shoreline. As such, construction and operation of the Proposed Action could have adverse affects on the six eligible prehistoric cultural resources found along the margins of these high mountain lakes. The Proposed Action also would have an adverse effect upon the 13 eligible dam sites.

No paleontological materials were encountered during the inventory of the 13 high mountain lakes.

3.6.6.1.2 Dams and Reservoirs. A cultural and paleontological inventory was completed for the Big Sand Wash Reservoir enlargement site during year 2000. A total of two sites were identified and recorded during the inventory. Site 42Dc1328, a segment of the historic "C" Canal, was found during the inventory. One prehistoric groundstone site (42Dc1326) was also found during the inventory, which was determined not eligible to the NRHP. The "C" Canal has been previously determined eligible to the NRHP. However, the segment of the "C" Canal evaluated during the Section 203 Inventory was determined to be a non-contributing element to the general eligibility of the site. No paleontological localities were identified.

3.6.6.1.3 Diversion Structure. A cultural and paleontological survey was completed for the Big Sand Wash Feeder Pipeline Diversion Structure during year 2000. No cultural or paleontological sites were encountered during the inventory.

3.6.6.1.4 Pipelines. A cultural and paleontological inventory was completed for the proposed routes of the Big Sand Wash Feeder Pipeline and the Big Sand Wash-Roosevelt Pipeline during year 2000. A total of one historic site, 42Dc1338, was found on the Big Sand Wash Feeder Pipeline route. Site 42Dc1338 is on a tertiary irrigation ditch with concrete headgate.

A total of 8 historic and 3 prehistoric sites were identified and recorded during the inventory of the proposed Big Sand Wash-Roosevelt Pipeline route. The 8 historic sites include: remnants of a homestead represented by a cobble berm or wall foundation with

associated historic debris (42Dc1327); a 1940s house and early 1900s secondary residence (Higley Property); a historic standing structure (house) and dump area (L-4); a homestead foundation with house and outbuilding foundations, trash scatter, concrete cistern, and fencelines (42Dc1330); a farmstead with house, four outbuildings, cistern, and cattle corral (Evans Ranch); a log cabin with privy (L-10); a historic irrigation ditch (42Dc1336); and a segment of Martin's Lateral Canal (42Dc1329). Prehistoric sites found and recorded include: two prehistoric campsites (42Dc1331 and 42Dc1333), and a Fremont petroglyph site (42Dc1332).

No paleontological localities were encountered during the inventory of the two pipelines.

Six of the historic sites were determined eligible to the NRHP, including the Higley Property, for architectural value; Site L-4, the Evans Ranch, and Site L-10 for architectural value and archaeological research potential; and 42Dc1330 for archaeological research potential. Site 42Dc1328 and Site 42Dc1329, Martin's Lateral, have already been determined eligible to the NRHP.

One of the prehistoric campsites (42Dc1333) was determined eligible to the NRHP for cultural depth potential. Site 42Dc1332, a Fremont petroglyph site, was determined eligible for its artistic value and research potential.

The effects caused by construction of the pipelines across the eligible historic sites, would, likely, be minimal. Additional recordation would, likely, satisfactorily mitigate any effects on these properties. Construction of the Big Sand Wash–Roosevelt Pipeline near the petroglyph site, 42Dc1332, would also probably have minimal effect, though construction across site 42Dc1333 could be adverse. Additional recordation of site 42Dc1332 would, likely, satisfactorily mitigate effects to this site. Avoidance of site 42Dc1333 would be the preferred mitigation measure and will be carried out if at all possible. If avoidance is not possible, test excavation and, possibly, data recovery through full excavation would, likely, mitigate the adverse effect to that site. Additional recordation of the canal segment that is crossed (42Dc1329) would, likely, satisfactorily mitigate any effects to that site.

3.6.6.1.5 Fish and Wildlife Mitigation and Enhancement Wetland/riparian creation areas impacted directly by excavation and construction may contain paleontological resources that could be affected. A cultural and paleontological survey of those areas will be carried out prior to construction once the specific creation areas have been identified.

3.6.6.1.6 Total Impacts A cultural resources inventory was conducted in most of the Proposed Action project area during the 2000-2001 field seasons. Areas inventoried included: four lakes located in the Lake Fork drainage, including Kidney, Island, Clements, and Brown Duck; four lakes located in the Yellowstone drainage, including Five Points, Superior, Drift, and Bluebell; five lakes located in the Swift Creek drainage, including Farmers, East Timothy, White Miller, Deer, and Water Lily; Big Sand Wash Reservoir; the proposed Big Sand Wash Feeder Pipeline route and diversion structure site; and the proposed Big Sand Wash–Roosevelt Pipeline route.

This inventory resulted in the recordation of 17 prehistoric sites and 23 historic sites. Of those totals, 8 prehistoric sites and 19 historic sites were recommended to be eligible to the NRHP and 9 prehistoric sites and 3 historic sites were recommended to be not eligible to the NRHP. A segment of the "C" Canal, 42Dc1328, was found to be a non-contributing element

to the general eligibility of the determined eligible site. The recorded segment falls into a third management category, Non-Contributing Eligible. As a non-contributing element the segment will require no further consideration. The recommended-eligible sites would be adversely affected by construction of project features associated with the Proposed Action.

The 8 prehistoric sites recommended eligible to the NRHP include 42Dc1332, a 3-panel Fremont rock art site (petroglyph), and 42Dc1333, 42Dc1340, 42Dc1341, 42Dc1342, and 42Dc1344, ET-1, and ET-2 (ET-1 and ET-2 are temporary designations), which are probable campsites.

The 19 historic sites recommended eligible to the NRHP include 42Dc1329, 42Dc1334, and 42Dc1335, consisting of standing-structure historic farmstead sites. Also, one historic home (currently in use), 42Dc1328, is located in the impact area. Site 42Dc1330 consists of a historic foundation, cistern, and outbuilding foundation. Also included are relatively large portions of the previously determined eligible C Canal (42Dc1337), and Martin's Lateral Irrigation Canal (42Dc1329). The determined eligible properties are Brown Duck Lake Dam, Clements Lake Dam, Island Lake Dam, Kidney Lake Dam, Five Points Lake Dam, Superior Lake Dam, Drift Lake Dam, Bluebell Lake Dam, Farmers Lake Tunnel, East Timothy Lake Dam, White Miller Lake Dam, Deer Lake Dam, and Water Lily Lake Dam.

Nine prehistoric sites recorded during the inventories were recommended not eligible to the NRHP. These include 42Dc1326, 42Dc1331, 42Dc1339, 42Dc1343, 42Dc1345, 42Dc1346, ET-3, ET-4, and ET-5, which are all probable campsites. Three historic sites were recommended not eligible to the NRHP. Site 42Dc1327 is a severely disturbed area, containing a cobblestone berm and little associated debris. Sites 42Dc1336 and 42Dc1338 are irrigation ditches. Although the "C" Canal as a whole has been determined eligible to the NRHP, the segment of the "C" Canal evaluated during the Section 203 Inventory was determined to be a non-contributing element to the general eligibility of the site.

There is high potential for finding more prehistoric and historic resources that are eligible to the NRHP in the remaining areas not yet inventoried in the Proposed Action project area. These areas include a few segments of the proposed pipeline route and a small portion of the proposed Big Sand Wash Reservoir enlargement area. Any NRHP-eligible historic site found could be affected if disturbed by construction activities, and would be mitigated as described in the following text.

3.6.6.1.7 Mitigation Class III surveys for cultural resources have been completed and the properties considered eligible for the NRHP have been identified. The results of the Class III surveys have been submitted to the State Historic Preservation Officer (SHPO) for review and approval. Based on the type of resources identified in the survey reports, mitigation plans for eligible properties consisting of avoidance or additional recordation would be developed with the SHPO. Following mitigation, there would be no unavoidable adverse impacts.

3.6.6.2 Revised Section 203 Alternative

Impacts and mitigation would be the same as described for the Proposed Action except that dams and resources at the 13 high mountain lakes would not be affected.

3.6.6.3 Twin Pots Section 203 Alternative

Potential effects on prehistoric, historic, ethnological, and paleontological resources include all of those described for the Proposed Action. Additional impacted resources at other project feature sites only associated with the Twin Pots Section 203 Alternative are described below. Mitigation measures would be the same as described for the Proposed Action, and there would be no remaining unavoidable adverse impacts or cumulative impacts.

3.6.6.3.1 Pipelines Cultural resources present in the proposed Big Sand Wash Feeder Pipeline route and Big Sand Wash–Roosevelt Pipeline route are described in Section 3.6.6.1.4, *Pipelines*. No known cultural resources are present in the proposed Lake Fork–Yellowstone Pipeline route, although it is likely some historic archaeological sites (fences, sheds, foundations, trash scatters) would be found. Ute Tribal members expressed concern that the pipeline would cross migratory paths of deer and elk (Albers and Lowry 1995). There is a slight possibility of finding Pleistocene fossils in glacial tills along the Lake Fork–Yellowstone Pipeline corridor.

3.6.6.3.2 Fish and Wildlife Mitigation and Enhancement There is some potential for finding prehistoric sites on the margins of Twin Pots Reservoir. Therefore, construction and operation of this feature may potentially have adverse effects on any prehistoric cultural resources found near the reservoir. Improvements to Twin Pots Reservoir would adversely affect Twin Pots Dam, which has been recommended eligible to the NRHP. Improvements may also adversely affect the historic Farnsworth Canal, which is within 100 feet of the reservoir. Twin Pots Reservoir may contain Pleistocene fossils that may be affected if encountered during construction.

3.6.6.4 No Action Alternative

Because no construction is proposed under the No Action Alternative, there would be no project-related impacts on those cultural and paleontological resources at project feature sites.