Diamond Fork System

Final Supplement to the Final Environmental Impact Statement

Bonneville Unit Central Utah Project

Central Utah Water Conservancy District (Lead Agency)
Utah Reclamation Mitigation and Conservation Commission (Joint-Lead Agency)
U.S. Department of the Interior (Joint-Lead Agency)

July 1999

U.S. DEPARTMENT OF THE INTERIOR · MARCH 3, 1849

UTAH RECLAMATION MITIGATION AND CONSERVATION COMMISSION

CENTRAL UTAH WATER CONSERVANCY DISTRICT

July 1, 1999

Dear Reader:

This Diamond Fork System Final Supplement to the Final Environmental Impact Statement on the features proposed to complete the Diamond Fork System was filed with U.S. Environmental Protection Agency on July 1, 1999. The features were previously covered in the Spanish Fork Canyon-Nephi Irrigation System (SFN) Draft Environmental Impact Statement (DEIS). The SFN DEIS (DES 98-13) was filed with the U.S. Environmental Protection Agency (EPA) on March 31, 1998, and announced in the Federal Register on April 3, 1998 (Volume 63, Number 64, Page 16568).

Based on previous NEPA documents (1973,1979, 1986) and planning documents, the Central Utah Water Conservancy District has contractual commitments to make municipal and industrial water deliveries in Salt Lake County, Utah County and Wasatch County. To continue a timely construction program to meet these commitments, the joint-lead agencies decided to complete the environmental documentation on the Diamond Fork portion of the SFN Draft EIS. This FS-FEIS contains four chapters: Chapter 1-Description of the Proposed Action and No Action Alternative; Chapter 2-Comparative Analysis of Impacts of the Proposed Action and No Action Alternative; Chapter 3-Affected Environment and Environmental Consequences; and Chapter 4-Consultaton and Coordination (this chapter contains responses to the comments made on the Diamond Fork System portion of the SFN DEIS).

A copy of this FS-FEIS has been sent to everyone who received a copy of the SFN DEIS. Additional copies may be requested from the following address:

Nancy Hardman
Central Utah Water Conservancy District
355 West University Parkway
Orem, Utah 84058
Telephone: (801) 226-7187
Fax: (801) 226-7150
Email: nancy@cuwcd.com

U.S. DEPARTMENT OF THE INTERIOR

DIAMOND FORK SYSTEM FINAL SUPPLEMENT TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT

Prepared by

Central Utah Water Conservancy District

July 1999

Don A. Christiansen, General Manager
Central Utah Water Conservancy District

Ronald Johnston, CUPCA Program Director
U.S. Department of the Interior

Michael C. Weland, Executive Director
Utah Reclamation Mitigation and Conservation Commission

COVER SHEET

Diamond Fork System Final Supplement to the Final Environmental Impact Statement

( ) Draft (X) Final

Joint Lead Agencies

Central Utah Water Conservancy District (CUWCD)
U.S. Department of the Interior (DOI)
Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission)

Cooperating Agencies
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Department of Agriculture, Forest Service

Counties that Could Be Affected
Utah County, Utah

Abstract

This FS-FEIS covers the features required to complete construction of the Diamond Fork System. The Proposed Action was formulated to complete the system and fulfill the same need, with the least long-term environmental impact, as the Recommended Plan described in the 1984 Diamond Fork Power System FEIS as modified by the 1990 Diamond Fork System FS-FEIS and the DOI 1995 ROD. The Diamond Fork System would be completed by constructing a series of tunnels and pipelines to convey water through the mountainous terrain of Diamond Fork Canyon and various Diamond Fork drainage tributary canyons in the Uinta National Forest. The following features are proposed for construction: 1) Sixth Water Connection to Tanner Ridge Tunnel, 2) Tanner Ridge Tunnel, 3) Diamond Fork Siphon, 4) Red Mountain Tunnel, 5) Red Hollow Pipeline and connection to Diamond Fork Pipeline, 6) Diamond Fork Creek Outlet, 7) Spanish Fork River Outlet from Diamond Fork Pipeline, and 8) if necessary, modifications to Spanish Fork River diversion dams. These features would be sized to convey the following: 1) Strawberry Valley Project (SVP) water from Strawberry Reservoir for agricultural use in the Spanish Fork area of southern Utah County, 2) Bonneville Unit water to Utah Lake, and 3) flows to meet the minimum streamflow requirements mandated by CUPCA.

The Spanish Fork River would be used to convey Bonneville Unit water to Utah Lake and SVP water to diversion dams on Spanish Fork River. The CUWCD would construct, operate and maintain the Diamond Fork System to provide minimum flows in Sixth Water and Diamond Fork creeks. Minimum flows in Sixth Water Creek (from the Strawberry Tunnel outlet to Diamond Fork Creek) would be not less than 32 cfs from May through October and not less than 25 cfs from November through April. Minimum flows in Diamond Fork Creek (from Diamond Fork Creek Outlet near Red Hollow to Spanish Fork River Outlet) would not be less than 80 cfs from May through September and not less than 60 cfs from October through April.

Other Requirements Served

This FS-FEIS is intended to serve other environmental review and consultation requirements pursuant to 40 CFR 1502.25 (a).

Date DEIS Made Available to EPA and the Public: INT DES 98-13, March 31, 1998
Date FS-FEIS Made Available to EPA and the Public: INT FS-FSEIS 99- , July 1, 1999

Preface

This Diamond Fork System Final Supplement to the Final Environmental Impact Statement (FS-FEIS) addresses potential impacts related to construction and operation of the features proposed for completing the Diamond Fork System. As joint-lead agencies for this document, the Central Utah Water Conservancy District (CUWCD), the U.S. Department of the Interior (DOI) and the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) will use this FS-FEIS and other relevant materials to plan actions and make decisions. It is intended to satisfy disclosure requirements of the National Environmental Policy Act (NEPA) and will serve as the NEPA compliance document for contracts, agreements and permits that would be required for construction and operation of the Diamond Fork System.

The features proposed to complete the Diamond Fork System were previously covered in the Spanish Fork Canyon-Nephi Irrigation System (SFN) Draft Environmental Impact Statement (DEIS). The SFN DEIS (DES 98-13) was filed with the U.S. Environmental Protection Agency (EPA) on March 31, 1998, and announced in the Federal Register on April 3, 1998 (Volume 63, Number 64, Page 16568). Substantial and significant comments were received on the SFN Draft EIS from the EPA, Utah Department of Environmental Quality, Division of Water Quality and Strawberry Water Users Association (SWUA).

The joint-lead agencies determined that a considerable amount of time and effort would be required to resolve the issues raised by the commentors. Significant issues and concerns dealt with purpose and need and operation of the irrigation portion of the SFN Project, not the features required to complete the Diamond Fork System. Based on previous NEPA documents and decisions, CUWCD had developed contractual commitments to deliver municipal and industrial (M&I) water in Salt Lake County, Utah County and Wasatch County. To continue a timely construction program to meet these commitments, the joint-lead agencies decided to complete the environmental documentation on the Diamond Fork portion of the SFN Draft EIS. They proposed a final supplement be prepared without issuing a draft supplement in order to complete the required environmental documentation in a timely manner. The Draft SFN EIS would serve as the draft document for the features required to complete the Diamond Fork System. The Department of the Interior and the Council on Environmental Quality approved this approach.

This FS-FEIS contains four chapters: Chapter 1-Description of the Proposed Action and No Action Alternative; Chapter 2-Comparative Analysis of Impacts of the Proposed Action and No Action Alternative; Chapter 3-Affected Environment and Environmental Consequences; and Chapter 4-Consultaton and Coordination (this chapter contains the responses to the comments made on the Diamond Fork System portion of the SFN DEIS). Five technical memoranda that provide detailed information on Water Resources, Water Quality, Aquatic Resources, Wetland Resources and Recreation support the impact analysis.

Copies of this FS-FEIS are available for public review at the DOI office at 302 East 1860 South, Provo, Utah; Mitigation Commission office at 102 West 500 South, Suite 315, Salt Lake City, Utah; and CUWCD office at 355 West University Parkway, Orem, Utah. Copies may be requested from the following address:

Nancy Hardman
Central Utah Water Conservancy District
355 West University Parkway
Orem, Utah 84058
Telephone: (801) 226-7187
Fax: (801) 226-7150
Email: nancy@cuwcd.com

Contents

Page

Contents
(continued)

Page

Chapter 1 – Description of the Proposed Action and No Action Alternative (continued)

Contents
(continued)

Contents
(continued)

Page

Chapter 1 – Description of the Proposed Action and No Action Alternative (continued)

Contents
(continued)

Page

Chapter 1 – Description of the Proposed Action and No Action Alternative (continued)

Chapter 2 – Comparative Analysis of Impacts of the Proposed Action and No Action Alternative

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences

Contents
(continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Page

Chapter 3 – Affected Environment and Environmental Consequences (continued)

Contents
(continued)

Tables

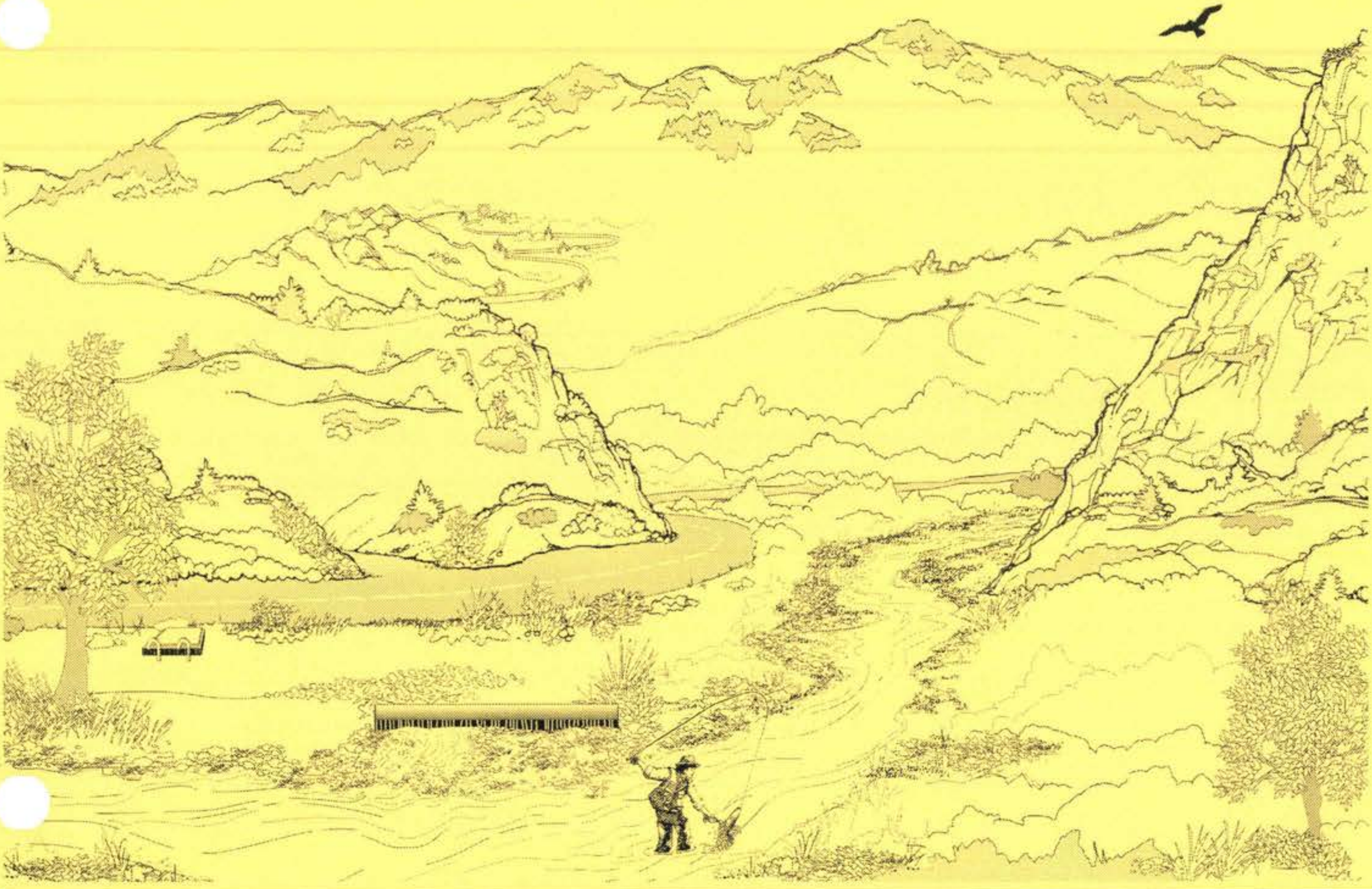
Tables
(continued)

Tables
(continued)

Tables
(continued)

Figures

Maps



Diamond Fork System

Final Supplement to the Final Environmental Impact Statement

Summary

Summary

S.1 Introduction

As joint-lead agencies, the Central Utah Water Conservancy District (CUWCD), U.S. Department of the Interior (DOI), and Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) prepared this Diamond Fork System Final Supplement to the Final Environmental Impact Statement (FS-FEIS). This FS-FEIS addresses potential impacts related to construction and operation of the features proposed for completing the Diamond Fork System.

This summary provides an overview of:

- The purpose and need for the project
- Proposed Action and No Action Alternative
- Major areas of concern
- Major significant impact conclusions
- Issues to be resolved
- Agency-preferred alternative

S.2 Purpose and Need

The Proposed Action would respond to the following needs:

1. To maintain the statutorily mandated minimum flows in Diamond Fork Creek and Sixth Water Creek (Sections 303(c)(1)(A) & (B) of Public Law 102-575).

2. To implement the DOI environmental commitments on the Diamond Fork Pipeline from the 1995 ROD, which includes but is not limited to removing the high flows brought over from Strawberry Reservoir (both Strawberry Valley Project and Central Utah Project water) into the Sixth Water and Diamond Fork creek drainages.

3. To meet the CUWCD's municipal and industrial (M&I) water contractual commitments to Salt Lake, Utah and Wasatch Counties by conveying Bonneville Unit water to Utah Lake (via new features) for exchange to Jordanelle Reservoir and historical Strawberry Valley Project (SVP) irrigation water.

4. To provide the Mitigation Commission the opportunity and flexibility for future restoration of aquatic and riparian habitat in Sixth Water and Diamond Fork creeks to protect water quality and threatened species in Diamond Fork Creek.

Following are the purposes of the Proposed Action:

1. To provide conveyance of SVP historical diversions into their existing system

2. To minimize adverse impacts on aquatic, riparian and other environmental resources in the Sixth Water and Diamond Fork creek drainages

. To minimize adverse impacts on threatened and endangered species, wetlands and floodplains

4. To minimize the cost of project features

5. To achieve full repayment by maximizing M&I water deliveries to fulfill outstanding commitments

6. To use existing Diamond Fork System facilities to their full hydraulic capacity

7. To evaluate an alternative to Monks Hollow Dam and Reservoir

S.3 Proposed Action and No Action Alternative Description

S.3.1 Proposed Action

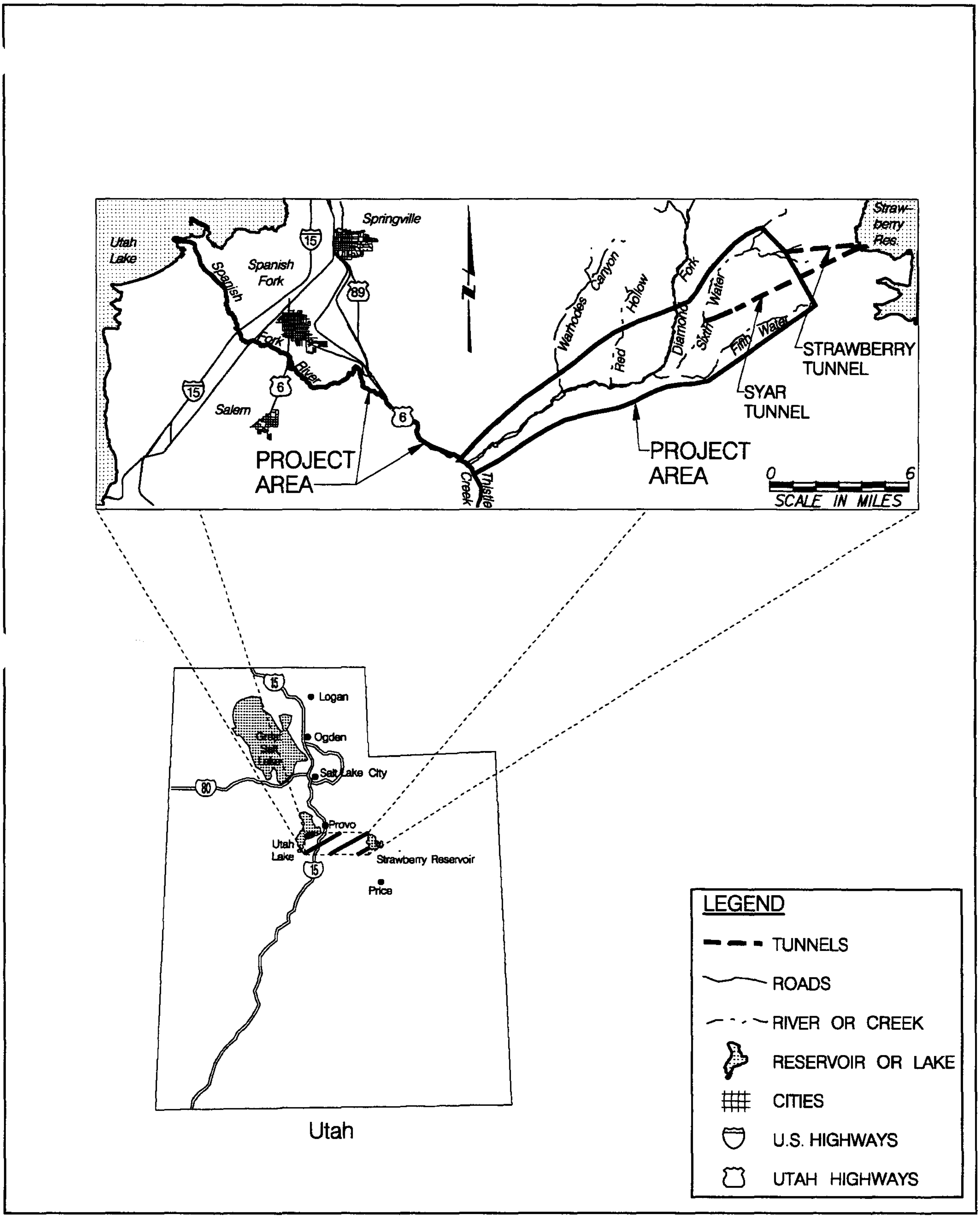
The Proposed Action was formulated to complete the Diamond Fork System and basically fulfill the same need, with the least long-term environmental impact, as the Recommended Plan described in the 1984 Diamond Fork Power System FEIS and as modified by the 1990 Diamond Fork System FS-FEIS. The Proposed Action does not preclude future opportunities to develop hydropower at certain features of the Diamond Fork System under a lease-of-power privilege. However, development of hydropower is not a part of this Proposed Action.

Map S-1 shows an overview of the location of the project area. The Diamond Fork System would be completed by constructing a series of tunnels and pipelines to convey water through the mountainous terrain of Diamond Fork Canyon and various Diamond Fork drainage tributary canyons in the Uinta National Forest. As described in Section 303(f) of the Central Utah Project Completion Act (CUPCA), the old Strawberry Tunnel only would be used to convey water for minimum streamflows except when "...the District, in consultation with the Commission, has determined that the Syar Tunnel or the Sixth Water Aqueduct is rendered unusable or emergency circumstances require the use of the Strawberry Valley Tunnel for the delivery of contracted Central Utah Project water and Strawberry Valley Reclamation Project water."

The following features are proposed for construction (see Map A-1 in map pocket): 1) Sixth Water Connection to Tanner Ridge Tunnel, 2) Tanner Ridge Tunnel, 3) Diamond Fork Siphon, 4) Red Mountain Tunnel, 5) Red Hollow Pipeline and connection to Diamond Fork Pipeline, 6) Diamond Fork Creek Outlet, 7) Spanish Fork River Outlet from Diamond Fork Pipeline, and 8) modifications to Spanish Fork River diversion dams (see Map A-2). These features would be sized to convey the following: 1) SVP water from Strawberry Reservoir for agricultural use in the Spanish Fork area of south Utah County, 2) Bonneville Unit water to Utah Lake, and 3) flows to meet the minimum streamflow requirements mandated by CUPCA.

The Spanish Fork River would be used to convey Bonneville Unit water to Utah Lake and SVP water to Spanish Fork Diversion Dam. The CUWCD would construct, operate and maintain the Diamond Fork System, to provide minimum flows in Sixth Water and Diamond Fork creeks. Minimum flows in Sixth Water Creek (from the Strawberry Tunnel outlet to Diamond Fork Creek) would be not less than 32 cfs from May through October and not less than 25 cfs from November through April. Minimum flows in Diamond Fork Creek (from Red Hollow to Spanish Fork River) would not be less than 80 cfs from May through September and not less than 60 cfs from October through April.

Table S-1 shows the feature name, length, diameter and capacity of the Proposed Action features. Map A-1 shows the location of these features and detailed insets of some features.



Map S-1
Location of Proposed Action Project Area

Table S-1 Diamond Fork System Proposed Action Features			
Feature Name/Map A-1 Location	**Length (miles)**	**Diameter (inches)**	**Capacity (cfs)**
Sixth Water Connection to Tanner Ridge Tunnel (Inset 2)	0.02	108	660
Tanner Ridge Tunnel (upper right)	0.99	114	660
Diamond Fork Siphon (Inset 3)	1.20	96	660
Red Mountain Tunnel (upper middle)	1.84	114	660
Red Hollow Pipeline and connection to Diamond Fork Pipeline (Inset 4)	2.24	96	660
Diamond Fork Creek Outlet (Inset 4)	0.00	96	660
Spanish Fork River Outlet from Diamond Fork Pipeline (Inset 5)	0.45	96	560
Total Length	**6.74**		

Six existing dams and diversions along Spanish Fork River from Diamond Fork Creek to Utah Lake would be involved in passing the flows generated under the Proposed Action (see Map A-2). If the increased flows required under the Proposed Action cannot be passed by the existing structures it may become necessary to modify them. If it becomes necessary, five of the diversions would require modifications to bypass flows and to provide fish passage. The impacts of modifications are included in this FS-FEIS to cover that possibility.

S.3.2 No Action Alternative

The No Action Alternative was called Alternative C in the Final Supplement to the Final Environmental Impact Statement Diamond Fork System, Bonneville Unit, Central Utah Project (1990 FS-FEIS). As stated in the 1990 FS-FEIS, "alternative C corresponds with the I&D (Irrigation and Drainage) System No Action Alternative and would be viable only if the I&D System were not built" (USBR 1990). Implementation of the No Action Alternative under this FS-FEIS would complete the Diamond Fork System if a decision were made not to proceed with the Utah Lake Drainage Basin Water Delivery System.

The features of the No Action Alternative have changed from those described in the 1990 FS-FEIS. The Last Chance and Diamond Fork powerplants were eliminated and minimum instream flow requirements were added for Sixth Water and Diamond Fork creeks.

The No Action Alternative would consist of the following features: 1) Three Forks Dam and Reservoir, 2) Diamond Fork Pipeline Extension (pipeline from the completed Diamond Fork Pipeline upstream to Three Forks Dam), and 3) Spanish Fork River Outlet (outlet at the end of the completed Diamond Fork Pipeline for release of flows to Spanish Fork River).

Water would be released from Strawberry Tunnel to maintain minimum streamflows in Sixth Water Creek above Sixth Water Aqueduct. The flows needed for SVP irrigation demand, supplemental irrigation and M&I exchanges would flow through Diamond Fork Pipeline until it is operating at maximum capacity of 560 cfs. Up to 388 cfs would be released to the creek from Three Forks Dam under normal operations, including minimum streamflows required below Monks Hollow and additional water in excess of the Diamond Fork Pipeline when it would convey capacity flows. This released water would flow through Diamond Fork Creek to Spanish Fork River.

Three Forks Dam would be 60 feet high and constructed at Three Forks about 10 miles upstream from the confluence of Diamond Fork Creek and Spanish Fork River. The dam would include a 560-cfs outlet to the intake of Diamond Fork Pipeline and a 250-cfs outlet to Diamond Fork Creek.

Three Forks Reservoir would have a total capacity of 430 acre-feet at normal water surface elevation (5,582 feet), and a surface area of 14 acres (8 acres at minimum pool). The reservoir would fluctuate a maximum of 27 feet daily to regulate irrigation and streamflow releases from Sixth Water Aqueduct.

The existing Diamond Fork Pipeline would be extended from its current upstream terminus about 2.7 miles to the outlet of the proposed Three Forks Dam. The extension (560-cfs capacity) would be routed along Diamond Fork Road on the north side of the creek.

The Spanish Fork River Outlet would be the same as for the Proposed Action.

S.4 Major Areas of Concern

Several areas of concern and issues were raised. The impact analysis contained in Chapter 3 of this FS-FEIS deals with the following issues:

- Flows in creeks and rivers
- Changes in sediment loads in Diamond Fork System water
- Water quality of releases from Strawberry Reservoir
- Wetlands and riparian habitat
- Wildlife habitat
- Aquatic life from changes in streamflows
- Threatened, endangered and other species of special concern
- Recreation use (fishing, hunting, hiking, horseback riding, sightseeing)
- Changes in roadless area classifications and characteristics
- Visual quality of the area

S.5 Major Impact Conclusions

S.5.1 Proposed Action

S.5.1.1 Water Resources

Monthly average flows in Sixth Water and Diamond Fork creeks above Red Hollow would be extremely constant under the Proposed Action. Except for peak natural runoff conditions, flows would be near minimum levels (25 cfs winter and 32 cfs summer on Sixth Water Creek; and 60 cfs winter and 80 cfs summer on Diamond Fork Creek). Compared to baseline flows, winter and early spring Proposed Action flows in Sixth Water Creek above Sixth Water Aqueduct would be increased by a maximum of 333 percent, or 21 cfs. Below Sixth Water Aqueduct, late spring and summer flows in Sixth Water Creek under the Proposed Action would be decreased by a maximum of 88 percent or 250 cfs compared to baseline.

The Proposed Action would increase winter flows and decrease summer flows in Diamond Fork Creek. Monthly average flows under the Proposed Action in Diamond Fork Creek below Diamond Fork Creek Outlet would be a maximum of 400 percent, or 48 cfs, higher during the winter, and a maximum of 72 percent, or 212 cfs, lower during the summer compared to baseline.

Monthly average flows in Spanish Fork River would be higher in all months under the Proposed Action. Flow increases would be most significant during the winter. Average flow increases also would be significant below the Spanish Fork, East Bench, Mill Race and Lake Shore diversion dams, where Bonneville Unit water being conveyed to Utah Lake would bypass the diversion dams and remain in the river. Under baseline conditions, essentially all of the water in Spanish Fork River is diverted out during the summer irrigation season.

S.5.1.2 Water Quality

Construction and interim operation are not expected to cause any significant impacts on groundwater quality. Interim operation of the project would reduce total dissolved solids (TDS) levels in Sixth Water and Diamond Fork creeks, and Spanish Fork River. It would also reduce phosphorus levels and average temperatures. Changes in dissolved oxygen levels would vary with stream segments, but standards would not be exceeded. Sediment load would be significantly reduced in all reaches except for Spanish Fork River where the sediment load would be increased over baseline. The Proposed Action does not include any Bonneville Unit water being delivered for irrigation. Delivery of Bonneville Unit water to Utah Lake for exchange to Jordanelle Reservoir would result in TDS levels in Utah Lake less than or equal to baseline conditions (*Water Quality Technical Memorandum for the 1999 Diamond Fork System FS-FEIS,* CUWCD 1999f, Attachment H).

S.5.1.3 Wetland Resources

Construction of the Proposed Action would result in a temporary disturbance of 2.01 acres of wetlands. These wetlands would be reclaimed and restored after construction is completed. A total of 0.04 acre would be permanently lost (a significant impact) because of facility construction. However, mitigation land already acquired for the Diamond Fork System would compensate for this loss. The reduction of flows in Sixth Water and Diamond Fork creeks would result in the improvement of wetlands and riparian vegetation along these creeks.

S.5.1.4 Wildlife Resources

A total of 53.3 acres of critical winter range for mule deer, moose and elk would be temporary disturbed by project construction. About 3.8 acres would be permanently removed by project facilities. However, wildlife mitigation land already acquired for the Diamond Fork System would compensate for this loss.

S.5.1.5 Aquatic Resources

The Proposed Action would increase trout populations in Sixth Water Creek, Diamond Fork Creek and Spanish Fork River as a result of a more stabilized flow regime, less erosion and turbidity, and suitable water temperatures. These conditions, combined with the optimal nutrient levels associated with the Strawberry Reservoir releases, would result in a net biomass increase of 15,949 pounds (218 percent) in wild trout standing crop throughout the impact area of influence. The temperature of water released from Strawberry Reservoir during the summer months would result in optimal conditions for trout growth throughout each reach.

S.5.1.6 Special Status Species

Interim operation of the Proposed Action would have a high potential for effect on 9.69 acres of occupied Ute ladies'-tresses (threatened) habitat along Diamond Fork Creek and 2,087 individual plants along Diamond Fork Creek and Spanish Fork River. However, the majority of the colonies, which have a potential to be significantly affected by the change in flows, are growing in sub-optimal habitat as indicated by the relationship between colony density and the potential to affect them.

Section 7 consultation with the Fish and Wildlife Service (FWS) for completion of the Diamond Fork System have not resulted in FWS recommending any provisions for June sucker in the Spanish Fork River. In the FWS Draft Biological Opinion, the FWS has agreed with the Biological Assessment conclusion with regard to direct effects of interim operation of the Diamond Fork System on the June sucker but has determined that there would be an indirect effect on the June sucker because interim operation of the Diamond Fork System would enable the exchange for water in the Provo River as part of the M&I System. The FWS provided the joint-lead agencies with a list of recommendations which if agreed to and implemented would result in a non-jeopardy Biological Opinion on the June sucker. The joint-lead agencies have agreed to the FWS recommendations which are presented in Section 3.20.6.1.2 and Appendix B.

Construction of the Red Mountain Tunnel outlet portal, Red Hollow Pipeline, and Diamond Fork Siphon could potentially indirectly affect the golden eagle by causing temporary nest abandonment, loss of eggs and young, and a short-term decline in recruitment of a localized population.

Interim operation would create a 24 to 25 percent improvement over baseline in Leatherside chub habitat in Diamond Fork Creek, which would be a positive significant effect. However, the decrease in flows in Diamond Fork Creek could decrease the number of cutoff pool and backwater habitats that the Leatherside chub uses, which would be a significant effect. The increase in trout standing crop could cause an increase in predation on the Leatherside chub.

S.5.1.7 Recreation Resources and Special Status Areas

Road closures would cause the major impact on recreation resources and use during construction. A 5.3-mile portion of Diamond Fork Road would be closed during the 3½-year construction period (35 percent of the total road length from State Highway 6 to Springville Crossing). The road closure would impact driving for pleasure and sightseeing, hiking, dispersed camping, fishing and hunting. The road closure associated with construction of the Proposed Action would temporarily eliminate the use of about 76 dispersed camping sites within the impact area of influence (61 percent). The number of users (hunters, picnickers and anglers) that this would impact is unknown.

Interim operation of the Proposed Action would result in a predicted overall increase of 29,321 angler days of use per year (Sixth Water and Diamond Fork creeks), a 330 percent increase over baseline. This could cause a significant increase in camping use in the impact area of influence.

The designated Red Mountain and Diamond Fork Roadless areas would be impacted during the 3½-year construction period. Man-made facilities would be added to each roadless area. The area permanently disturbed, 4.1 acres for Red Mountain and 1.3 acres for Diamond Fork, may be removed from the roadless area classification.

S.5.1.8 Visual Resources

Significant short-term impacts on the quality of visual resources would occur in the Spanish Fork River Outlet area and the Diamond Fork Creek Outlet area during construction. Significant long-term impacts on the quality of visual resources would result from construction of project features in the areas of the Red Mountain Tunnel Outlet and permanent access road, and the Red Hollow Pipeline and Diamond Fork Siphon areas.

S.5.2 No Action Alternative

S.5.2.1 Water Resources

Monthly average flows in Sixth Water Creek above Sixth Water Aqueduct, and in Diamond Fork Creek below Red Hollow would vary little under the No Action Alternative. Except for variations caused by natural runoff, flows would be maintained at minimum flow levels (25 cfs winter and 32 cfs summer on Sixth Water Creek and 60 cfs winter and 80 cfs summer on Diamond Fork Creek). Compared to baseline flows, winter and early spring flows in Sixth Water Creek above Sixth Water Aqueduct under the No Action Alternative would be increased by a maximum of 333 percent, or 21 cfs. Below Sixth Water Aqueduct, monthly average flows in Sixth Water Creek under the No Action Alternative would be increased in all months, ranging from 40 cfs in October to 191 cfs in May compared to baseline.

The No Action Alternative would increase winter flows and decrease summer flows in Diamond Fork Creek. Monthly average flows under the No Action Alternative in Diamond Fork Creek below Three Forks Dam would be a maximum of 400 percent, or 48 cfs, higher during the winter, and a maximum of 73 percent, or 215 cfs, lower during the summer compared to baseline.

Flows in Spanish Fork River would be higher in virtually all months under the No Action Alternative. Flow increases would change most significantly during the winter. Average flow increases also would be significant below the Spanish Fork, East Bench, Mill Race and Lake Shore diversion dams, where Bonneville Unit water being conveyed to Utah would bypass the diversion dams and remain in the river.

S.5.2.2 Water Quality

Construction would not be expected to cause any significant surface or groundwater quality impacts. Some decreases in salinity levels would be expected from operation of the No Action Alternative. Water temperatures and phosphorus levels would decrease. Operation of the No Action Alternative would result in increased sediment loads in almost all stream and river stretches, except Sixth Water Creek above the Sixth Water Aqueduct, and Diamond Fork Creek below Three Forks. The No Action Alternative would not have any significant impacts on water quality in Utah Lake. It is estimated that each acre-foot of irrigation water return flow adds 0.34 ton of salt to Utah Lake (CUWCD 1998f). Delivery of 14,700 acre-feet of supplemental irrigation water under the No Action Alternative would result in about 4,200 acre-feet of return flow, which would add 1,428 tons of salt a year over baseline to Utah Lake. This would be a 0.3 percent increase over a baseline of 443,400 tons of salt annually (CUWCD 1998f).

S.5.2.3 Wetland Resources

Construction of the No Action Alternative would result in a temporary disturbance of 9 acres of wetlands, which would be reclaimed and restored after construction is completed. A total of 0.5 acre would be permanently lost (a significant impact) because of facility construction. Operation of the No Action alternative would cause a permanent loss of 9.1 acres (a significant impact) of wetlands, but mitigation land already acquired for the Diamond Fork System would compensate for these losses. Reduced flows in Sixth Water Creek above the aqueduct and Diamond Fork Creek would result in the improvement of wetlands and riparian vegetation along these creeks.

S.5.2.4 Wildlife Resources

A total of 63.3 acres of critical winter range for mule deer and elk would be temporary disturbed by construction activities. About 30.1 acres would be permanently removed by project facilities, but wildlife mitigation land already acquired for the Diamond Fork System would compensate for this loss.

S.5.2.5 Aquatic Resources

The No Action Alternative would increase trout populations in Sixth Water Creek above the aqueduct, Diamond Fork Creek, and Spanish Fork River as a result of a more stabilized flow regime, less erosion and turbidity, and suitable water temperatures. These conditions, combined with the optimal nutrient levels associated with the Strawberry Reservoir releases, would result in a net biomass increase of 13,084 pounds (179 percent) in wild trout standing crop throughout the impact area of influence. The temperature of water released from below the thermocline in Strawberry Reservoir during the summer months would provide optimal conditions for trout growth throughout each reach.

S.5.2.6 Special Status Species

The impact on Ute ladies'-tresses would be the same as under the Proposed Action.

The impact on June sucker would be the same as under the Proposed Action.

Diamond Fork Creek habitat and predation impacts on Leatherside chub would be the same as under the Proposed Action.

S.5.2.7 Recreation and Special Status Areas

Road closures would cause the major impact on recreation resources and use during construction. A 3.4-mile portion of Diamond Fork Road would be closed during the 3-year construction period (22 percent of the total road length from State Highway 6 to Springville Crossing). The closure would impact driving for pleasure and sightseeing, hiking, dispersed camping, fishing and hunting. A new road that bypasses the area and reconnects the lower Diamond Fork road with the upper portion would not be completed until July of 2003. The closure associated with construction of the No Action Alternative would temporarily eliminate the use of about 50 dispersed camping sites (40 percent) within the impact area of influence. The number of users (hunters, picnickers and anglers) that this would impact is unknown. Construction of the road to bypass Three Forks Reservoir would result in creation of a 6.9-acre rock disposal area along the existing Diamond Fork Creek Road, which would eliminate an unknown number of dispersed campsites.

Operation of the No Action Alternative would result in a predicted overall increase of 25,698 angler days of use per year (Sixth Water and Diamond Fork Creeks), a 289 percent increase over baseline. This increase could cause a significant increase in camping use in the impact area of influence.

Three Forks Dam and Reservoir would eliminate stream fishing along 2,400 feet of Diamond Fork Creek above Three Forks, 2,700 feet of Sixth Water Creek, and 1,600 feet of Cottonwood Creek, which would cause a loss of an estimated 153 angler days per year.

The designated Diamond Fork Roadless Area would be impacted during the 3-year construction period. Man-made facilities would be added to the roadless area. The area permanently disturbed, 29.6 acres in the Diamond Fork Roadless Area, may be removed from the roadless area classification.

S.5.2.8 Visual Resources

Significant short-term impacts on the quality of the visual resource would occur in the Spanish Fork River Outlet area during construction. Significant long-term impacts would result from construction and operation of the No Action Alternative. The dam and reservoir would permanently change the visual landscape character in the Three Forks area.

S.6 Issues To Be Resolved

EPA's water conservation concerns are long standing. As early as 1972, EPA raised concerns about the lack of incentive among the Wasatch Front communities to manage the existing water supplies in a sustainable manner. The Wasatch Front is still recognized as having one of the highest consumptive use rates in the nation while at the same time having relatively low water pricing structures when compared to other major metropolitan areas in the arid west. EPA believes that stronger M&I water conservation policies and programs should be implemented, and conservation savings similar to other metropolitan areas attained, prior to additional reductions in native stream flows.

In the 1987 Final Supplement of the M&I FEIS the BOR committed to working with EPA and the Wasatch Front communities to assure that water conservation became a major part of the Central Utah Project (CUP) water supply ethic of the Wasatch Front and the DOI and CUWCD continue to support this commitment. However, the 1987 commitments were modified by the passage of PL 102-575 Section 207 (CUPCA).

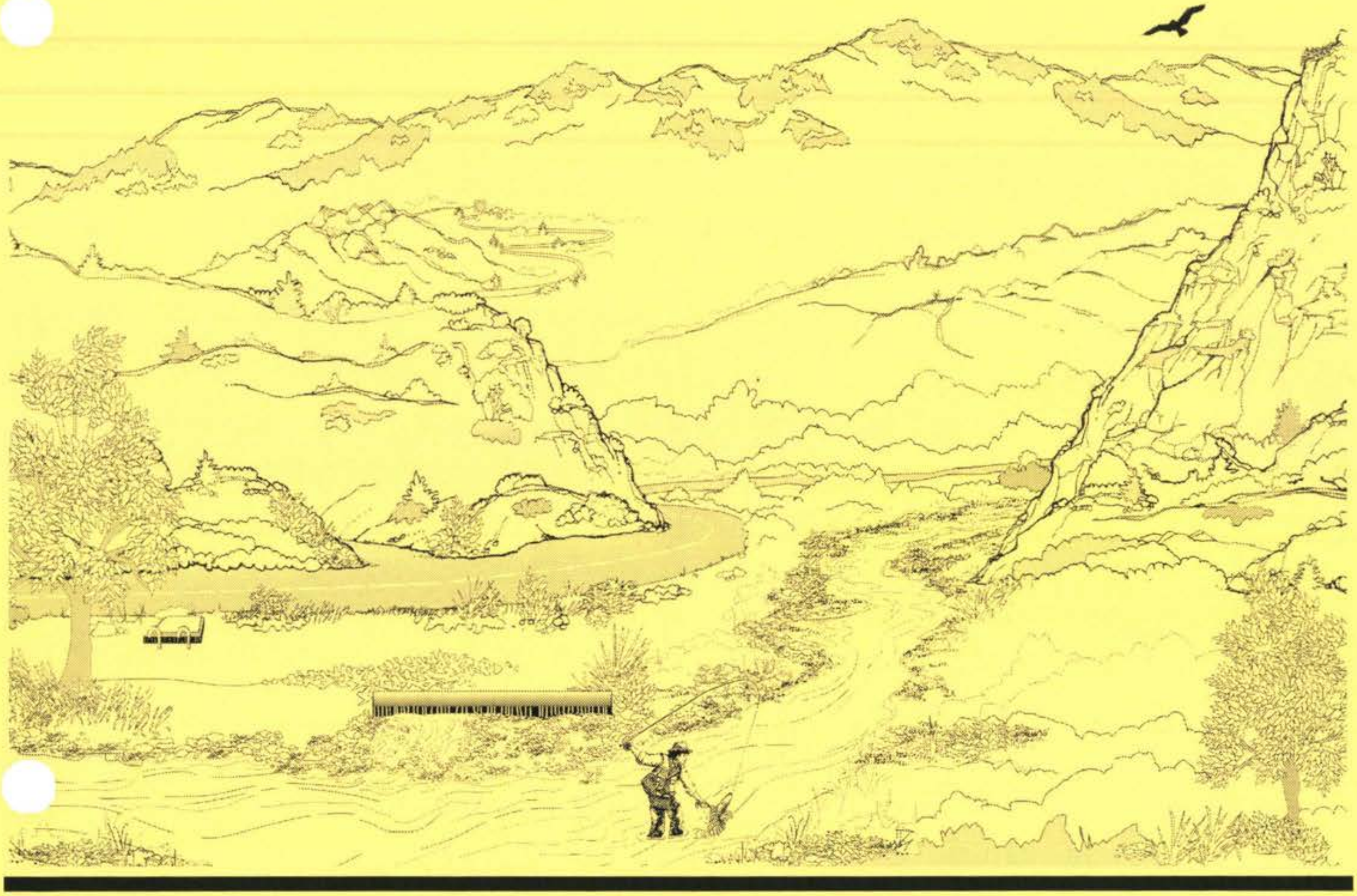
In 1992, Congress took the unprecedented step of establishing a comprehensive water conservation program and instream flow obligations for the CUP. Section 207 of CUPCA, provides specific water conservation goals which are a Project obligation. If the CUWCD fails to meet these water conservation goals, the Secretary of the Interior is authorized to impose financial penalties on the CUWCD.

Section 207 of CUPCA provides $50 million (federal 1992 dollars) to construct water conservation projects at a 65 percent federal and 35 percent local cost share. The initial goal included in the 1994 Water Management Improvement Plan was 39,294 acre-feet of annual conservation. This goal was increased to 49,622 acre-feet in the 1997 update. The conservation goal is to be met in 15 years (2113), with one half the goal (24,811) being met in seven years (2005). To date, there have been 99 applications received and 20 conservation measures funded under CUPCA. When fully implemented, these 20 conservation measures will conserve more than 60,000 acre-feet annually. However, there is no plan to utilize these savings to reduce transbasin diversions so EPA's concern is not being directly addressed in this FS-FEIS.

EPA's approach to water conservation will be included in the next CUP planning effort on the Utah Lake Drainage Basin Water Distribution System. This planning effort will be considering the use of 101,900 acre-feet of CUP Water and future potential changes in use of Strawberry Valley Project water in the Utah Lake Drainage basin. Water conservation as it relates to these municipal and industrial water uses will be included and addressed in the alternatives analysis of the planning/NEPA process for the Utah Lake System. All of the action alternatives considered in the planning/NEPA process for the Utah Lake Drainage Basin Water Distribution System will include the acquisition, or assignment, of the CUWCD's water rights in Utah Lake to the United States.

S.7 Preferred Alternative

The alternative preferred by the joint-lead agencies is the Proposed Action.



Diamond Fork System

Final Supplement to the Final Environmental Impact Statement

Chapter 1
Description of the Proposed Action and No Action Alternative

Chapter 1
Description of the Proposed Action and No Action Alternative

1.1 Introduction

The Diamond Fork System is one of six proposed systems of the Bonneville Unit of the Central Utah Project that would develop central Utah's water resources for irrigation, municipal and industrial supply, fish and wildlife, and recreation. It was first identified in the Bonneville Unit Final Environmental Impact Statement in 1973 (USBR 1973) and described in detail in the Diamond Fork Power System Final Environmental Impact Statement in 1984 (USBR 1984). The Diamond Fork System has been modified over the years and has been partially constructed.

This chapter describes the following:

- History of the Diamond Fork System
- Purpose and need of this final supplement
- How this document is related to other environmental documentation
- Details of proposed features to complete the Diamond Fork System under the Proposed Action or No Action Alternative
- Details on interim operations of the completed system and actions required to allow construction and operation

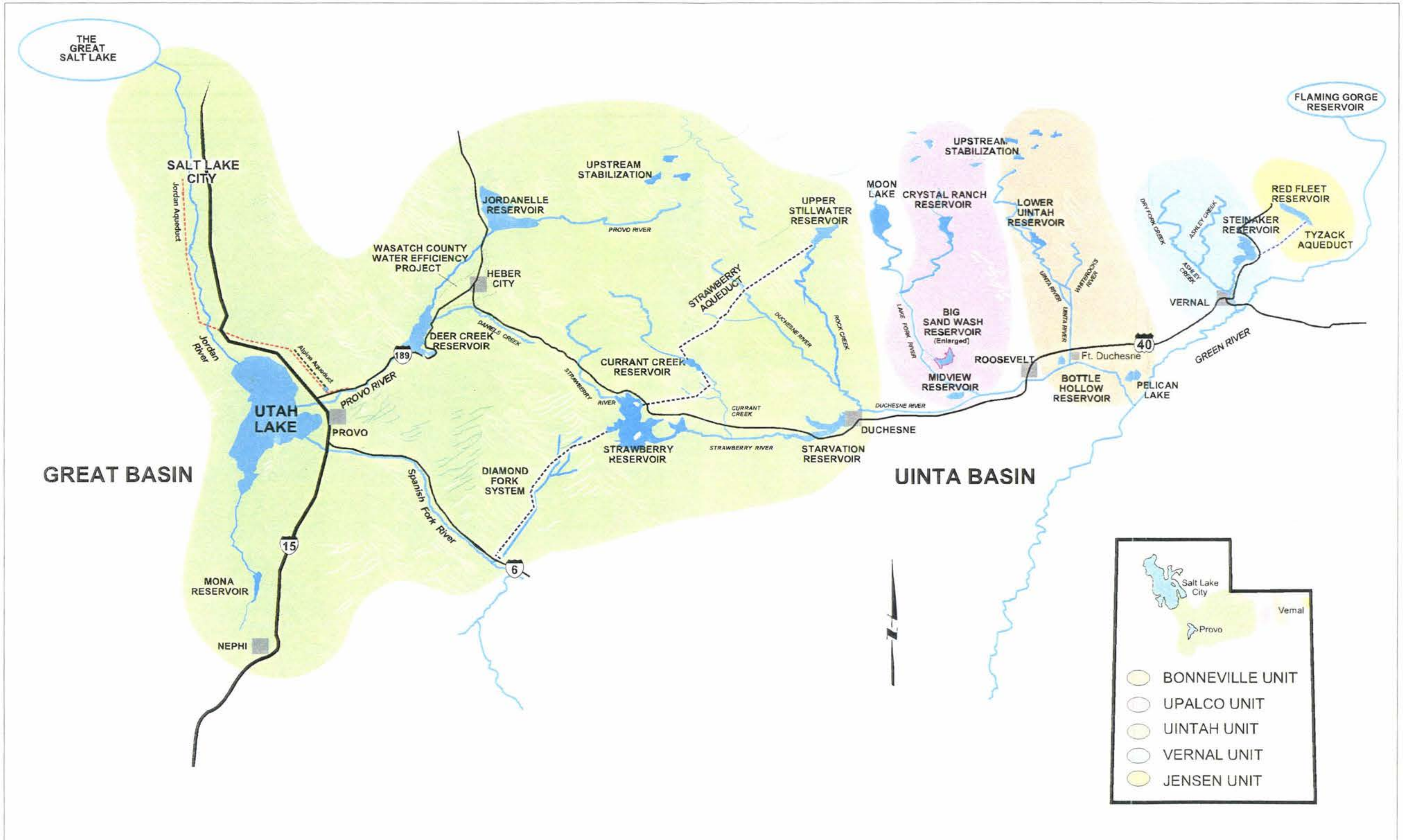
1.1.1 Purpose of This Final Supplement

This Diamond Fork System 1999 Final Supplement to the 1984 Diamond Fork Power System Final Environmental Impact Statement (1999 FS-FEIS) addresses potential impacts related to construction and operation of the features proposed for completing the Diamond Fork System. As joint-lead agencies for this document, the Central Utah Water Conservancy District (CUWCD), the U.S. Department of the Interior (DOI) and the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) will use this FS-FEIS and other relevant materials to plan actions and make decisions. It is intended to satisfy disclosure requirements of the National Environmental Policy Act (NEPA) and will serve as the NEPA compliance document for contracts, agreements and permits that would be required for construction and operation of the Diamond Fork System.

1.1.2 Diamond Fork System History

The Central Utah Project (CUP) (see Map 1-1) was authorized for construction as a participating project under the Colorado River Storage Project Act of 1956 (CRSPA) (43 United States Code [USC] 620). The CUP consists of six individual units: 1) the Vernal Unit, completed in 1962; 2) the Jensen Unit, essentially completed in 1980; 3) the Upalco Unit; 4) the Uintah Unit 5) the Ute Indian Unit; and 6) the Bonneville Unit (including the Diamond Fork System), which has been under construction since 1965. Public Law 102-575, the Central Utah Project Completion Act (CUPCA) of 1992 amended CRSPA, authorized the reevaluation of the Upalco and Uintah Units, and de-authorized the Ute Indian Unit.

The Diamond Fork System allows the transbasin diversion of Bonneville Unit water from Strawberry Reservoir in the Colorado River drainage basin to Spanish Fork Canyon and Utah Lake in the Bonneville Basin. As



Map 1-1
Central Utah Project Units

originally proposed (USBR 1984) the Diamond Fork Power System included Syar, Sixth Water and Monks Hollow dams and reservoirs, and Syar, Sixth Water, Dyne, Monks Hollow and Diamond Fork "flow-through" powerplants and associated power facilities. It also included Syar Tunnel and penstock, Corona Aqueduct and Sixth Water penstock, Dyne Aqueduct and penstock, and the Diamond Fork Pipeline.

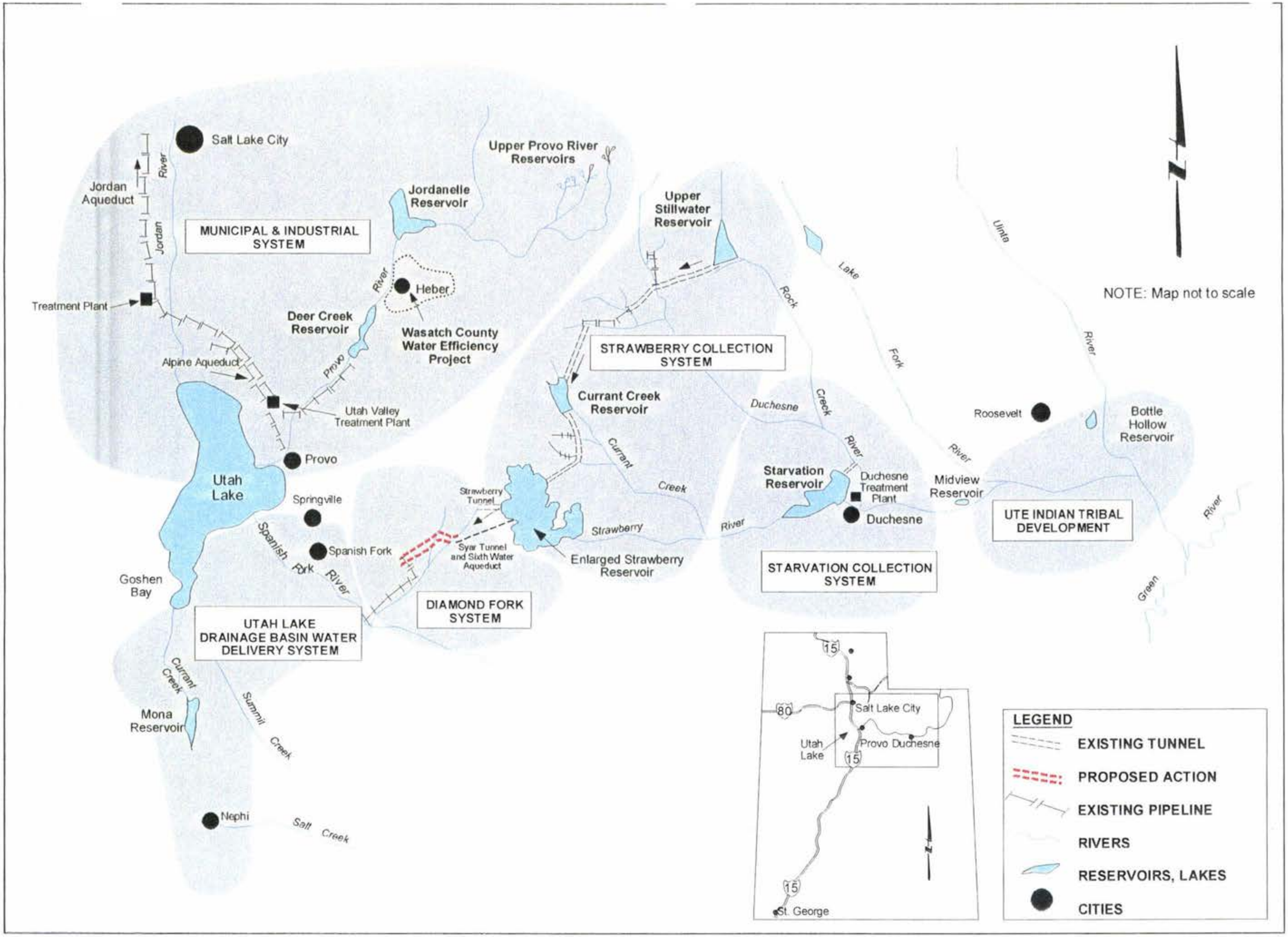
The original plan was modified and reduced in size in 1990 (USBR 1990). Power generation facilities were scaled back and the term "power" was deleted from the name. Features under the modified plan included Syar Tunnel, Sixth Water Pipeline, Sixth Water Shaft, Sixth Water Tunnel, Monks Hollow Dam and Reservoir, Diamond Fork Pipeline, and three flow-through power plants and associated power facilities: Last Chance, Monks Hollow and Diamond Fork.

The partially completed Diamond Fork System is the link between Strawberry Reservoir and the previously proposed Spanish Fork Canyon-Nephi Irrigation System (SFN). The Diamond Fork System would have conveyed water from Strawberry Reservoir through the Wasatch Mountain crest, to Rays Valley into Sixth Water Creek, and through Diamond Fork Canyon to the confluence of Diamond Fork Creek and Spanish Fork River where it would have been connected to the SFN System.

Diamond Fork System features that have been constructed and placed in operation are the Syar Tunnel inlet, Syar Tunnel (including a cross-connection to Strawberry Tunnel as shown in Inset 1, Map A-1 in pocket at back of document) and Sixth Water Aqueduct (see Inset 2, Map A-1). Sixth Water Aqueduct includes two components: Sixth Water Pipeline and Sixth Water Shaft. Since these features have been completed, Strawberry Tunnel no longer conveys the majority of Strawberry Valley Project (SVP) water from Strawberry Reservoir to Sixth Water Creek. Diamond Fork Pipeline has been completed, but is nonfunctional; its use awaits completion of the Diamond Fork System. Syar Tunnel and Sixth Water Aqueduct, which together form a continuous 7.3-mile conduit from Strawberry Reservoir to Sixth Water Creek currently discharges water into Sixth Water Creek approximately 3.5 miles upstream of its confluence with Diamond Fork Creek. The 96-inch-diameter Diamond Fork Pipeline has been completed along Diamond Fork Creek between Monks Hollow to just before where the creek crosses under Highway 6, but the pipeline will not be operable until upstream features are constructed to divert water into it. The purpose of Diamond Fork Pipeline is to reduce flows in Diamond Fork Creek to help enhance existing aquatic and riparian habitat, and to deliver Bonneville Unit and SVP water to Spanish Fork River for delivery to downstream users and Utah Lake.

1.1.3 Bonneville Unit Environmental Documentation History

In August 1973, the U.S. Bureau of Reclamation (USBR) issued the Bonneville Unit Final EIS (USBR 1973). That document was a programmatic Environmental Impact Statement (EIS) for the Bonneville Unit, and provided specific NEPA compliance for construction of the Strawberry and Starvation Collection Systems. Several environmental organizations initiated a legal challenge to that document's adequacy (i.e., Sierra Club v. Stamm). In 1974, the U.S. District Court for the State of Utah ruled that the Bonneville Unit Final EIS was in compliance with NEPA (Ritter 1974). The decision was upheld by the United States Tenth Circuit Court of Appeals. The USBR committed to prepare a site-specific EIS for each of the remaining Bonneville Unit Systems (i.e., the municipal and industrial [M&I], Diamond Fork and Irrigation & Drainage Systems whose name was changed to the SFN System, and is now called the Utah Lake Drainage Basin Water Delivery System) (see Map 1-2) before initiating construction. A draft EIS for the M&I System was issued in April 1979 (USBR 1979b), and a Final EIS was issued in October 1979 (USBR 1979a). A supplement to the M&I System's Final EIS was issued in March 1987 (USBR 1987).



Map 1-2
Bonneville Unit Systems

The Diamond Fork System also has been the subject of previous NEPA compliance activity. A draft EIS was prepared for the Diamond Fork Power System in June 1983 (USBR 1983) and a Final EIS in October 1984 (USBR 1984). Further refinements in the development plan prompted supplemental environmental analyses, resulting in the issuance of the Final Supplement to the FEIS, Diamond Fork System in February 1990 (USBR 1990). The 1990 Final Supplement was issued as a Draft on April 26, 1989, and the Final Supplement was issued on February 22, 1990. Any changes in the environmental analysis of impacts from the 1973 FEIS on Utah Lake and Strawberry Reservoir due to operation of the Diamond Fork and Irrigation & Drainage System (replaced by SFN) were deferred until completion of the anticipated SFN EIS. Based on the 1990 supplement, the USBR Commissioner signed a Record of Decision (ROD) in July 1990 and the DOI Assistant Secretary for Water and Science signed a subsequent ROD in January 1995 for construction of the Diamond Fork Pipeline.

A Draft EIS was prepared on the SFN System (CUWCD 1998b) which replaced the Irrigation & Drainage System. The SFN Draft EIS, released for public review on March 31, 1998, included a Proposed Action that covered features necessary to complete the Diamond Fork System. These features were identified as the "Diamond Fork Tunnel Alternative" portion of the SFN Proposed Action.

1.1.4 Relationship of this Supplement to Previous Environmental Documents

Since it was first planned, each modification of Diamond Fork System has required and received additional environmental analysis and documentation to comply with the NEPA. The 1990 Final Supplement provided the environmental documentation required for the modifications made to the Diamond Fork System Plan as described in the 1984 Final EIS.

Parts of the Diamond Fork System have been completed since the 1990 Final Supplement was issued. However, in order to complete the system, additional modifications have been made to the plan originally described in the 1984 Final EIS and modified in the 1990 Final Supplement. These were included in the SFN Draft EIS that was released for public review and comment in March 1998.

Substantial and significant comments were received on the SFN Draft EIS from the U.S. Environmental Protection Agency (EPA), Utah Department of Environmental Quality, Division of Water Quality and Strawberry Water Users Association (SWUA). The joint-lead agencies determined that a considerable amount of time and effort would be required to resolve the issues raised by the commentors. The significant issues and concerns raised in the comments dealt with purpose and need, and operation of the irrigation portion of the SFN Project and not the features required to complete the Diamond Fork System. Based on previous NEPA documents and decisions, CUWCD developed contractual commitments to make M&I water deliveries in Salt Lake County, Utah County and Wasatch County. To continue a timely construction program to meet these commitments, the joint-lead agencies decided to complete the environmental documentation on the Diamond Fork portion of the SFN Draft EIS. They proposed a final supplement be prepared without issuing a draft supplement in order to complete the required environmental documentation in a timely manner. The Draft SFN EIS would serve as the draft document for the features required to complete the Diamond Fork System.

As required by the U.S. Department of the Interior Manual (516 DM 4.5B), the joint-lead agencies requested consultation with the DOI Office of Environmental Policy and Compliance, DOI Solicitor, and the Council on Environmental Quality (CEQ) to prepare a final supplement without an intervening draft. Approval was given to the joint-lead agencies on August 5, 1998 to proceed with preparing a Final Supplement to the 1984 Diamond Fork Power System Final EIS to cover completion of the Diamond Fork System. In addition to approval from CEQ and DOI officials, the CUWCD Board of Directors passed Resolution 98-08-17 (August 19, 1998) designating the

Diamond Fork Tunnel Alternative as the proposed action for this Final Supplement to the 1984 Diamond Fork Power System Final Environmental Impact Statement (FS-FEIS).

The joint-lead agencies filed two notices of intent that were published in the Federal Register on October 14, 1998 – one to prepare the 1999 FS-FEIS (FR Doc. 98-27483) and the other to discontinue planning on the SFN System as presented in the Draft EIS (DEIS 98-13) and initiate a new planning process, with public involvement, for the facilities authorized in Section 202(a)(1) of CUPCA (FR Doc. 98-27484).

1.2 Purpose and Need

This section describes the purpose and need for the Proposed Action.

1.2.1 Needs

The Proposed Action would respond to the following needs:

1. To maintain the statutorily mandated minimum flows in Diamond Fork Creek and Sixth Water Creek (Sections 303(c)(1)(A) & (B) of Public Law 102-575).

2. To implement the DOI environmental commitments on the Diamond Fork Pipeline from the 1995 ROD, which includes but is not limited to removing the high flows brought over from Strawberry Reservoir (both SVP and CUP water) into the Sixth Water and Diamond Fork creek drainages.

3. To meet the CUWCD's M&I water contractual commitments to Salt Lake, Utah and Wasatch counties, by conveying Bonneville Unit water to Utah Lake (via new features) for exchange to Jordanelle Reservoir and historical Strawberry Valley Project irrigation water.

4. To provide the Mitigation Commission the opportunity and flexibility for future restoration of aquatic and riparian habitat in Sixth Water and Diamond Fork creeks to protect water quality and threatened species in Diamond Fork Creek.

Section 303(c)(1) of CUPCA specifies that operating plans for the Bonneville Unit shall be established or adjusted to maintain minimum streamflows in Sixth Water Creek and Diamond Fork Creek "continuously and in perpetuity" from the first feasible date after the Diamond Fork System is completed. The CUWCD is responsible to establish or adjust the Bonneville Unit yield and operating plans to provide the statutorily mandated minimum streamflows from the date first feasible, as determined by the Mitigation Commission in consultation with the U.S. Fish and Wildlife Service and Utah Division of Wildlife Resources. Therefore, since the CUWCD is responsible for constructing and operating a Diamond Fork System that will deliver those minimum flows, the Diamond Fork System must be designed and completed to meet this CUPCA requirement. The CUWCD and Mitigation Commission will work together to provide the minimum streamflows and flexibility for future research and restoration.

Minimum flows in Sixth Water Creek are to be maintained through releases of water and seepage flow from Strawberry Tunnel as shown in the *Hydrology and Water Resources Technical Memorandum* for the 1999 Diamond Fork System FS-FEIS (CUWCD 1999d). A cross-connection between Syar Tunnel and Strawberry Tunnel (see Inset 1, Map A-1) allows up to 200 cubic feet per second (cfs) of water to flow through Strawberry Tunnel. The required minimum flows at the Strawberry Tunnel outlet are not less than 32 cfs from May through October and not less than 25 cfs from November through April.

Minimum streamflows in Diamond Fork Creek are to be maintained through releases of water from the Diamond Fork System below Diamond Fork Creek Outlet, which also is shown in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d). The required minimum streamflows in Diamond Fork Creek below Diamond Fork Creek Outlet are not less than 80 cfs from May through September and not less than 60 cfs from October through April.

The DOI 1995 ROD (DOI 1995) identified environmental commitments from the 1990 Final Supplement that were applicable to Diamond Fork Pipeline, access road and appurtenant facilities construction. In their Preconstruction Report the CUWCD committed to comply with all environmental commitments associated with construction of the Diamond Fork Pipeline. These commitments would be implemented by the CUWCD and/or the Mitigation Commission and include the following: 1) providing a total capacity of 510 cfs in the Diamond Fork Pipeline to remove project water and SVP flows from Diamond Fork Creek, 2) acquiring public fishing access in the lower 2 miles of Diamond Fork Creek, 3) preparing a General Plan for mitigation measures involving land transfers to other agencies, and 4) monitoring the nesting activity of golden eagles in the Diamond Fork area for 5 years after completion of the project.

Although the DOI 1995 ROD contained a general commitment to remove project water and SVP flows from lower Diamond Fork Creek, this FS-FEIS quantifies the magnitude, timing, and variation of these streamflows, and expands this commitment to include Sixth Water Creek and Diamond Fork Creek from Three Forks to Diamond Fork Creek Outlet. The magnitude, timing, and variation of this instream flow commitment is generally described and documented in Section 1.4.3 for the Proposed Action and Section 1.6.3 for the No Action Alternative. The detailed documentation of this instream flow commitment during the interim operation is included in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d). This FS-FEIS also commits the joint-lead agencies in their planning and NEPA process associated with the Utah Lake Drainage Basin Water Distribution System to provide the transbasin diversion of 101,900 acre-feet and instream flows which would be equal to or less than the instream flows described and documented in detail in the "Draft Water Supply Appendix – March 1998, Supplement to the 1988 Bonneville Unit Definite Plan Report" which was a supporting document to the SFN DEIS. The joint–lead agencies would implement these environmental commitments as required in the 1995 ROD and as expanded, quantified, and documented in this FS-FEIS. The joint-lead agencies acknowledge that the removal of the high flows (historical project water and SVP irrigation deliveries) would result in significant environmental benefits. Although difficult to quantify, some Sixth Water and Diamond Fork creek riverine ecosystem restoration would occur naturally, simply from the removal of these high flows and providing the statutorily mandated minimum streamflows.

Table 1-1 shows the contracts for Bonneville Unit M&I water in Jordanelle Reservoir that require exchanges from Strawberry Reservoir and the annual contracted water amounts.

Under the M&I System plan, the USBR stipulated that Bonneville Unit water conveyed through the Diamond Fork drainage to Utah Lake would be limited to 30,000 acre-feet per year until the Diamond Fork System is completed. This environmental requirement was acknowledged and included in the DOI 1995 ROD on the Diamond Fork Pipeline, access road and appurtenant facilities construction. Continued population growth in Salt Lake County and north Utah County is expected to increase demand for Bonneville Unit water beyond the 30,000 acre-feet by 2002.

The CUPCA directs the Mitigation Commission to administer the mitigation and conservation funds available under the CUPCA to conserve, mitigate and enhance fish, wildlife and recreation resources affected by development and operation of federal reclamation projects in Utah (Section 301(f)(1) of Public Law 102-575). Aquatic and riparian habitat in Sixth Water Creek and Diamond Fork Creek has been affected by high sustained irrigation flows ischarged from Strawberry Tunnel between 1913 and 1996, resulting in erosion and sedimentation of the stream and alteration of habitat. Removal of high irrigation flows and provision of minimum streamflows would allow the

Mitigation Commission to study the affected stream reaches under the new flow regimes and develop future plans to mitigate the impacts from operation of the SVP. The Mitigation Commission would prepare separate NEPA compliance documents prior to implementing any future mitigation plans. The Mitigation Commission needs to have the Diamond Fork System completed to provide the opportunity and flexibility to restore aquatic and riparian habitat in Diamond Fork and Sixth Water creeks to protect future water quality and threatened and endangered species.

Table 1-1
Contracts for Bonneville Unit M&I Water in Jordanelle Reservoir That Require Exchanges From Strawberry Reservoir and Annual Contracted Water Amounts

Name of Entity Contracting With CUWCD	Annual Contract Amount (acre-feet)
Salt Lake County Water Conservancy District	50,000
Metropolitan Water District of Salt Lake City	20,000
Total Salt Lake County Bonneville Unit M&I Water	**70,000**
Town of Vineyard	35
City of Pleasant Grove	2,120
City of Lindon	1,425
Lehi Metropolitan Water District	1,145
City of Highland	1,415
Town of Cedar Hills	710
American Fork Metropolitan Water District	2,095
City of Alpine	1,645
Metropolitan Water District of Orem	7,520
Metropolitan Water District of Provo	1,800
Total North Utah County Bonneville Unit M&I Water	**20,000**[a]
South Utah Valley Municipal Water Users Association	1,590
Total South Utah County Bonneville Unit M&I Water	**1,590**
Wasatch County Special Service Area No. 1	2,400
Total Wasatch County Bonneville Unit M&I Water	**2,400**
Total Bonneville Unit M&I Water	**93,990**

[a] The 1984 EIS identified a total of 20,000 acre-feet of M&I water available for north Utah County. Existing water contracts total 19,910 acre-feet, with an additional 90 acre-feet available that has not yet been contracted.

1.2.2 Purposes

Following are the purposes of the Proposed Action:

1. To provide conveyance of SVP historical diversions into their existing system

2. To minimize adverse impacts on aquatic, riparian and other environmental resources in the Sixth Water and Diamond Fork creek drainages

3. To minimize adverse impacts on threatened and endangered species, wetlands and floodplains

4. To minimize the cost of project features

5. To achieve full repayment by maximizing M&I water deliveries to fulfill outstanding commitments

6. To use existing Diamond Fork System facilities to their full hydraulic capacity

7. To evaluate an alternative to Monks Hollow Dam and reservoir

1.3 Description of the Proposed Action (Diamond Fork System Completion)

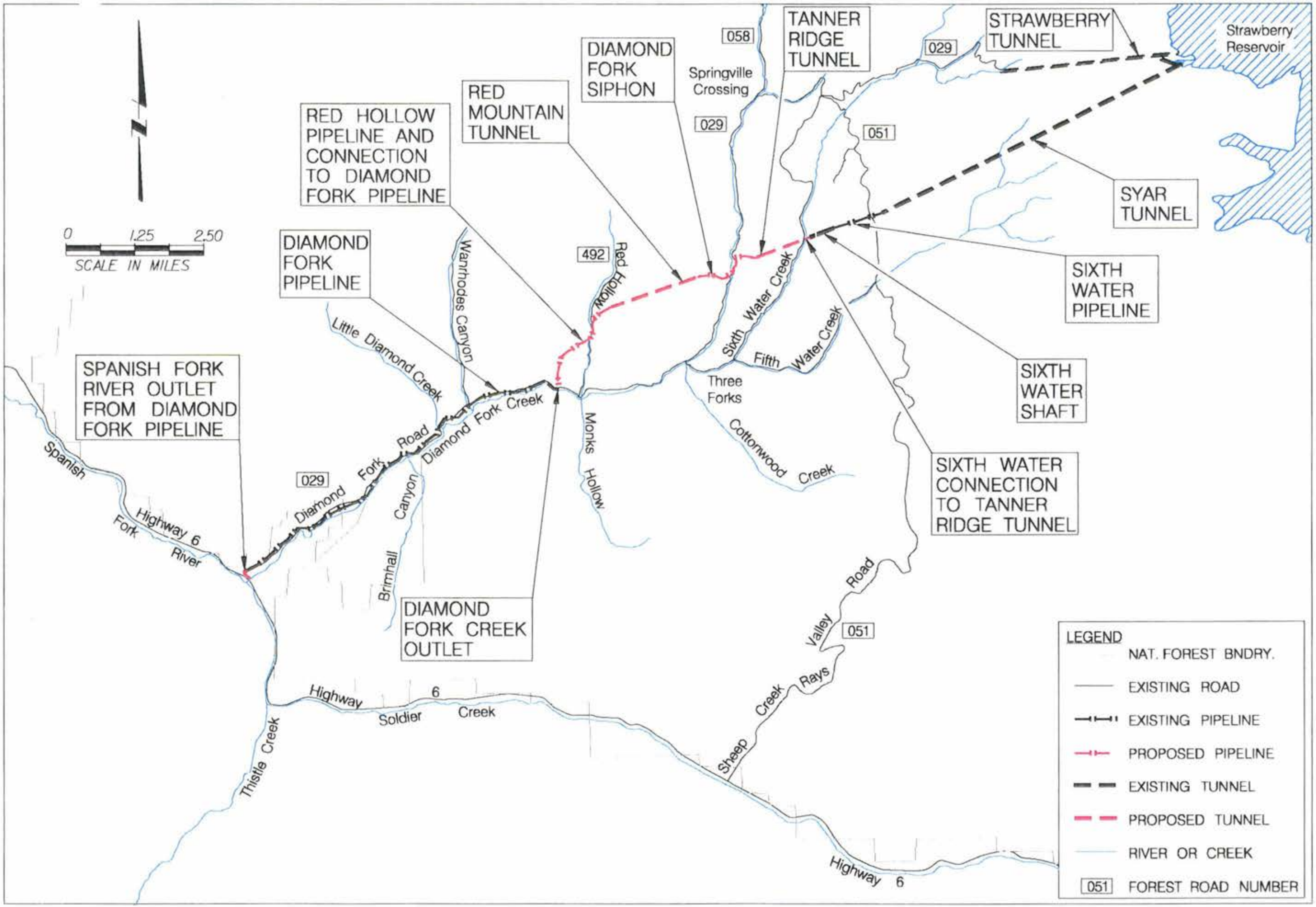
1.3.1 Introduction to the Proposed Action

The Proposed Action was formulated to complete the Diamond Fork System and fulfill the same need, with the least long-term environmental impact, as the Recommended Plan described in the 1984 Diamond Fork Power System FEIS as modified by the 1990 Diamond Fork System FS-FEIS and the DOI 1995 ROD. The development of power features within the Diamond Fork System would be implemented by non-federal entities through a lease-of-power-privilege with the Secretary of the Interior. In compliance with Section 208 of CUPCA, any such power development must be incidental to the delivery of water for other purposes and within the environmental commitments for instream flows in this FS-FEIS. The development of power features within the Diamond Fork System are not covered in this document but would be covered in a separate NEPA document.

The Diamond Fork System would be completed by constructing a series of tunnels and pipelines to convey water through the mountainous terrain of Diamond Fork Canyon and various Diamond Fork drainage tributary canyons in the Uinta National Forest (see Map 1-3). As described in Section 303(f) of CUPCA, the old Strawberry Tunnel only would be used to convey water for minimum streamflows except when "...the District, in consultation with the Commission, has determined that the Syar Tunnel or the Sixth Water Aqueduct is rendered unusable or emergency circumstances require the use of the Strawberry Valley Tunnel for the delivery of contracted Central Utah Project water and Strawberry Valley Reclamation Project water."

The following features are proposed for construction (see Map 1-3 or Map A-1): 1) Sixth Water Connection to Tanner Ridge Tunnel, 2) Tanner Ridge Tunnel, 3) Diamond Fork Siphon, 4) Red Mountain Tunnel, 5) Red Hollow Pipeline and connection to Diamond Fork Pipeline, 6) Diamond Fork Creek Outlet, 7) Spanish Fork River Outlet from Diamond Fork Pipeline, and 8) modifications to Spanish Fork River diversion dams if necessary (see Map A-2). These features would be sized to convey the following: 1) SVP water from Strawberry Reservoir for agricultural use in the Spanish Fork area of southern Utah County, 2) Bonneville Unit Water to Utah Lake, and 3) flows to meet the minimum streamflow requirements mandated by CUPCA.

The Spanish Fork River would be used to convey Bonneville Unit water to Utah Lake and SVP water to diversion dams on Spanish Fork River. The CUWCD would construct, operate and maintain the Diamond Fork System, to provide minimum flows in Sixth Water and Diamond Fork creeks. Minimum flows in Sixth Water Creek (from the Strawberry Tunnel outlet to Diamond Fork Creek) would be not less than 32 cfs from May through October and not less than 25 cfs from November through April. Minimum flows in Diamond Fork Creek (from Diamond Fork



Map 1-3

Features of the Diamond Fork System Proposed Action

Creek Outlet near Red Hollow to Spanish Fork River Outlet) would be not less than 80 cfs from May through September and not less than 60 cfs from October through April.

Five other alternatives for completing the Diamond Fork System were examined to determine their feasibility and were eliminated from detailed analysis (see Section 1.10).

1.3.2 Diamond Fork System Features

The primary features of the Diamond Fork System are presented in the following subsections. Table 1-2 shows the feature name, length, diameter and capacity. Map A-1 shows the location of these features and detailed insets of some features.

Table 1-2
Diamond Fork System Proposed Action Features

Feature Name/Map A-1 Location	Length (miles)	Diameter (inches)	Capacity (cfs)
Sixth Water Connection to Tanner Ridge Tunnel (Inset 2)	0.02	108	660
Tanner Ridge Tunnel (upper right)	0.99	114	660
Diamond Fork Siphon (Inset 3)	1.20	96	660
Red Mountain Tunnel (upper middle)	1.84	114	660
Red Hollow Pipeline and connection to Diamond Fork Pipeline (Inset 4)	2.24	96	660
Diamond Fork Creek Outlet (Inset 4)	0	96	660
Spanish Fork River Outlet from Diamond Fork Pipeline (Inset 5)	0.45	96	560
Total Length	**6.74**		

1.3.2.1 Sixth Water Connection to Tanner Ridge Tunnel

Sixth Water Connection would be a pipeline crossing under Sixth Water Creek. This pipeline would convey water from the existing outlet structure at the end of Sixth Water Aqueduct to the Tanner Ridge Tunnel inlet portal on the opposite side of Sixth Water Creek (see Inset 2, Map A-1). An inlet box would be constructed adjacent to the existing weir, which is part of the existing flow-control facility, with an overflow weir that would allow a discharge of water from Sixth Water Aqueduct to Sixth Water Creek.

The existing Sixth Water Aqueduct outlet bifurcation would accommodate hydroelectric generating facilities. The new connection inlet to Tanner Ridge Tunnel would not prevent the non-federal development of hydroelectric generating facilities. The 108-inch-diameter pipeline would be about 100 feet long with a capacity of 660 cfs and would connect the inlet box to the Tanner Ridge Tunnel inlet portal. The mortar-lined steel pipe would be encased in concrete beneath the natural grade of Sixth Water Creek. The connection structure also would include a 36-inch outlet pipe and valve capable of discharging 60 to 80 cfs to Sixth Water Creek. This outlet would provide emergency release of the minimum streamflows if the Tanner Ridge or Red Mountain tunnels have to be shut down for maintenance. It also would provide flexibility for any future Sixth Water Creek restoration plans. A 32-foot-wide pad would be constructed for crane access to maintain the connection and Tanner Ridge Tunnel.

1.3.2.2 Tanner Ridge Tunnel

Tanner Ridge Tunnel would convey water through Tanner Ridge, which lies between Sixth Water Canyon and Diamond Fork Canyon (see upper right, Map A-1). The concrete-lined, 660 cfs tunnel would be about 5,230 feet long with a finished diameter of 114 inches. The tunnel inlet portal would be near the same elevation as the outlet of Sixth Water Connection at the bottom of Sixth Water Canyon. Tunnel access would be through the connection inlet box on the east side of Sixth Water Creek. The outlet portal would be in Diamond Fork Canyon, 2.3 miles upstream of Three Forks. It would be set back horizontally 2,250 feet from the creek, about 385 feet higher than Diamond Fork Creek. There would be no permanent equipment access at the portal, but a permanent, 30-inch-diameter, limited-access portal would provide access for maintenance personnel. A helicopter pad would be constructed near the portal to provide access to the site by maintenance personnel.

1.3.2.3 Diamond Fork Siphon

Diamond Fork Siphon (see Inset 3, Map A-1) would feature a pipeline through Diamond Fork Canyon with a crossing under Diamond Fork Creek, forming the connection between the Tanner Ridge Tunnel outlet and the Red Mountain Tunnel inlet. The pipeline connection with the Tanner Ridge Tunnel outlet would have a screened vent to release air from the tunnel and pipeline.

The 96-inch-diameter pipeline would be about 6,340 feet long, with a capacity of 660 cfs. It would descend 400 vertical feet from the Tanner Ridge Tunnel outlet to the floor of Diamond Fork Canyon for about 2,065 linear feet; continue in a downstream direction along the east side of the canyon bottom for about 2,000 linear feet; cross under Diamond Fork Creek for 60 linear feet; and then ascend the west side of Diamond Fork Canyon for about 2,275 linear feet to the Red Mountain Tunnel inlet portal.

Along the bottom of Diamond Fork Canyon, the pipeline would be constructed under the road right-of-way and outside the riparian zone, except where it crosses under the creek. Along the 1,440-foot pipeline segment in the canyon bottom, the road would be raised 6 to 10 feet, moving it away from the edge of Diamond Fork Creek. Permanent slopes would be cut above the road to accommodate pipeline construction. The pipeline would cross the creek under the natural grade of the creek with a cement-lined steel pipe encased in concrete. A blow-off vault with a valved discharge pipe to the creek would be located on the west side of the creek at the pipeline crossing. It would discharge water from Diamond Fork Siphon and Tanner Ridge Tunnel if the Diamond Fork System is shut down for maintenance. Pipeline construction would require a temporary 150 foot-wide right-of-way which would be reduced to a permanent 50 foot-wide right-of-way after construction is completed.

1.3.2.4 Red Mountain Tunnel

Red Mountain Tunnel would convey water through Red Mountain, which lies between Diamond Fork Canyon and Red Hollow (see Map A-1). The steel and concrete-lined, 660-cfs tunnel would be about 9,700 feet long, with a finished diameter of 114 inches. The tunnel inlet portal would be connected to Diamond Fork Siphon. Air would be released from the pipeline and tunnel through a screened vent at the siphon connection with the Red Mountain Tunnel inlet portal. The inlet portal would be about 430 feet higher than the floor of Diamond Fork Canyon. There would be no permanent equipment access at the portal, but a permanent, 30-inch-diameter, limited-access portal would provide access for maintenance personnel. A helicopter pad would be constructed near the portal to provide access to the site by maintenance personnel. The tunnel outlet portal with a permanent access portal would be constructed in Red Hollow about 1.8 miles upstream from Diamond Fork Creek and 220 feet above the bottom of Red Hollow.

1.3.2.5 Red Hollow Pipeline and Connection to Diamond Fork Pipeline

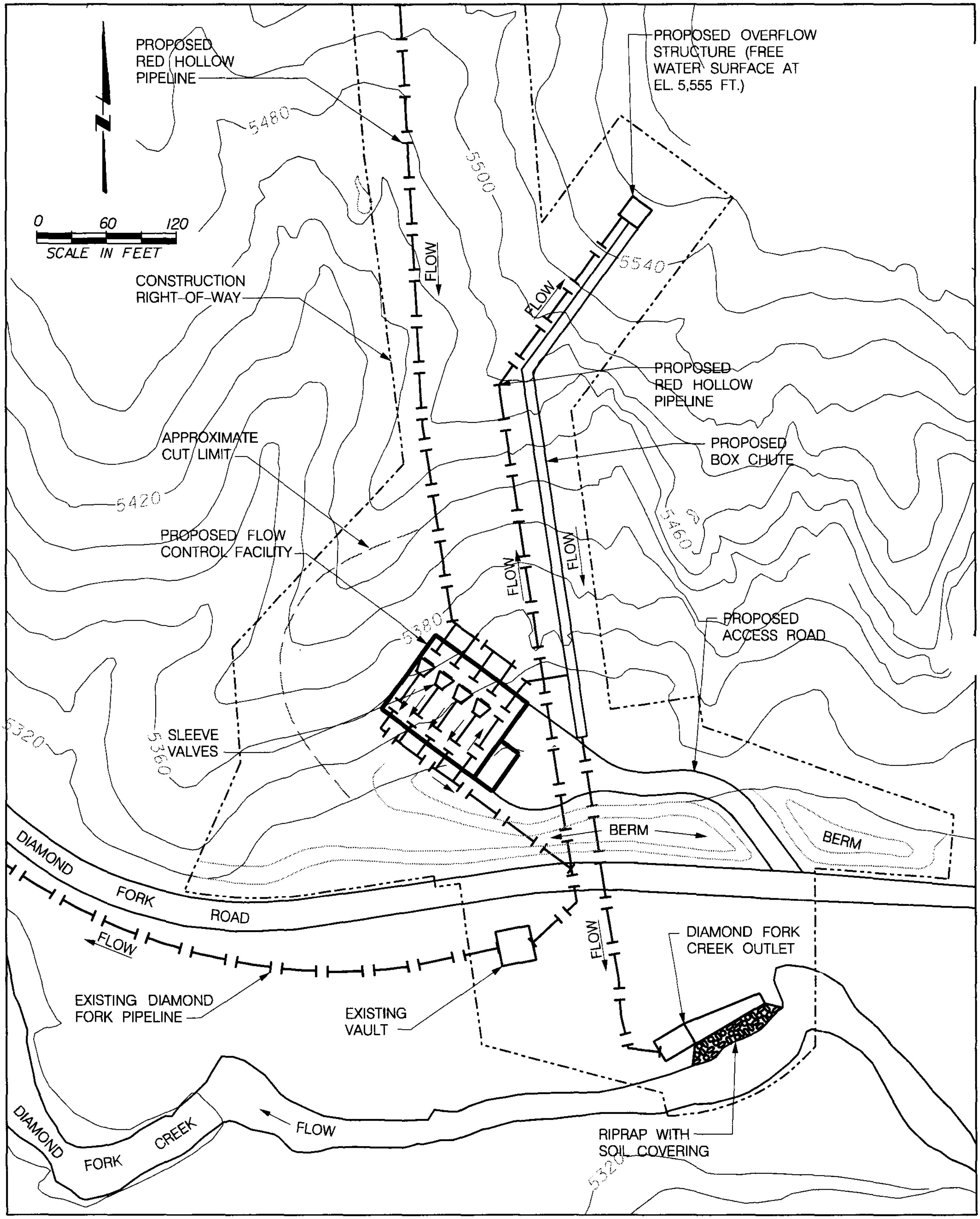
The Red Hollow Pipeline would connect the Red Mountain Tunnel outlet portal to the upstream end of the existing Diamond Fork Pipeline (see Inset 4, Map A-1). The 96-inch-diameter pipeline would be about 11,700 feet long, with a capacity of 660 cfs. Air would be released from the pipeline and tunnel through a screened vent at the pipeline connection with the Red Mountain Tunnel outlet. From the Red Mountain Tunnel outlet, the pipeline would descend west into Red Hollow for about 4,040 linear feet, cross under the creek bed, and ascend the west side of Red Hollow for about 700 linear feet. One air release valve would be located between the tunnel outlet portal and the creek crossing.

The location of the creek bed crossing would be selected to minimize disturbance of riparian vegetation at the edge of the creek channel. The pipeline would cross beneath the natural grade of the creek with a concrete-lined steel pipe. A blow-off vault at the pipeline crossing would have a valved discharge pipe to the creek that would discharge water from Red Mountain Tunnel and part of Red Hollow Pipeline if the Diamond Fork System is shut down for maintenance. The pipeline would continue west of Red Hollow over a low saddle, then turn south and descend into Diamond Fork Canyon at the upstream end of Diamond Fork Pipeline. This reach is about 5,660 linear feet and includes four air release valves.

Map 1-4 shows the flow control facility and overflow structure that would be constructed at the end of the pipeline. The flow control facility, adjacent to Diamond Fork Road across from the upstream end of Diamond Fork Pipeline, would dissipate pressure buildup resulting from the elevation difference (about 1,000 feet) between the Red Mountain Tunnel outlet and the end of Red Hollow Pipeline. It would be designed to accommodate a hydroelectric generating plant at the end of Red Hollow Pipeline under a lease-of-power privilege under future nonfederal funding. A pipeline parallel to Red Hollow Pipeline would convey water back up the slope for about 660 linear feet to a buried overflow structure with an internal weir at elevation 5,555 feet. The overflow structure would be required to maintain the existing design head for Diamond Fork Pipeline. The weir would discharge water back down the slope through an 8- by 12-foot concrete box chute with baffles for about 600 linear feet and then into a 180-foot-long, 96-inch pipeline to Diamond Fork Creek. Construction of the Red Hollow Pipeline and connection to Diamond Fork Pipeline would require a temporary 150 foot-wide right-of-way which would be reduced to a permanent 50-foot-wide right-of-way after construction is completed.

1.3.2.6 Diamond Fork Creek Outlet

The Diamond Fork Creek Outlet would be constructed where Red Hollow Pipeline would connect to Diamond Fork Pipeline near Monks Hollow (see Inset 4 on Map A-1, and Map 1-4). The outlet would be about 2,500 feet downstream from the confluence of Red Hollow, Monks Hollow and Diamond Fork Creek, as shown on Map A-1. The outlet would consist of a baffled outlet connected to the 96-inch-diameter, 660-cfs pipeline and a covered weir discharging to Diamond Fork Creek. The baffled outlet would dissipate pressure buildup due to the elevation difference (about 250 feet) between the elevation 5,555 overflow weir and the Diamond Fork Creek outlet structure. The outlet would release water from the pipeline to the creek to meet minimum streamflow requirements and discharge to the creek if Diamond Fork Pipeline requires an emergency shutdown. Riprap would be placed on the bank between the covered weir and the creek.



Map 1-4

Proposed Red Hollow Pipeline Overflow Structure, Flow Control Facility and Diamond Fork Creek Outlet

1.3.2.7 Spanish Fork River Outlet from Diamond Fork Pipeline

The 96-inch Spanish Fork River Outlet pipeline would connect to the 560 cfs Diamond Fork Pipeline south terminus at the concrete air release/manway vault along Diamond Fork road near Highway 6 (see Inset 5, Map A-1). It would extend about 1,150 feet to a new Spanish Fork River flow control facility (with an energy dissipater) at the northwest corner of the Highway 6 and Diamond Fork Road intersection. The pipe would continue 1,250 feet from the flow control facility, under Diamond Fork Road, and across the toe of the highway embankment to the box culvert that conveys Diamond Fork Creek under the Highway 6 embankment. The pipeline would be connected to the box culvert inlet. At the point of discharge, the bottom of the box culvert would be reinforced and baffles would be installed. The water would flow into and through the Highway 6 embankment culvert, through the railroad embankment culverts, and into the Spanish Fork River.

1.3.2.8 Spanish Fork River Diversions

Six existing dams and diversions along the Spanish Fork River from Diamond Fork Creek to Utah Lake would be involved in passing the flows generated under the Proposed Action (see Map A-2). If the increased flows required under the Proposed Action can not be passed by the existing structures it may become necessary to modify them. If it becomes necessary, five of the diversions would require modifications to bypass flows and to provide fish passage. In order to cover the possibility that they may need modification the impact of modifications are included in this FS-FEIS.

1.3.2.8.1 Spanish Fork Diversion Dam. The Spanish Fork Diversion Dam has three radial gates in the main channel of the Spanish Fork River. One of the gates would be modified and automated; the channel would be extended approximately 80 feet and a flow measurement device installed; and the end of the extended channel would be riprapped to avoid increased erosion of the river bed.

1.3.2.8.2 East Bench Dam. The East Bench Dam has two radial gates in the main Spanish Fork River channel and a submerged radial gate at the inlet of the diversion canal. A new channel, approximately 230 feet long, would be built on the opposite side of the river from the diversion canal. This channel would include a new radial gate at its inlet, energy dissipater and flow measurement device. The outlet would be riprapped to reduce erosion of the river bed.

1.3.2.8.3 Salem-South Field Diversion. The Salem-South Field Diversion has two slide gates adjacent to a 6-foot-wide spillway formed into a low dam that extends across the main channel of Spanish Fork River. The slide gates lead to a 4-foot-wide concrete diversion channel, which terminates at the connection to a 24-inch-diameter pipe. At higher flows, the spillway and dam are submerged. This diversion is used sporadically and is not expected to require any modifications.

1.3.2.8.4 Mill Race Diversion. This diversion includes a spillway and one radial gate in the main Spanish Fork River channel just downstream from the outlet of the Power Canal and an unused diversion channel adjacent to the diversion channel. A new radial gate would be installed on the unused diversion channel; the existing channel would be extended approximately 70 feet to the main Spanish Fork River channel; the new channel would include an energy dissipater and flow measurement device; and its outlet would be riprapped to reduce erosion of the river bed.

1.3.2.8.5 Lake Shore Diversion. This diversion has a radial gate in the main Spanish Fork River channel and a timber slide gate at the inlet of the Lake Shore diversion canal. A new channel (approximately 240 feet long) would be constructed on the opposite side of the river from the Lake Shore diversion canal. It would include a radial gate, energy dissipater and flow measurement device. The outlet would be rip-rapped to reduce erosion of the river bed.

1.3.2.8.6 Huff Dam. Rebuilt in 1991, this dam has a gate structure in the main Spanish Fork River, an irrigation diversion canal on each side of the river, and a temporary construction bypass pipe on the east side of the structure. Modifications would consist of installing a radial gate at the inlet of the bypass pipe, an energy dissipater, and a flow measurement device; riprapping the outlet end of the pipe to reduce river bed erosion; and extending the irrigation diversion on the east side of the dam by about 80 feet.

1.3.3 Land Management Status and Right-of-Way Acquisition

The land that would be required to construct and operate the features of the Proposed Action consists of National Forest System and State of Utah land. Permanent rights-of-way would be required for the features, and temporary rights-of-way would be required during construction to provide space for equipment operation and staging areas. The permanent rights-of-way for the siphons and pipelines and other associated features would be 50 feet wide. The permanent rights-of-way at tunnel portals would be 150 feet wide and extend 100 feet out from the portals. During construction, an additional average 100 feet of right-of-way would be required to accommodate the construction activities. Some of the National Forest System land that would be required has already been withdrawn by USBR for the Diamond Fork System (see Map 1-5). For this FS-FEIS, it is assumed that CUWCD would have to acquire a Forest Service Special Use Permit for land not yet withdrawn. However, DOI is working with the Forest Service and the Bureau of Land Management (BLM) to withdraw additional lands required for the project and to revoke previous USBR withdrawals that are not needed for the project. If the lands are withdrawn before construction is scheduled, the permits with the Forest Service listed in Table 1-38 would not be necessary. Also, a right-of-way from the Utah Department of Transportation would be required for construction of the Spanish Fork River Outlet.

1.3.4 Tunnel Construction Procedures

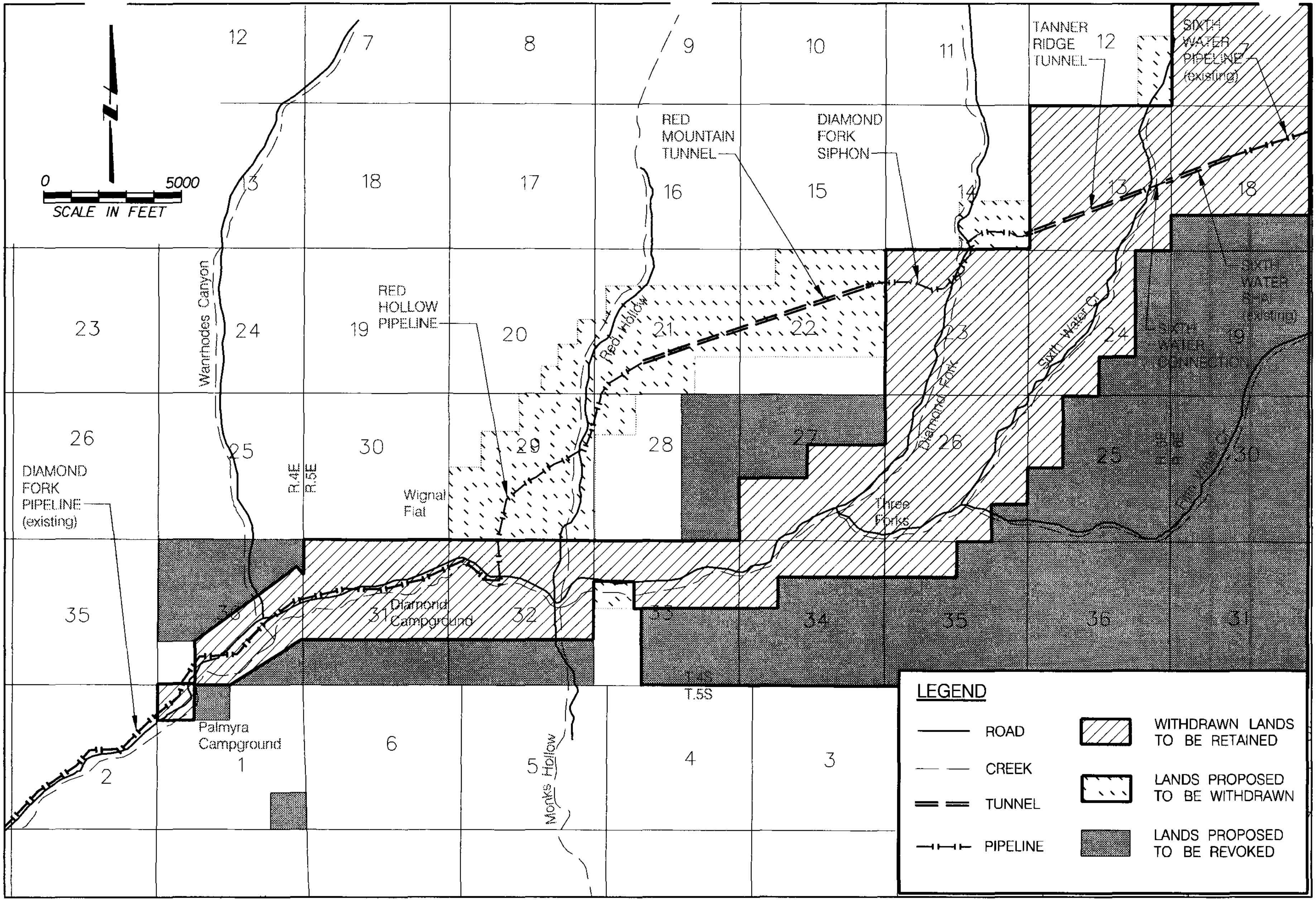
1.3.4.1 Construction Sequence

The construction sequence for each tunnel would involve the following activities:

- Construct access roads and staging areas
- Construct outlet portal area, shot rock and tunnel muck storage area
- Assemble tunnel equipment plant at outlet portal
- Construct tunnel inlet structure
- Tunnel boring and removal/disposal of tunnel spoil
- Disassemble tunnel equipment plant at inlet portal
- Install tunnel lining (concrete) and steel liner at tunnel portals
- Construct tunnel outlet structure
- Connect tunnel to pipeline

Tunnel construction would begin at the Tanner Ridge Tunnel outlet portal, advance through Tanner Ridge, and end at the Tanner Ridge Tunnel inlet portal. The outlet portal construction would require a 125-foot-wide base cut and a 200-foot-wide top cut. Construction of the Tanner Ridge Tunnel inlet portal probably would be finished before Tanner Ridge Tunnel is completed.

Construction of Red Mountain Tunnel would follow construction of Tanner Ridge Tunnel, starting at the Red Mountain Tunnel outlet portal and proceeding through to the inlet portal. The outlet portal construction would require a 125-foot-wide base cut and a 190-foot-wide top cut. Construction of the Red Mountain Tunnel inlet por probably would be finished before Red Mountain Tunnel is completed.



Map 1-5

Land Management Status

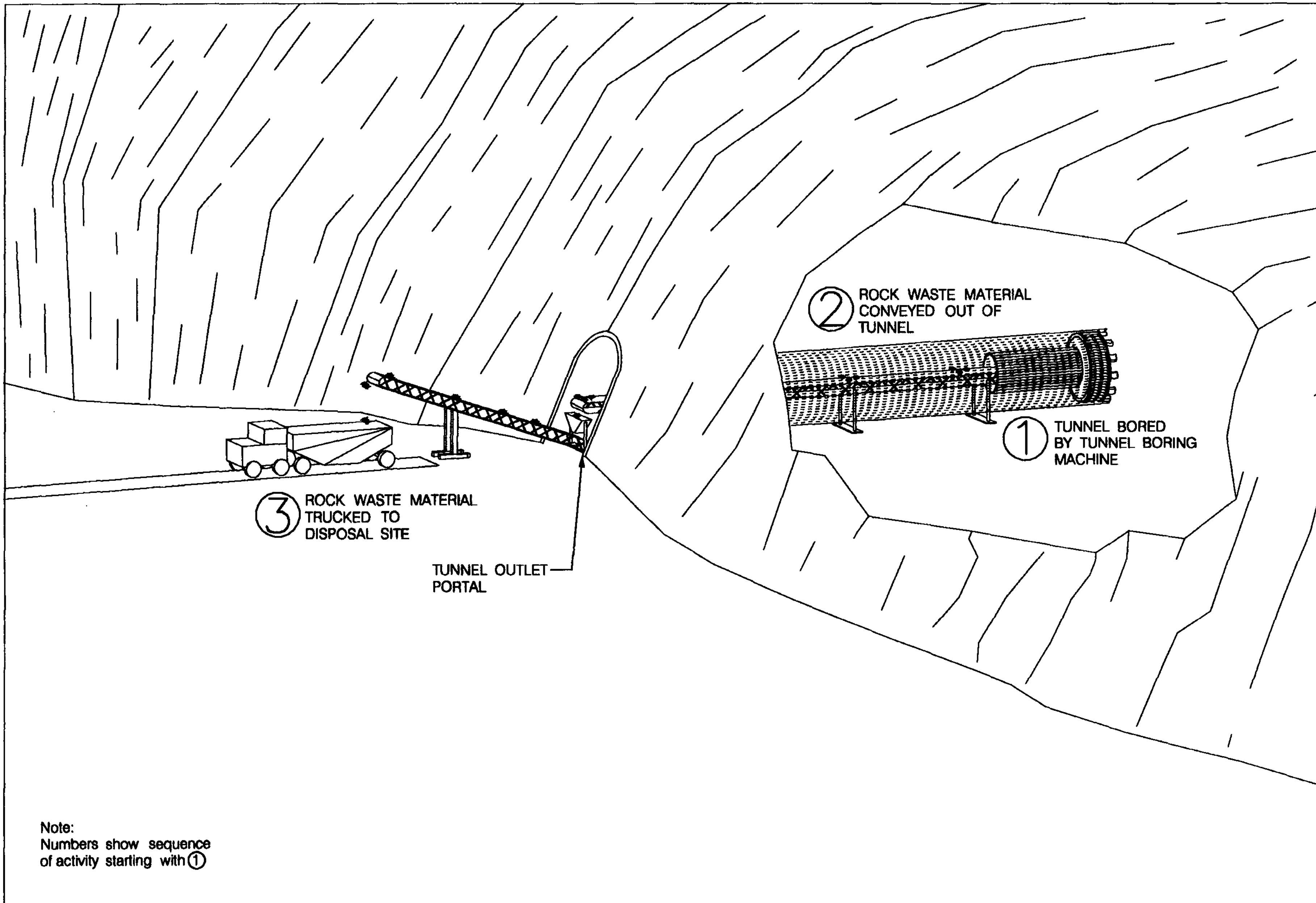


Figure 1-1

Schematic Drawing of Typic-' Tunnel Boring Sequence

The Tanner Ridge and Red Mountain tunnels likely would be excavated with a tunnel boring machine (see Figure 1-1, tunnel boring sequence). Other tunnel construction methods that could be used are roadheader or drill-and-blast. The excavated tunnels would be lined with reinforced concrete to prevent cave-ins, control groundwater infiltration and exfiltration, and provide a smooth lining surface. Welded steel pipe would be used instead of reinforced concrete at each end of the tunnels to control leakage from the tunnels.

1.3.4.2 Construction Utilities

Electricity and water would be needed to support tunnel drilling. Electricity would be generated on-site with diesel or gasoline-powered electric generators at each tunnel outlet portal or construction portal. Operation of the generators would require above-ground diesel storage tanks, spill containment plans and bermed containment areas around the tanks. The tanks would be regularly refilled by tank trucks that would haul the fuel to the tunnel outlet facilities during construction.

Water to support tunnel operations would be pumped from Sixth Water Creek at Sixth Water Aqueduct for construction of the Tanner Ridge Tunnel and from Diamond Fork Creek at Red Hollow for construction of the Red Mountain Tunnel. In both cases, the water would come from Bonneville Unit water conveyed through Strawberry Tunnel. This supply would be pumped through a flexible hose laid on the ground (over Tanner Ridge for the Tanner Ridge Tunnel and along the Red Mountain Tunnel access road for the Red Mountain Tunnel). A small water tank would be installed at the tunnel portal to provide storage. The pump would be surrounded with a fuel containment berm and operated under a spill containment plan.

1.3.4.3 Spoil Management and Disposal

Construction of the Tanner Ridge Tunnel (inlet and outlet portals and tunnel) would generate about 46,500 cubic yards of earth (muck) and shot rock, which would be disposed in a spoil pile on a north-facing slope immediately southwest of the outlet portal (see Inset 3, Map A-1). After clearing and grubbing the shot rock storage area, surface soils and colluvium would be excavated and stockpiled for site reclamation. The shot rock would be placed in a deposit from 1 to 10 feet deep with 1.5 horizontal to 1 vertical side slopes and a maximum 3.2 horizontal to 1 vertical slope on top of the fill.

The muck would be hauled or conveyed from the outlet portal and temporarily stored on top of the shot rock spoil pile area (see Inset 3, Map A-1). After completing the tunnel connection with the Diamond Fork Siphon, the tunnel muck would be hauled or conveyed to fill the excavated area at the outlet portal. The pre-excavation, intermittent drainageway would be reestablished over the top of the muck fill after it is machine compacted, then covered by an 18-inch layer of surface soil and colluvium and a 24-inch layer of rock riprap in the channel. The remaining muck fill would be machine compacted, covered with stockpiled surface soil and colluvium, and planted with shrub transplants to restore vegetative cover. The Tanner Ridge Tunnel shot rock storage area also would be covered with stockpiled surface soil and colluvium and planted with shrub transplants to restore vegetative cover.

The shot rock storage area would cover about 4 acres, and the outlet portal construction area would cover 1 acre.

Construction of the Red Mountain Tunnel (inlet and outlet portals and tunnel) would generate about 73,800 cubic yards of earth and shot rock, which would be disposed in a combined shot rock and tunnel muck spoil pile adjacent to the outlet portal on a southwest-facing slope immediately below the outlet portal (see Inset 4, Map A-1). After clearing and grubbing the shot rock and tunnel muck storage area, surface soils and colluvium would be excavated and stockpiled for site reclamation. The shot rock would be placed in a deposit from 1 to 12 feet deep with 2 horizontal to 1 vertical side slopes and a 2.4 horizontal to 1 vertical slope or flatter on top of the fill.

The muck would be hauled or conveyed from the outlet portal and permanently deposited over the top of the spoil pile area immediately below the outlet portal (see Inset 4, Map A-1). The muck fill would be machine compacted, covered with topsoil and planted with shrub transplants to restore vegetative cover.

The outlet portal construction area would cover 0.9 acre, and the shot rock and tunnel muck storage area would cover about 4.3 acres.

1.3.5 Pipeline Construction Procedures

Figure 1-2 illustrates the general steps for constructing a buried pipeline.

1.3.5.1 Construction Sequence

Construction of the pipelines would occur in the following sequence:

- Construct access roads
- Clear and grade pipeline alignments
- Excavate trench for pipe installation
- Haul pipe to construction sites
- Place pipe along trenches
- Place pipe in trenches and connect pipe
- Backfill trenches and grade surface
- Clean up and restore areas disturbed by construction

1.3.5.2 Clearing and Grading

Clearing would be performed in accordance with the Special Use Permit issued by the Uinta National Forest if the land withdrawal has not been completed, or in accordance with an agreement if the withdrawal has been completed. Vegetation and obstacles would be cleared as necessary to allow safe and efficient use of construction equipment. Debris from right-of-way preparation would be disposed in accordance with any applicable regulations, permits or agreements. Right-of-way grading would be limited to that necessary to ensure safe and efficient movement of machinery. Topsoil would be stripped where possible and stockpiled for use in site revegetation. Temporary bridges or culverts across creeks on the right-of-way may need to be constructed to ensure vehicle safety and to reduce harmful environmental effects. Rights-of-way would be graded to minimize effects on drainage and slope stability. Steep terrain, where the right-of-way must be terraced to provide a level temporary work area, would be restored after construction to approximate original contours.

1.3.5.3 Pipe Trench Excavation

The open trench method would be used for the Diamond Fork Siphon and Red Hollow Pipeline (see Figure 1-2). The trench would accommodate 96-inch-diameter pressure pipelines with a depth of cover averaging about 7 feet. The pipeline trenches would be excavated with crawler-tracked excavators and sloped or shored to meet OSHA standards to protect workers from cave-ins. Jackhammers and blasting may be required to excavate the trench in rock. Much, if not all, of the excavated material would be unsuitable for pipe backfill and would be disposed along the trenches in ways that blend with adjacent terrain.

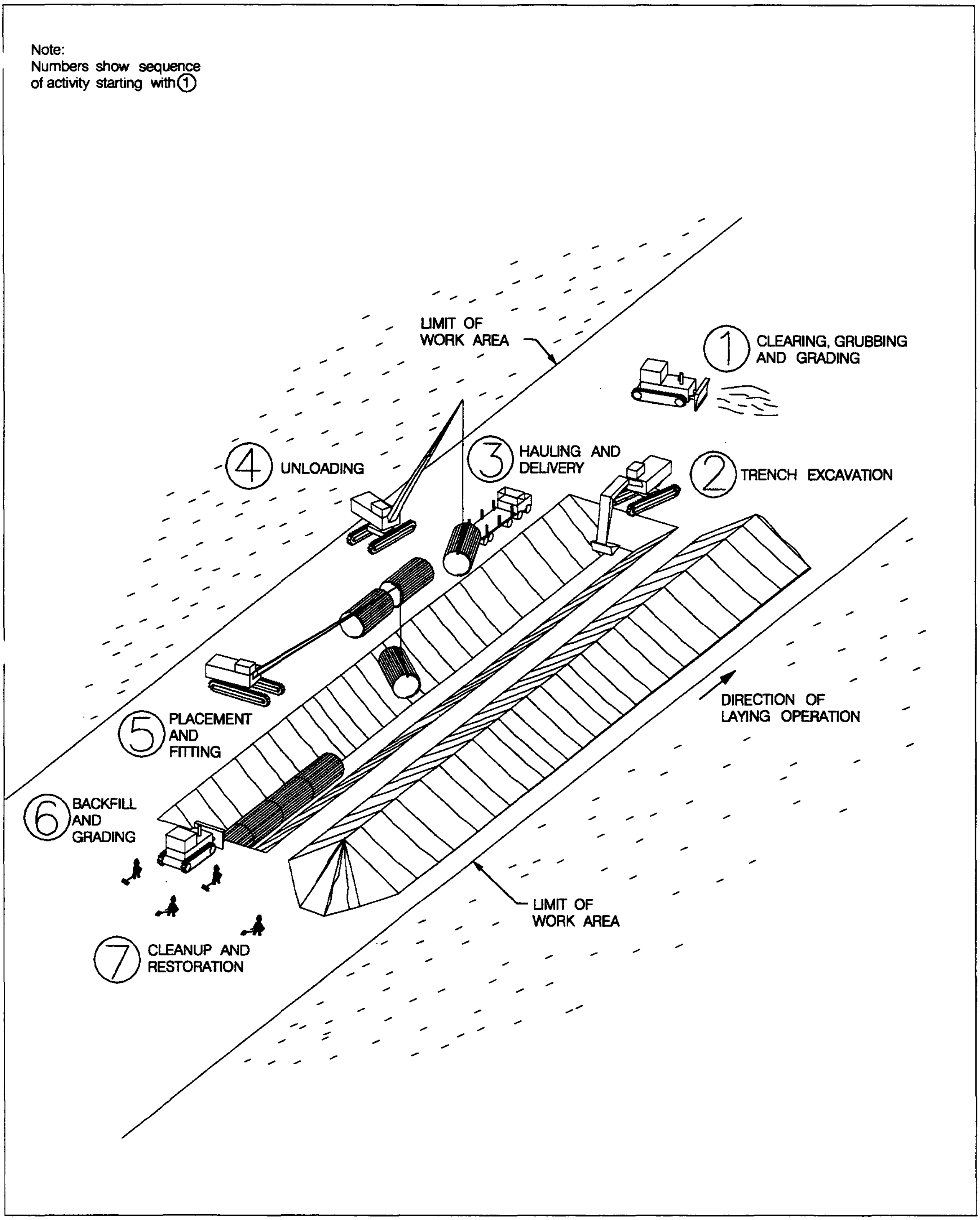


Figure 1-2

Schematic Drawing of Typical Pipeline Construction Procedures

The Sixth Water Connection would consist of a 108-inch-diameter pressure pipeline with minimum cover that would exceed the scour depth of Sixth Water Creek under design flow conditions. Excess material would be disposed in the existing spoil disposal area adjacent to the Sixth Water Aqueduct access road utilized during construction of the Sixth Water Aqueduct.

Rippers, hammers, blasting or other specialized equipment may be required for excavation in rocky areas. If blasting is required, all blasting operations, including transportation, storage and handling of explosives and blasting agents, would be in conformance with county, state and federal regulations.

1.3.5.4 Pipe Installation

The steel, mortar-lined pipe would be shipped to the job site from the manufacturer by rail and/or truck in lengths up to 40 feet and unloaded by crane (see Figure 1-2).

Pipe would be installed in lengths up to 40 feet and would be transported from a Diamond Fork Road staging area near Monks Hollow to the work site by flatbed truck and/or specially outfitted loaders. Pipe bedding and special backfill material would be imported from existing commercial sources. Trench excavation for the Diamond Fork Siphon and Red Hollow Pipeline would produce an estimated 85,000 cubic yards of earth and rock material, most of which would need to be disposed. Some of the material excavated from the Diamond Fork Siphon would be used to raise the grade of the Diamond Fork Road where the pipeline would be constructed in the road right-of-way. Arrangements for excess earth disposal would be formulated with the Forest Service, using existing disposal areas in Diamond Fork Canyon as much as possible.

Pipe would be placed in the excavated trench by crane and connected to previously laid sections by pushing it into place and welding the pipe together. If local materials are unsuitable for pipe bedding, imported bedding material would be used. Sections of pipe would be coated inside and out with cement mortar to protect the steel from corrosion.

After the pipe sections are connected, concrete slurry would be carefully placed around the pipe and allowed to cure to form a secure bed for the pipe. If the native material excavated from the trench is suitable (i.e., it does not contain large rocks or a large amount of organic material and is easily compacted), it could be used for backfill. If the native material contains unsuitable material, it could be screened. Alternatively, backfill material could be imported from other locations along the right-of-way or offsite. Compacted and uncompacted backfill for a typical trench section are illustrated in Figure 1-3. Typically, backfill in a pipe trench would be mechanically compacted with a vibratory compactor. Mechanical compaction normally would not be used near the ground surface, except at road crossings (see Subsection 1.3.5.5 below).

Following construction, all debris would be removed by the contractor. Spoil in work areas would be spread evenly to blend with contours and maintain local drainage patterns. Stockpiled topsoil then would be spread evenly over the work area and revegetated. Marker monuments would be placed at pipeline features such as air release and vacuum valves, blow-off valves and manholes. A typical marker monument would consist of a brass cap on a concrete base at least 4 inches above ground at maximum intervals of about 0.5 mile.

1.3.5.5 Road Crossings

The pipe trench excavation method described in Section 1.3.5.4 would be used at all road crossings encountered during construction. Pipe backfill would be heavily compacted all the way to the ground surface at road crossings to prevent the road surface from subsiding under repeated traffic loads during and after construction. The only public road to be crossed by any of the proposed project features would be Diamond Fork Road (pipelines would

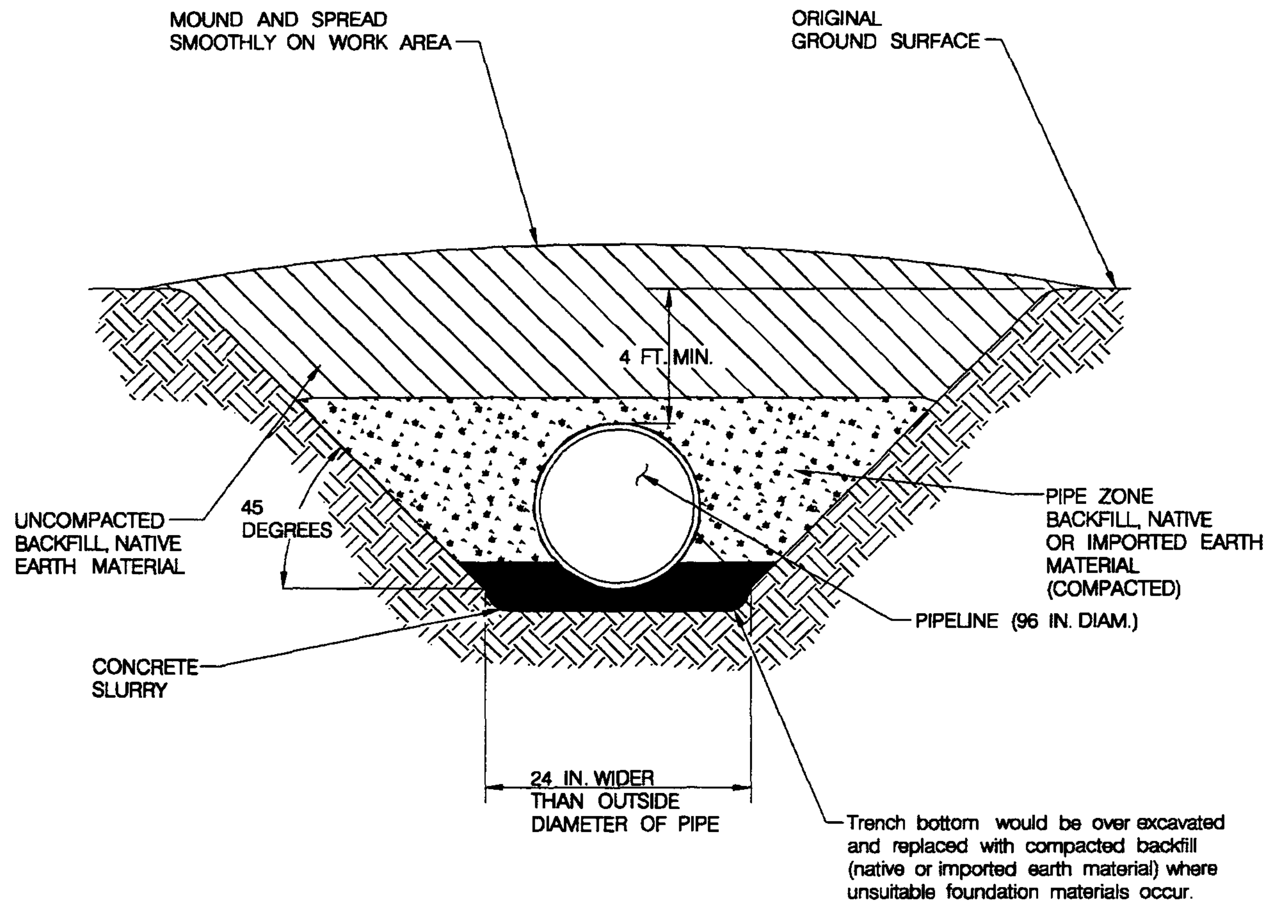


Figure 1-3

Schematic Drawing of Typical Pipe Trench Cross Section

cross the road three times). The upstream crossing would be at Diamond Fork Siphon just upstream from Diamond Fork Bridge. The middle crossing would be at Red Hollow Pipeline where it would connect to Diamond Fork Pipeline. The downstream crossing would be near the Spanish Fork River Outlet near Highway 6. Pavement at the road crossings would be restored to a condition better than or equal to existing conditions.

1.3.5.6 Stream Crossings

Map A-1 (upper right quadrant) shows that the proposed pipeline would cross three creeks – Sixth Water, Diamond Fork and Red Hollow. The open trench method would be used for all three crossings.
Construction of Sixth Water Connection would involve installing temporary upstream and downstream cofferdams to dewater the work area, and about 280 feet of temporary culvert to pass the flow of Sixth Water Creek through the construction site. Pipeline excavation would extend about 25 feet below the existing streambed (see Inset 2, Map A-1). The stream channel would be reconstructed over the top of the concrete encasement poured around the steel pipe and rock riprap would be placed on all slopes adjacent to the creek throughout the work area. The Sixth Water Connection construction work area would cover about 0.9 acre.

Construction of Diamond Fork Siphon creek crossing would involve installing temporary upstream and downstream cofferdams to dewater the work area and about 150 feet of temporary culvert to pass the flow of Diamond Fork Creek through the construction site. Pipeline excavation would extend approximately 15 to 25 feet below the existing streambed. The stream channel would be reconstructed over the top of the steel pipe (see Figure 1-4). The Diamond Fork Siphon construction work area would cover about 0.2 acre.

Construction of the Red Hollow Pipeline crossing would involve installing a temporary culvert to pass the creek flow through the work area. Pipeline excavation would extend approximately 15 to 20 feet below the existing streambed. The stream channel would be reconstructed over the top of the steel pipe. The Red Hollow Pipeline construction work area in the creek would cover about 0.07 acre.

Trench excavation would likely occur during the non-irrigation and nonrunoff season when the creeks have their lowest flows. Trenches would likely be excavated by backhoe, and the excavated material would be placed above the streambanks and the average high water mark. A minimum burial depth of 6 to 8 feet would be used unless a scour analysis indicates potential scouring could exceed this depth. After installation, the trench would be backfilled, stabilized and restored to approximate preconstruction contours. If temporary vehicle crossings are needed at any creek crossings, they would consist of clean rock fill with culverts. The culverts and all fill would be removed and the stream channel restored upon completion of construction.

1.3.5.7 Quality Control Procedures

After backfilling and all construction work is completed, the contractor would ensure quality control of pipeline construction through visual inspection and hydrostatic testing. To ensure that the system will operate to design specifications, pressure would be developed for hydrotesting through contractor-supplied pumps. If the pipeline leaks or breaks, it would be repaired and retested until it meets specifications. Test segment lengths would be determined by topography and availability of water through agreements consistent with federal, state and local regulations and codes. After testing a segment, the water may be pumped into the next segment for testing and ultimately be disposed in accordance with water quality regulations.

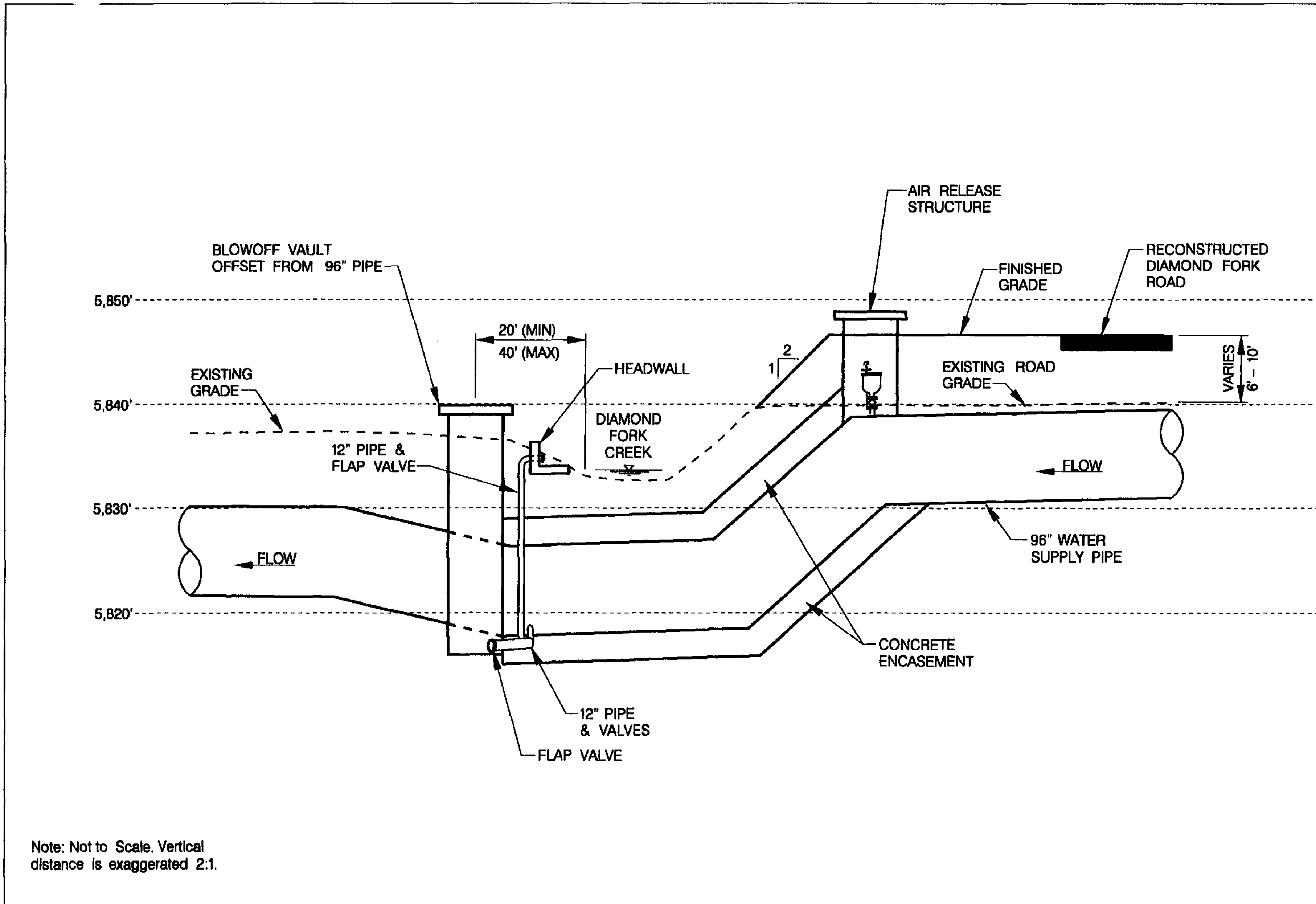


Figure 1-4

Diamond Fork Siphon Creek Crossing Profile

1.3.6 Access Roads

Existing and new roads would provide access to proposed construction sites (see Map A-1). Sixth Water Connection and the Tanner Ridge Tunnel inlet portal would be accessed from Highway 6, up Sheep Creek-Rays Valley Road to the existing unpaved maintenance road to Sixth Water Aqueduct. A crane would be operated from a permanent concrete pad adjacent to the existing Sixth Water Aqueduct outlet facility to lift construction materials over Sixth Water Creek. No bridge or new access road would be required across Sixth Water Creek.

Construction traffic would need access to Tanner Ridge Tunnel, Diamond Fork Siphon and the Red Mountain Tunnel inlet portal on the recently improved section of Diamond Fork Road from Highway 6 and on the older, narrower section of Diamond Fork Road upstream of Monks Hollow and Red Hollow creeks.

Two temporary access roads would be constructed on opposite sides of Diamond Fork Road near Diamond Fork Bridge (see Inset 3, Map A-1). The east temporary access road would be about 0.49 mile long, 24 feet wide at a 14 percent grade, and would provide access for construction of Tanner Ridge Tunnel and the eastern portion of Diamond Fork Siphon. The surface of this road would be paved for safety and erosion protection. A permanent helicopter pad would be located near the Tanner Ridge Tunnel outlet.

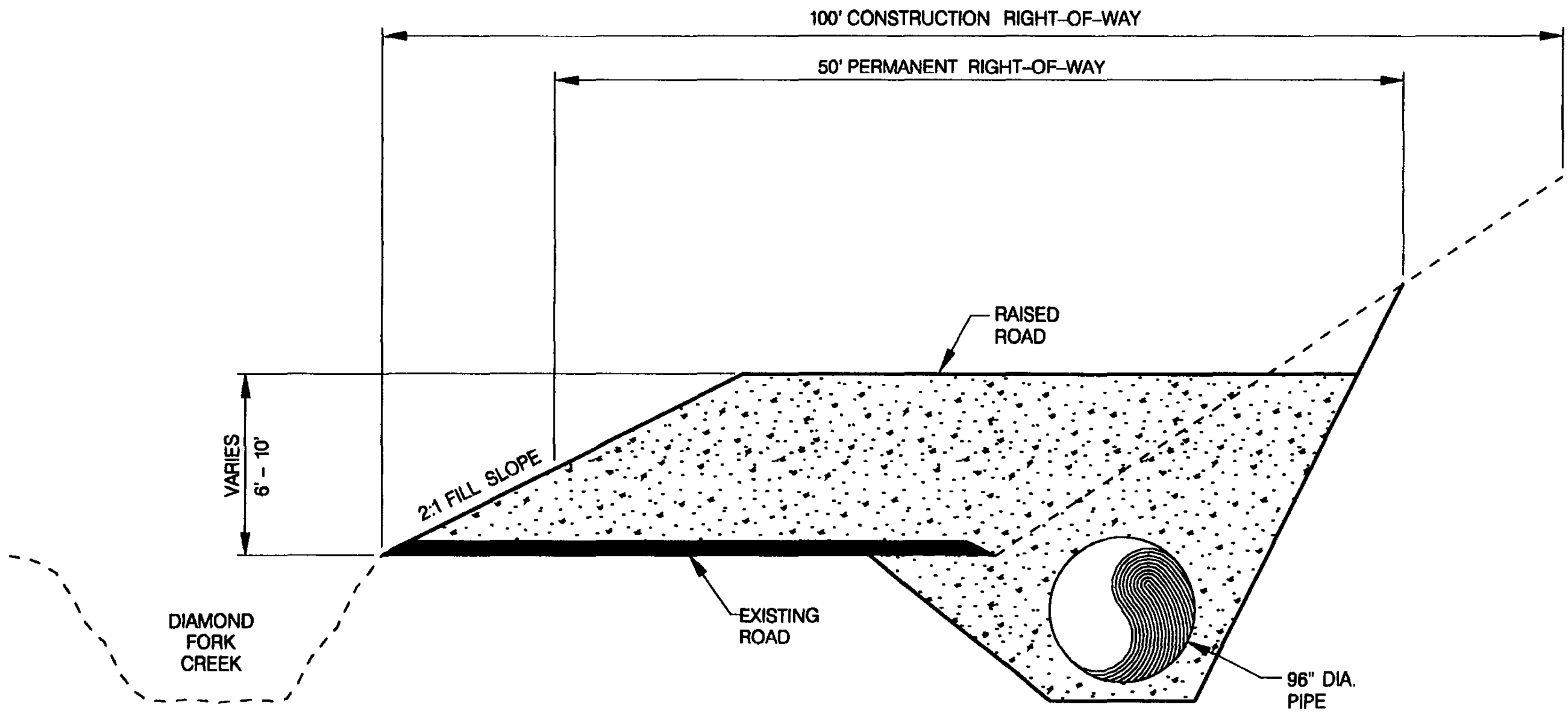
The west temporary access road would be about 0.73 mile long, 16 feet wide at a 12 percent grade with turnouts, and would provide access for construction of the Red Mountain Tunnel inlet portal and the western portion of Diamond Fork Siphon. This road would require end-bench cuts along portions of the alignment, and the road surface would be paved for safety and erosion protection. Both temporary access roads would be restored to approximate original contours and revegetated after construction is complete.

Diamond Fork Bridge would be replaced with a new bridge after construction is completed. About 0.45 mile of road along the Diamond Fork Siphon alignment would be reconstructed at an elevation 6 to 10 feet above the existing grade and further away from Diamond Fork Creek (see Inset 3, Map A-1 and Figure 1-5).

Diamond Fork Road would be closed to the public from the Red Ledges area downstream from Monks Hollow to just north of Diamond Fork Siphon during the 3 ½ year construction period (see Map A-1). This would eliminate the public safety risk from heavy construction traffic along the narrow portion of Diamond Fork Road. Construction traffic would travel in both directions on Diamond Fork Road and would be coordinated by the contractor. Any damage to the existing road by construction traffic would be repaired, and the road would be returned to a condition better than or equal to the pre-construction condition.

Access to the beginning of the Red Hollow Pipeline and Red Mountain Tunnel would be along Diamond Fork Road and the existing Red Hollow Road. One new permanent access road would branch off Red Hollow Road northeast of Diamond Family Monument (see Inset 4, Map A-1). The 24-foot-wide paved road would follow the Red Hollow Pipeline alignment for 0.5 mile to the Red Mountain Tunnel outlet portal. To provide access to the Red Hollow Pipeline west of Red Hollow Road, a temporary access road would branch off of Red Hollow Road to the west (see Inset 4, Map A-1) and would be approximately 0.3 miles long and 24 feet wide. Past the end of the temporary road, construction access would be along the Red Hollow Pipeline within the construction right-of-way. Both the temporary road and the access route within the right-of-way would be reclaimed upon completion of the pipeline.

To accommodate construction traffic, 1.5 miles of the uphill side of Red Hollow Road would be widened to 24 feet with a paved surface from Diamond Fork Road to north of Diamond Family Monument, (see Inset 4, Map A-1) except in the most confined sections. Retaining walls would be used in confined sections to minimize slope cuts. A



Note: Not to Scale

Figure 1-5

Conceptual View of Raised Portion of Diamond Fork Road

culvert would be replaced at the existing ford across Red Hollow Creek during construction to reestablish drainage conveyance under the road. The road surface over the culvert would be hardened with an asphalt concrete surface.

The new permanent access road would follow the Red Hollow Pipeline alignment for 0.5 mile to the Red Mountain Tunnel outlet portal. This new road would be 24 feet wide with a paved surface. A temporary access road would be constructed along the Red Hollow Pipeline west of the creek in Red Hollow during the pipeline construction. This temporary access road would be reclaimed upon completion of the pipeline construction. The Red Hollow Road would be gated and closed during construction to motorized public access at the junction with Diamond Fork Road. Following construction, the Red Hollow Road would be reopened to motorized public access up to the location of the existing gate (about 0.75 mile from the Diamond Fork Road junction). The air relief valves along Red Hollow Pipeline west of Red Hollow would be accessed using a 4-wheel drive, all-terrain vehicle and small trailer traveling over the revegetated pipeline alignment. During maintenance activities, the creek in Red Hollow would be crossed using wood planks placed from bank to bank to access the pipeline alignment. The valves would be visually inspected twice each year. Maintenance work would probably be required once every ten years.

1.3.7 Spanish Fork River Outlet From Diamond Fork Pipeline Construction Procedures

Construction of the pipeline portion of the Spanish Fork River Outlet would be the same as the pipeline construction procedures described in Section 1.3.5. The pipeline would connect to existing box culverts under the Highway 6 embankment. Diamond Fork Creek flow would be diverted into one box culvert while the dry culvert is modified. The procedure would be reversed to modify the other culvert.

1.3.8 Construction Staging Areas

Five construction staging areas (see Map A-1) would be needed to provide parking space for vehicles and equipment, storage for construction material and fuel, space for equipment maintenance, and reporting locations for workers.

Staging Area 1 would be located near the existing pond and building near the Syar Tunnel outlet. This 2-acre site would be used for construction of Sixth Water Connection and the Tanner Ridge Tunnel inlet portal.

Staging Area 2 would be located southwest of the Diamond Fork Bridge. This 2-acre site along with Staging Area 3 would be used for construction of Diamond Fork Siphon, Red Mountain Tunnel inlet portal and Tanner Ridge Tunnel.

Staging Area 3 would be located near Monks Hollow in an area that has been disturbed by dispersed camping activities. This 7-acre site would be used for construction of Red Hollow Road and Pipeline and Diamond Fork Creek Outlet.

Staging Area 4 (about 2 acres) would be located in the spoil area for Red Mountain Tunnel and used for the construction of Red Mountain Tunnel.

Staging Area 5 would be located 1.75 miles up Diamond Fork Road from Highway 6 on the south side of the road. This 2-acre site would be used for construction of Spanish Fork River Outlet.

Construction contractors would be required to submit plans for actual construction sites that clearly establish minimal impact, consistent with this FS-FEIS. Each staging area would be graded and revegetated following construction.

1.3.9 Construction at Spanish Fork River Diversions

During modifications to the five Spanish Fork River diversions (including temporary cofferdams upstream and downstream of the existing diversion dams) work areas would be separated from the active flow in the river channel to control sediment and turbidity and protect aquatic resource habitat. Cofferdams would be installed first at each site, then removed after modifications are completed.

1.4 Interim Operation of the Proposed Action

The Proposed Action would be operated on an interim basis until: 1) NEPA compliance is completed for future operations of the system that may include restoration of Diamond Fork Creek, or 2) the future Utah Lake Drainage Basin Water Delivery System is completed; NEPA compliance is met through an EIS and a ROD is issued; and additional future actions are implemented. Regardless of the facilities or actions proposed under the Utah Lake Drainage Basin Water Delivery System the interim operation of the Diamond Fork system is anticipated to be in place until 2010 to achieve the flows described in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d). The average annual flows consist of the Bonneville Unit and SVP waters that originate as transbasin diversions from Strawberry Reservoir. They do not include natural flows in Diamond Fork Creek or Spanish Fork River, which historically have been used for irrigation. However, these natural flow and seepage waters are included in the streamflow analysis under interim operation of the Diamond Fork System.

An elevation profile of the Proposed Action is shown on Inset 6, Map A-1.

1.4.1 Water Sources

1.4.1.1 Transbasin Diversion

Water conveyed through the Diamond Fork System and the Strawberry Tunnel (including seepage), would consist of a transbasin diversion from Strawberry Reservoir averaging about 147,600 acre-feet per year, including 61,500 acre-feet of SVP water and 86,100 acre-feet of Bonneville Unit water. The 86,100 acre-feet of Bonneville Unit water is the amount needed to meet minimum streamflow requirements in Sixth Water and Diamond Fork creeks and to exchange water between Utah Lake and Jordanelle Reservoir for the M&I system. Natural streamflow is not included in these figures. The water delivered to Utah Lake includes 1,590 acre-feet of M&I water for exchange to wells and springs in southern Utah County and 84,510 acre-feet to exchange water between Utah Lake and Jordanelle Reservoir for the M&I System.

1.4.1.2 Other Water Sources

Water from three other sources would be considered for interim operation of the proposed completed Diamond Fork System. First is the current Strawberry Tunnel discharge of 3,600 acre-feet that seeps into the tunnel annually. Second is water from the natural flow of Diamond Fork Creek, which averages 16,900 acre-feet per year at Diamond Fork Creek Outlet. These two sources would supply water for interim operation of the Diamond Fork System. The third source is the natural flow of Spanish Fork River. Water from these three sources is not Bonneville Unit water.

1.4.2 Water Delivery

Delivery of water to maintain minimum streamflows in Sixth Water Creek (from Strawberry Tunnel to Sixth Water Aqueduct) and Diamond Fork Creek below Diamond Fork Creek Outlet would receive first priority and would govern release of water to the creek. The rest of the water needed for SVP irrigation demand and M&I exchange would flow through the Diamond Fork Pipeline until it is operating at maximum capacity of 560 cfs. The average release from Diamond Fork Creek Outlet would be 25 cfs. Up to a maximum of 100 cfs would be released to the creek from the Diamond Fork Creek Outlet under normal operations. This would occur one year out of the 44-year period of record and would be necessary to meet the delivery requirements for Bonneville Unit water to Utah Lake when the Diamond Fork Pipeline is flowing at capacity. This released water would flow through Diamond Fork Creek to Spanish Fork River.

1.4.2.1 Normal Operation

Syar Tunnel and Sixth Water Aqueduct would convey about 130,500 acre-feet of Strawberry Reservoir water per year (see Table 1-3). The maximum flow capacity of these features is 800 cfs when Strawberry Reservoir is full and 660 cfs when the reservoir level is at its operational minimum. Under interim water operation, maximum flow through Syar Tunnel would range from 659 cfs to 5 cfs based on the 44-year period of record used to develop system operations. The hydrology for interim operation of the Proposed Action was developed by CUWCD (1998c) using the methodology described in the *Draft Hydrology and Water Resources Technical Report* (CUWCD 1998c, Page 3-1). Detailed tables supporting interim operation of the Proposed Action in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d) contain numbers that are rounded to the nearest 100 acre-feet, which means some total water volumes presented in this section do not exactly agree with the tables.

Table 1-3
Distribution of Transbasin Diversion From Strawberry Reservoir
Under Interim Operation of the Proposed Action

Component	Average Acre-Feet per Year
Distribution of Transbasin Diversion Between the Tunnels	
• Syar Tunnel release volume	130,500
• Strawberry Tunnel release volume	17,100
Total	**147,600**
Distribution of Transbasin Diversion in Diamond Fork Creek and Diamond Fork Pipeline	
• Diamond Fork Creek conveyance volume[a]	35,000
• Diamond Fork Pipeline conveyance volume	112,600
Total	**147,600**

[a] In addition to this Strawberry Reservoir water, 16,900 acre-feet of natural flow and 3,600 acre-feet of seepage from Strawberry Tunnel would be conveyed in Diamond Fork Creek.

Strawberry Tunnel would release about 17,100 acre-feet of Strawberry Reservoir water and 3,600 acre-feet of tunnel seepage per year (see Table 1-3). Strawberry Reservoir water from Strawberry Tunnel would be released primarily to meet minimum streamflows in Sixth Water Creek. The maximum rate of transbasin diversion from both Syar and Strawberry tunnels would be 691 cfs under interim operation of the Proposed Action.

Strawberry Reservoir water would be released as necessary to maintain minimum streamflows for Sixth Water Creek as specified in Section 303(c) of CUPCA. These minimum flows are not less than 32 cfs from May through October and not less than 25 cfs from November through April for Sixth Water Creek in the 6-mile stretch between the outlet of Strawberry Tunnel and the outlet of the Sixth Water Aqueduct.

The transbasin diversions through Strawberry and Syar tunnels would continue year-round except during maintenance shutdowns. During the non-irrigation season, the continuous release from Strawberry Tunnel would maintain minimum flows, except as described in Section 1.4.2.2. Winter releases through Syar Tunnel would maintain a continuous flow through the features of the Diamond Fork System, part of which would be released to Diamond Fork Creek for flow maintenance. Releases to Diamond Fork Creek would be made at Diamond Fork Creek Outlet about 2,500 feet downstream of the confluence of Monks Hollow, Red Hollow and Diamond Fork Creek (see Inset 4, Map A-1). The rest of the water would continue through Diamond Fork Pipeline to be released into Diamond Fork Creek near its confluence with Spanish Fork River.

Average annual releases from Strawberry Tunnel (17,100 acre-feet) and Diamond Fork Creek Outlet (17,800 acre-feet) would be combined with the average annual natural flow of Diamond Fork Creek (16,900 acre-feet) to maintain required minimum flows in Diamond Fork Creek downstream from Diamond Fork Creek Outlet.

1.4.2.2 Maintenance Operations

Maintenance operations would involve shutdown of all or part of the Diamond Fork System for short periods of time as described in the following sections. During system shutdowns requiring siphon and pipeline inspections, water remaining in Diamond Fork Siphon and Red Hollow Pipeline would be discharged by gravity to Diamond Fork Creek and the creek in Red Hollow, respectively, through the 12-inch diameter blow-off vault discharge pipeline. The release would be controlled by valves at rates that would not adversely affect aquatic, wetland and riparian resources. Water remaining in the blow-off vaults following completion of the gravity draining of the pipelines would be pumped out and discharged to the same streams at rates that would not adversely affect aquatic, wetland and riparian resources. Interim operation of the Diamond Fork System would be subject to the following maintenance interruptions:

1.4.2.2.1 Annual Spring Shutdown of All Features Except Syar Tunnel. The Syar Tunnel guard gate (see Map A-1 and Section 1.9.3.2) would be closed annually during spring runoff to allow CUWCD to inspect tunnels (except Syar Tunnel), pipelines and valves. This maintenance inspection is expected to take one week. The guard gate would back water up in Syar Tunnel and allow continuous releases for minimum streamflows through the clamshell valve to Strawberry Tunnel where it is connected to Syar Tunnel (see Inset 1, Map A-1). The shutdown normally would be scheduled during spring runoff when water delivery to Utah Lake is at a minimum and natural flows in Diamond Fork Creek below Diamond Fork Creek Outlet would satisfy minimum streamflow requirements. These minimum flows would not be achieved in Diamond Fork Creek below Diamond Fork Creek Outlet under natural flow conditions plus Strawberry Tunnel flows in 7 dry years during the 44-year analysis period. Therefore, up to 35 cfs additional flow would be released from Strawberry Tunnel in April of these dry years to meet minimum streamflow requirements in Diamond Fork Creek below Diamond Fork Creek Outlet.

1.4.2.2.2 Periodic Inspection of Syar Tunnel Inlet Gates. The Syar Tunnel inlet gates would be inspected periodically during spring runoff on a schedule as determined by CUWCD, but not annually. When this inspection is scheduled, it would be in addition to the annual shutdown and inspection of the rest of the Diamond Fork System. The Syar Tunnel inlet gates would be closed for one day while the tunnel is drained and the inlet gates inspected to ensure proper operation. Minimum streamflows in Sixth Water Creek would be met through delivery of flows through Strawberry Tunnel using the new connection to the bypass pipe (see Inset 1, Map A-1, and Section 1.9.3.2). The periodic inspection would be performed during years when natural flows plus Strawberry Tunnel releases would meet minimum streamflow requirements at Diamond Fork Creek Outlet.

1.4.2.2.3 Annual Fall Inspection of Sixth Water Aqueduct. Sixth Water Aqueduct would be inspected annually every October after the irrigation season. The Syar Tunnel guard gate would be closed for two days to allow inspection of Sixth Water Aqueduct and other features. During this shutdown, minimum streamflows in Diamond Fork and Sixth Water creeks would be released from Strawberry Tunnel to Sixth Water Creek.

1.4.2.2.4 Periodic Clamshell Valve Maintenance. The clamshell valve in the connection between Strawberry and Syar Tunnel (see Inset 1, Map A-1) would require periodic maintenance once every 5 to 7 years (period to be determined by CUWCD). The clamshell valve would be closed and Strawberry Tunnel would be dewatered to allow maintenance crews to move equipment through the tunnel to the valve. This maintenance shutdown would occur following the irrigation season; minimum streamflow requirements in Sixth Water Creek above Sixth Water Aqueduct would not be met during this two-day period.

1.4.2.2.5 Periodic Shutdown of Diamond Fork System Except for Syar Tunnel. The Diamond Fork System would be shut down below the Syar Tunnel guard gate for up to three weeks once every 5 to 7 years (period to be determined by CUWCD) for inspection and maintenance. During this three-week period, the Syar Tunnel inlet gates also would be closed for a two-day period to allow for inspection and maintenance. This system-wide shutdown would not be scheduled during the same year as the clamshell valve periodic maintenance. The Diamond Fork System shutdown would occur in April or May during high runoff years to the extent possible. Minimum streamflow requirements in Diamond Fork Creek would not be met during the two-day shutdown of the Syar Tunnel inlet gates. During the rest of the shutdown period, minimum streamflows would be delivered through the clamshell valve and Strawberry Tunnel to Sixth Water and Diamond Fork creeks.

1.4.2.3 Emergency Operations

If an emergency occurred in the Diamond Fork System anywhere from Syar Tunnel to Diamond Fork Pipeline requiring a shutdown of the system, water may be released from Strawberry Tunnel, Sixth Water Aqueduct outlet pipe or Diamond Fork Creek Outlet to meet minimum streamflows. Emergency operations would be necessary in the unlikely event of a valve failure, pipeline rupture or tunnel collapse. The Diamond Fork System would be designed to use any of these three options to maintain minimum flows and Utah Lake deliveries until repairs are made.

Up to 200 cfs could be released from Syar Tunnel into Strawberry Tunnel if Sixth Water Aqueduct became unusable, or emergency circumstances require use of Strawberry Tunnel to deliver contracted Bonneville Unit M&I water or SVP water as stipulated in Section 303(f) of CUPCA. Even though no such releases are anticipated or proposed, for purposes of worst-case impact analysis, a one-month release of 200 cfs is assumed.

Minimum streamflows could be released from the Sixth Water Aqueduct outlet pipe if Tanner Ridge Tunnel, Diamond Fork Siphon, Red Mountain Tunnel, Red Hollow Pipeline, Diamond Fork Pipeline or Spanish Fork Rive

Outlet must be shut down. The 36-inch-diameter outlet pipe would have a capacity of 80 cfs down Sixth Water Creek to meet the minimum flow requirements in Diamond Fork Creek below Diamond Fork Creek Outlet.

1.4.3 Streamflows

This section describes streamflows and water volumes that would be conveyed through key reaches of Sixth Water Creek, Diamond Fork Creek and Spanish Fork River under the Proposed Action. Additional water supply details are located in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d).

Two sets of numbers are shown on all of the tables to describe the flows in various ways. The first set shows monthly average flows in cfs and acre-feet when averaged over the entire 44-year analysis period. The second set shows monthly average flows from a single, extremely dry year and a single, extremely wet year. The following section headings refer to a reach while the tables refer to a specific point.

The Mitigation Commission, under Title III of CUPCA, is authorized to perform stream channel restoration work along Diamond Fork and Sixth Water creeks. The minimum flows described under the Proposed Action would facilitate these efforts. The Mitigation Commission will conduct additional studies to determine optimal seasonal flows in cooperation with the U.S. Fish and Wildlife Service, Utah Division of Wildlife Resources, Forest Service and the CUWCD. Based on these studies the Mitigation Commission in the future would prepare a Sixth Water Creek and Diamond Fork Creek Restoration Plan (not part of this FS-FEIS), that could involve recommended changes to the Diamond Fork System interim operation plan. The Mitigation Commission would conduct additional NEPA compliance documentation on any plans that they develop.

1.4.3.1 Sixth Water Creek Between Strawberry Tunnel and Sixth Water Aqueduct

Under the Proposed Action, flows in this stretch of Sixth Water Creek would normally consist of releases from Strawberry Tunnel of not less than 32 cfs in summer and not less than 25 cfs in winter to maintain minimum flows, plus natural inflow downstream of the tunnel. Table 1-4 shows the estimated average monthly flows in Sixth Water Creek above Sixth Water Aqueduct. Total annual average volume of water above Sixth Water Aqueduct would be 23,200 acre-feet. This would consist of 14,900 acre-feet of Bonneville Unit Water, 2,200 acre-feet of SVP water, 3,600 acre-feet of Strawberry Tunnel Seepage, and 2,500 acre-feet of natural gains.

Table 1-4
Estimated Streamflows in Sixth Water Creek Immediately Above Sixth Water Aqueduct
Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	34	27	26	26	26	27	33	48	37	34	33	34
Acre-feet[b]	2,100	1,600	1,600	1,600	1,500	1,700	2,000	2,900	2,200	2,100	2,000	2,000
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	33	26	26	26	26	26	27	35	32	32	32	33
Wet year[d]	34	27	27	27	27	27	58	87	52	35	35	34

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.2 Sixth Water Creek Between Sixth Water Aqueduct and Fifth Water Creek

The flows downstream of Sixth Water Aqueduct would be the same as above Sixth Water Aqueduct (see Section 1.4.3.1). Table 1-5 shows the estimated average monthly flows in Sixth Water Creek below Sixth Water Aqueduct.

Table 1-5
Estimated Streamflows in Sixth Water Creek Immediately Below Sixth Water Aqueduct Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	34	27	26	26	26	27	33	48	37	34	33	34
Acre-feet[b]	2,100	1,600	1,600	1,600	1,500	1,700	2,000	2,900	2,200	2,100	2,000	2,000
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	33	26	26	26	26	26	27	35	32	32	32	33
Wet year[d]	34	27	27	27	27	27	58	87	52	35	35	34

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.3 Sixth Water Creek Between Fifth Water Creek and Diamond Fork Creek

Table 1-6 shows the estimated average monthly flows in Sixth Water Creek below Fifth Water Creek. Total annual average volume of water below Fifth Water Creek would be 27,700 acre-feet. The only change from the annual average volume of 23,200 acre-feet above Sixth Water Aqueduct would be the 4,500 acre-feet of natural gain from Fifth Water Creek.

Table 1-6
Estimated Streamflows in Sixth Water Creek Below Fifth Water Creek
Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	36	30	29	28	29	31	48	75	45	37	36	36
Acre-feet[b]	2,200	1,800	1,800	1,700	1,600	1,900	2,800	4,600	2,700	2,300	2,200	2,200
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	35	29	27	28	27	28	30	39	32	32	32	35
Wet year[d]	37	31	30	29	29	31	115	182	86	42	40	38

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.4 Diamond Fork Creek Between Three Forks and Diamond Fork Creek Outlet

Table 1-7 shows the estimated average monthly flows in Diamond Fork Creek below Three Forks. Total annual average volume of water in Diamond Fork Creek below Three Forks would be 37,600 acre-feet. This represents an annual average natural gain (from Diamond Fork Creek above Three Forks and Cottonwood Creek) of more than 9,800 acre-feet over the flow of 27,700 acre-feet in Sixth Water Creek below Fifth Water Creek.

Table 1-7
Estimated Streamflows in Diamond Fork Creek Below Three Forks
Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	42	36	33	32	34	38	80	134	64	45	42	42
Acre-feet[b]	2,600	2,100	2,000	2,000	1,900	2,300	4,800	8,200	3,800	2,800	2,600	2,500
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	41	34	29	33	31	31	37	49	32	33	33	39
Wet year[d]	44	40	36	34	35	37	239	389	162	59	51	47

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.5 Diamond Fork Creek Between Diamond Fork Creek Outlet and Spanish Fork River Outlet

Releases to Diamond Fork Creek at Diamond Fork Creek Outlet would maintain minimum flows of 60 cfs from October through April and 80 cfs from May through September.

The total annual average volume of water in Diamond Fork Creek below Diamond Fork Creek Outlet would be 55,400 acre-feet. Table 1-8 shows estimated flows in Diamond Fork Creek at a point about 2,500 feet downstream (see Inset 4, Map A-1) from Red Hollow under the Proposed Action. The flows would consist of releases from Strawberry Tunnel (17,100 acre-feet) to maintain minimum flows in Sixth Water Creek, Strawberry Tunnel seepage and natural flow in Sixth Water and Diamond Fork Creeks (20,500 acre-feet), and releases from the proposed Diamond Fork Creek Outlet (17,800 acre-feet). The streamflows are estimated at the upper end of the reach and accretion flows occur throughout the stream reach to Spanish Fork River.

Table 1-8
Estimated Streamflows in Diamond Fork Creek Below Diamond Fork Creek Outlet Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	61	60	60	60	60	60	85	140	89	82	81	80
Acre-feet[b]	3,700	3,600	3,700	3,700	3,400	3,700	5,000	8,600	5,300	5,100	4,900	4,80[illegible]
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	61	60	60	60	60	60	60	81	80	81	81	80
Wet year[d]	61	60	60	60	59	60	239	389	162	82	81	80

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.6 Spanish Fork River Between Diamond Fork Creek and Spanish Fork Diversion Dam

Table 1-9 shows estimated flows in Spanish Fork River at Castilla gage, which consist of natural river flow and the discharge of Diamond Fork Creek and Diamond Fork Pipeline. This stretch of river is defined as the section of river from the confluence of Diamond Fork Creek and Spanish Fork River to the Spanish Fork Diversion Dam near the mouth of Spanish Fork Canyon (see Map A-1 and Map A-2). The total annual average volume of 237,900 acre-feet includes 61,500 acre-feet of SVP water, 86,100 acre-feet of Bonneville Unit water, 3,500 acre-feet Strawberry Tunnel seepage, and 86,800 acre-feet of Spanish Fork River natural flow. The streamflows are estimated at the Castilla gage and accretion flows occur throughout the stream reach between Diamond Fork Creek confluence and Spanish Fork Diversion Dam.

Table 1-9
Estimated Streamflows in Spanish Fork River at Castilla Gage
Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	135	170	181	193	221	259	407	667	583	496	380	249
Acre-feet[b]	8,300	10,100	11,100	11,800	12,400	15,900	24,200	40,900	34,600	30,400	23,300	14,800
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	163	203	123	146	174	191	175	295	347	266	233	147
Wet year[d]	115	139	161	191	203	246	1,081	1,912	686	502	366	330

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.7 Spanish Fork River Between Spanish Fork Diversion Dam and East Bench Dam

Table 1-10 shows estimated flows in Spanish Fork River immediately below Spanish Fork Diversion Dam, which consist of natural river flow, Bonneville Unit water, and SVP water flowing to East Bench Canal. This reach of Spanish Fork River is defined as the section of river from below Spanish Fork Diversion Dam near the mouth of Spanish Fork Canyon to East Bench Dam (see Map A-2). Accretion flows occur throughout the stream reach between Spanish Fork Diversion Dam and East Bench Dam. Total annual average volume of 104,200 acre-feet includes 6,900 acre-feet of SVP water, 86,100 acre-feet of Bonneville Unit water, and Spanish Fork River natural flow.

Table 1-10
Estimated Streamflows in Spanish Fork River Below Spanish Fork Diversion Dam
Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	43	101	113	126	140	147	180	292	222	165	119	81
Acre-feet[b]	2,600	6,000	7,000	7,800	7,800	9,000	10,700	17,900	13,200	10,100	7,300	4,800
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	113	155	83	101	124	133	137	116	76	75	101	60
Wet year[c]	15	72	97	116	122	138	581	1,412	186	68	45	34

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.8 Spanish Fork River Between East Bench Dam and Mill Race Diversion

Table 1-11 shows estimated flows in Spanish Fork River below East Bench Dam (see Map A-2), which consist of natural river flow and Bonneville Unit water. The projected flows in this reach do not include water released to the river from the Power Canal. The total annual average volume of 90,800 acre-feet includes 86,100 acre-feet of Bonneville Unit water and Spanish Fork River natural flow. The streamflows are estimated just below East Bench Dam and accretion flows occur throughout the stream reach between East Bench Dam and Mill Race Diversion.

Table 1-11
Estimated Streamflows in Spanish Fork River Below East Bench Dam
Under the Proposed Action[a]

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	37	101	113	126	140	146	171	243	165	118	85	62
Acre-feet[b]	2,300	6,000	7,000	7,800	7,800	9,000	10,100	14,900	9,800	7,300	5,200	3,700
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	107	155	83	101	124	133	118	79	19	56	88	54
Wet year[d]	11	72	97	116	122	138	581	1,374	106	1	1	0

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.9 Spanish Fork River From Mill Race Diversion to Lake Shore Diversion

Table 1-12 shows estimated flows in Spanish Fork River below the Mill Race Diversion, which consist of natural river flow and Bonneville Unit water. The total annual average volume of 138,600 acre-feet includes 86,100 acre-feet of Bonneville Unit water, 2,500 acre-feet of SVP water and 50,200 acre-feet of Spanish Fork River natural flow.

Table 1-12
Estimated Streamflows in Spanish Fork River Below Mill Race Diversion
Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	82	170	181	193	221	258	341	345	199	137	101	76
Acre-feet[b]	5,000	10,100	11,100	11,800	12,400	15,800	20,300	21,200	11,800	8,400	6,200	4,500
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	138	203	123	146	174	191	130	79	19	62	93	62
Wet year[d]	45	139	161	191	203	246	1,081	1,636	196	32	14	14

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.3.10 Spanish Fork River From Lake Shore Diversion to Utah Lake

Table 1-13 shows estimated flows in Spanish Fork River at the Lake Shore gage, which consist of natural river flow and Bonneville Unit water. The total annual average volume of 137,300 acre-feet includes 86,100 acre-feet of Bonneville Unit water and 51,200 acre-feet of Spanish Fork River natural flow.

Table 1-13
Estimated Streamflows in Spanish Fork River at Lake Shore Gage
Under the Proposed Action

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	68	168	190	205	236	276	352	322	189	120	86	70
Acre-feet[b]	4,100	10,000	11,700	12,600	13,200	16,900	20,900	19,700	11,200	7,400	5,300	4,100
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	127	207	139	161	187	199	134	82	20	55	88	55
Wet year[d]	56	140	168	201	221	282	1,114	1,551	281	2	4	40

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.4.4 Operating Entity

The CUWCD would operate and maintain the completed Diamond Fork System under operating agreements with the federal government and a number of local water districts and water companies that would address historical operational aspects. SVP deliveries would be conveyed in Sixth Water Creek, Diamond Fork Creek and in the Diamond Fork System. The agreements are described in Section 1.8.

1.4.5 Automated Control System

A Supervisory Control and Data Acquisition System (SCADA) would be installed to control and monitor operation of the Proposed Action from an operations center at CUWCD headquarters. The SCADA system would consist of remote telemetry units (RTUs) linked to one or more personal computers at the operations center. The RTUs would be located at the inlet to Syar Tunnel, the outlet of Sixth Water Aqueduct, the end of the Red Hollow Pipeline, Diamond Fork Creek Outlet, and Spanish Fork River Outlet. The RTUs would be connected to instruments or sensors to monitor pressure, flow, valve position and other parameters and would allow remote control of valves at outlets. Fiber optic cables would be installed through the tunnels as part of the automated control system. The SCADA would have an alarm system capable of notifying key personnel when emergency situations occur and would store operational data for accounting purposes. Satellite-linked remote sensor units would be located on previously disturbed lands in the Diamond Fork drainage.

1.4.6 Project Maintenance

The CUWCD would operate and maintain the Diamond Fork System. Operations and maintenance (O&M) access to primary project features would be along existing roads and the new permanent access road in Red Hollow to the Red Mountain Tunnel outlet that would involve use of existing Forest Road No. 492. The Red Hollow Road would be gated at approximately 0.75 mile up from Diamond Fork Road to prohibit motorized public use. O&M access to Red Mountain Tunnel would be through an access portal at the Red Mountain Tunnel outlet. O&M access to Tanner Ridge Tunnel would be along the existing Sixth Water Aqueduct maintenance road (Forest Route 622) through the Sixth Water Connection inlet box, as well as from a helicopter pad constructed at the outlet portal. O&M access to other surface features such as air release valves, vents and marker posts would be by foot, mountain bike, or helicopter. An all-terrain vehicle (ATV) would be used along the Red Hollow Pipeline corridor to access features as necessary. The road to the Strawberry Tunnel outlet (Forest Route 029 past the intersection with Forest Route 051) would be maintained only as needed.

The proposed features would be constructed to current standards and require minimal maintenance. Minor repairs would include repairs to erosion control structures, replacement of pipeline marker posts, and removal of debris from the permanent pipeline right-of-way. Other repairs could require reducing pipeline pressure and some excavation, with limited service interruption. Pipeline damage needing major repairs could require extended interruption of water deliveries. Access for major repairs in areas with no permanent access would be on temporary roads that would be restored following completion of repair work. All Diamond Fork System features would be inspected periodically to determine necessary maintenance.

1.5 Description of the No Action Alternative

1.5.1 Background and Overview

The No Action Alternative was called Alternative C in the 1990 FS-FEIS. As stated in the 1990 FS-FEIS, "alternative C corresponds with the I&D System No Action Alternative and would be viable only if the I&D System were not built" (USBR 1990). Implementation of the No Action Alternative under this FS-FEIS would complete the Diamond Fork System if a decision were made not to proceed with the Utah Lake Drainage Basin Water Delivery System.

The features of the No Action Alternative have changed from those described in the 1990 FS-FEIS. The following features have been eliminated: 1) Last Chance Powerplant, and 2) Diamond Fork Powerplant. Minimum instream flow requirements were added for Sixth Water and Diamond Fork creeks.

1.5.2 No Action Alternative Features

The No Action Alternative would consist of the following features (see Map 1-6): 1) Three Forks Dam and Reservoir, 2) Diamond Fork Pipeline Extension (pipeline from the completed Diamond Fork Pipeline upstream to Three Forks Dam), and 3) Spanish Fork River Outlet (outlet at the end of the completed Diamond Fork Pipeline for release of flows to the Spanish Fork River). Minimum streamflows in Diamond Fork Creek would be released from Three Forks Dam.

1.5.2.1 Three Forks Dam

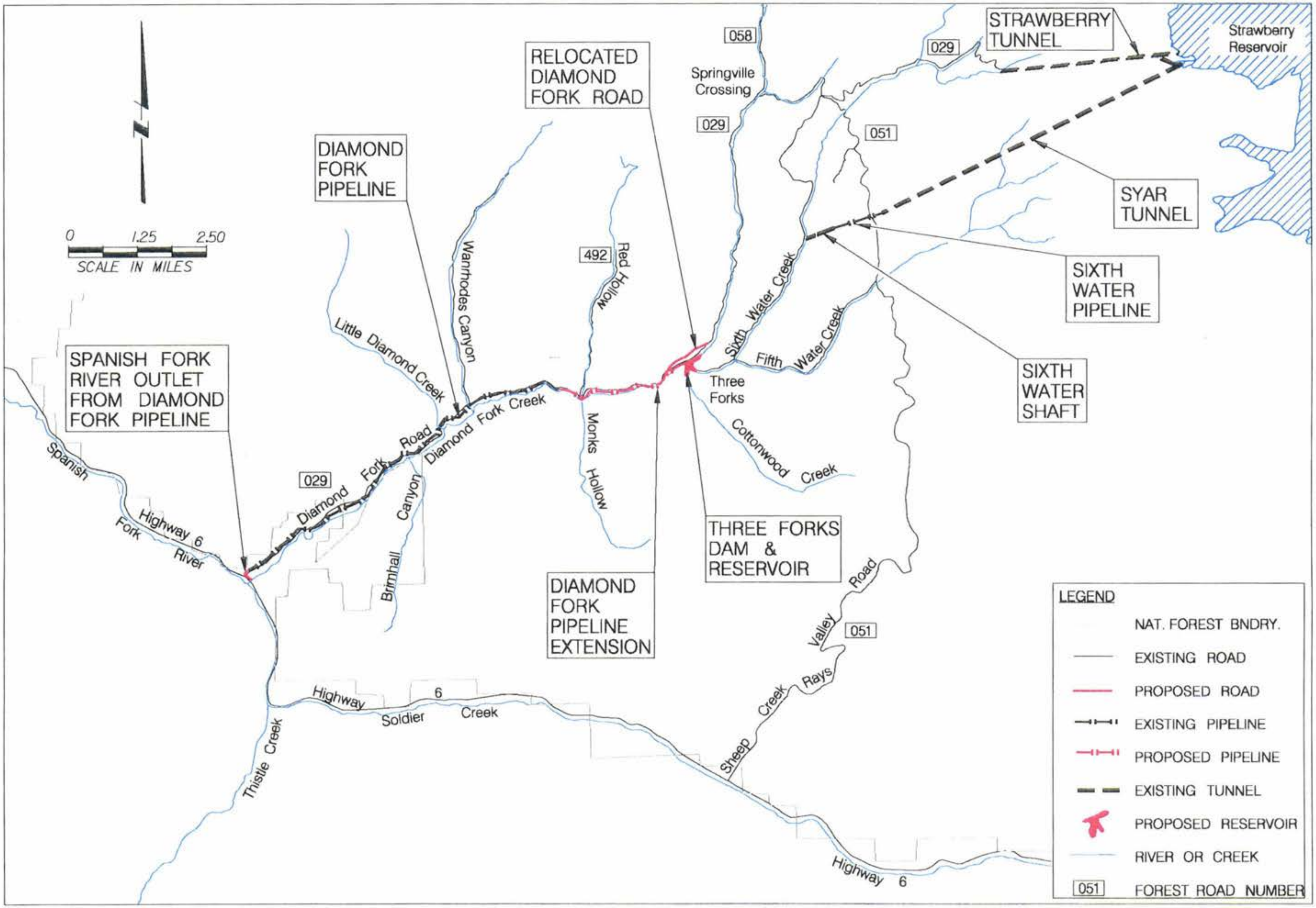
A 60-foot-high dam would be constructed at Three Forks about 10 miles upstream from the confluence of Diamond Fork Creek and Spanish Fork River. The dam would be constructed with about 65,000 cubic yards of roller-compacted concrete, with a 275-foot-long crest that would serve as a spillway to safely pass anticipated floods. The dam would include a 560-cfs outlet to the intake of Diamond Fork Pipeline Extension and a 250-cfs outlet to Diamond Fork Creek.

1.5.2.2 Three Forks Reservoir

Three Forks Reservoir would have a total capacity of 430 acre-feet at normal water surface elevation (5,582 feet), and a surface area of 14 acres (8 acres at minimum pool). The reservoir would fluctuate a maximum of 27 feet daily to regulate irrigation and streamflow releases from Sixth Water Aqueduct. Most of the sediment load would be flushed through the reservoir (about 3 percent trap efficiency) during high spring runoff conditions, but some bedload material may be occasionally removed to maintain proper operation. Sediment collected in the reservoir during the first 5 years of operation would be mechanically removed.

1.5.2.3 Diamond Fork Pipeline Extension

The existing Diamond Fork Pipeline would be extended from its current upstream terminus about 2.7 miles to the outlet of the proposed Three Forks Dam. The extension (560 cfs capacity) would be routed along Diamond Fork Road on the north side of the creek.



Map 1-6

Features of the No Action Alternative

1.5.2.4 Spanish Fork River Outlet From Diamond Fork Pipeline

The outlet for the No Action Alternative would be the same as described for the Proposed Action (see Section 1.3.2.7).

1.5.3 Land Management Status and Right-of-Way Acquisition

All of the area (except for the Spanish Fork River Outlet location) required to construct and operate the features of the No Action Alternative is on National Forest land that has been withdrawn by the USBR for use by the Diamond Fork System and would not require a Forest Service permit. A right-of-way permit would be required for construction of the Spanish Fork River Outlet, which would be on land owned by the Utah Department of Transportation.

1.5.4 Dam and Reservoir Construction Procedures

The foundation area of the Three Forks Dam would be cleared and grubbed, and the foundation soils and loose rock would be excavated and blasted to competent bedrock. A small cofferdam would be constructed around the location of the outlet pipe. The outlet pipe and valve structure would be constructed at the bottom of the dam, and the cofferdam would be removed from the pipeline intake to pass Diamond Fork Creek flows through the site during dam construction. The dam foundation would be constructed of formed concrete to a common base elevation. The dam construction would continue from the foundation with successive lifts of roller-compacted concrete applied up to the dam crest elevation. The Diamond Fork Pipeline outlet would be built into the roller-compacted concrete portion of the dam and connected to the pipeline extension. The dam crest would be constructed of reinforced concrete tied into the roller-compacted concrete structure. The dam would be grouted at its contact with the bedrock.

Construction of Three Forks Reservoir would consist of clearing and grubbing large vegetation (trees and bushes) and debris from the reservoir area and placing riprap at key locations on the reservoir banks to control erosion. The reservoir would be filled with water and the dam and outlets tested.

1.5.5 Pipeline Construction Procedures

The procedures used for the No Action Alternative would be the same as for the Proposed Action (see Section 1.3.5).

1.5.6 Spanish Fork River Outlet From Diamond Fork Pipeline Construction Procedures

The procedures used for the No Action Alternative would be the same as for the Proposed Action (see Section 1.3.7).

1.5.7 Access Roads

Diamond Fork Road would be used for construction access from Highway 6 to the Three Forks Dam site. The road would be closed (see Map A-1) from the Red Ledges area downstream from Monks Hollow to 0.5 mile north of Three Forks during the 3-year construction period. This would eliminate the public safety risk from heavy construction traffic along the narrow portion of Diamond Fork Road. Construction traffic would travel in both irections on Diamond Fork Road and would be coordinated by the contractor.

The existing road alignment would be used to construct the extension of the Diamond Fork Pipeline. A new public access road would be constructed from just upstream from Red Hollow to Diamond Fork Road upstream from Three Forks Reservoir. This new road would be 0.9 mile long on the west side of Diamond Fork Canyon with an average 3 percent grade. The new access road and the portion of existing road down to the Diamond Fork Pipeline inlet would be constructed to the same standard as the lower Diamond Fork Road along the existing Diamond Fork Pipeline. Spoil material from road excavation would be permanently disposed on a 6.9-acre site near the primary staging area.

1.5.8 Construction Staging Areas

The primary construction staging area, between Diamond Fork Road and Diamond Fork Creek just upstream from Red Hollow, would cover 5 acres. This would be used for the Diamond Fork Pipeline Extension, Three Forks Dam and Reservoir, and the new public access road. A second, 2-acre staging area on the south side of Diamond Fork Road about 1.75 miles up from Highway 6 would be used for construction of the Spanish Fork River Outlet from Diamond Fork Pipeline. After construction, both staging areas would be ripped, graded and revegetated.

1.6 Operation of the No Action Alternative

The average annual flows under operation of the No Action Alternative would consist of Bonneville Unit and SVP waters that originate as transbasin diversions from Strawberry Reservoir. They would not include natural flows in Diamond Fork Creek or Spanish Fork River, which historically have been used for irrigation. However, these natural flow and seepage waters are included in the streamflow analysis under operation of the No Action Alternative.

1.6.1 Water Sources

1.6.1.1 Transbasin Diversion

Under the No Action Alternative, 61,500 acre-feet of SVP water and 96,800 acre-feet of Bonneville Unit water (a total of 158,300 acre-feet per year) would be released from Strawberry Reservoir for irrigation, for M&I use and for exchange from Utah Lake to Jordanelle Reservoir. The 96,800 acre-feet of Bonneville Unit water would consist of 14,700 acre-feet of supplemental irrigation water delivered to water users in southern Utah County and 82,100 acre-feet of water delivered to Utah Lake. The water delivered to Utah Lake includes 1,590 acre-feet of M&I water for exchange to wells and springs in southern Utah County and 80,510 acre-feet to exchange water between Utah Lake and Jordanelle Reservoir for the M&I System. In accordance with the 1979 M&I FEIS, up to 30,000 acre-feet of Bonneville Unit water has been released annually from Strawberry Reservoir and delivered through Syar Tunnel and Sixth Water Aqueduct to Utah Lake for exchange to Jordanelle Reservoir. Temporary contracts for supplemental irrigation water have been issued for up to 14,000 acre-feet of Bonneville Unit water for irrigators in the Spanish Fork area, and 1,590 acre-feet of M&I water was made available to the South Utah Valley Municipal Water Users Association by exchange through Utah Lake.

1.6.1.2 Other Water Sources

Water from three other sources (none of them Bonneville Unit water) would be considered in the operation of the No Action Alternative. First is the current Strawberry Tunnel discharge of 3,600 acre-feet that seeps into the tunnel annually. Second is water from the natural flow of Diamond Fork Creek, which averages 16,900 acre-feet per ye at Monks Hollow. These two sources would be involved in the operation of the No Action Alternative. The third source is the natural flow of Spanish Fork River.

1.6.2 Water Delivery

Under the No Action Alternative, an average of 158,300 acre-feet per year of SVP and Bonneville Unit water would be released from Strawberry Reservoir and conveyed to the Spanish Fork River for irrigation and Utah Lake water supply. This includes 61,500 acre-feet of SVP water and 96,800 acre-feet of Bonneville Unit water for delivery to Utah Lake, for supplemental irrigation, M&I water for exchange for use of southern Utah County wells and springs, exchange to Jordanelle Reservoir, and to meet minimum streamflow requirements in Sixth Water Creek and Diamond Fork Creek. Natural streamflow is not included in these figures.

Delivery of water to maintain the minimum streamflows in Sixth Water Creek (from Strawberry Tunnel to Sixth Water Aqueduct) and Diamond Fork Creek below Monks Hollow would receive first priority and would govern release of water to the creek. The rest of the water needed for SVP irrigation demand, supplemental irrigation and M&I exchanges would flow through Diamond Fork Pipeline until it is operating at maximum capacity of 560 cfs. Up to 388 cfs would be released to the creek from Three Forks Dam under normal operations, including the minimum streamflows required below Monks Hollow and additional water in excess of the Diamond Fork Pipeline when it would convey capacity flows. This released water would flow through Diamond Fork Creek to Spanish Fork River.

The 14,700 acre-feet per year of supplemental irrigation water would be diverted from Spanish Fork River as a supplemental irrigation supply for the 47,800 acres of presently irrigated lands in the Spanish Fork area. These lands could include non-SWUA lands served by the High Line, East Bench, Salem, South Field, Mill Race and Lake Shore Canals, as well as the Mapleton Lateral. This supplemental irrigation water would be diverted from the Spanish Fork River at existing diversion facilities and conveyed to farms through existing distribution facilities. No new facilities would be constructed, and no water would be delivered to Juab County. Lands requested to receive Bonneville Unit supplemental irrigation water that have not already been certified arable by the Secretary of the Interior would need to be certified before receiving Bonneville Unit irrigation water.

The total amount of the transbasin diversion under the No Action Alternative would be 96,800 acre-feet. Of this 96,800 acre-feet, 14,700 acre-feet would be delivered to south Utah County for supplemental irrigation. About 1,590 acre-feet would be delivered for M&I use in south Utah County. A net of 80,500 acre-feet would be directly delivered to Utah Lake. The difference between the 80,500 acre-feet and the Provo River depletion of 98,500 acre-feet would be made up from return flows (13,000 acre-feet from M&I use in Northern Utah County, 4,200 acre-feet from the supplemental irrigation deliveries, and 800 acre feet from the M&I water delivered to south Utah County).

1.6.2.1 Normal Operation

Syar Tunnel and Sixth Water Aqueduct would convey about 141,200 acre-feet per year (see Table 1-14). Maximum flow capacity of Syar Tunnel and Sixth Water Aqueduct is 800 cfs when Strawberry Reservoir is full and 660 cfs when the reservoir is at its operational minimum. Under the water operation, maximum flow of Syar Tunnel would range from 600 cfs to 0 cfs based on the 44-year record used to develop system operations. The hydrology for operation of the No Action Alternative was developed by CUWCD (1998c) using the methodology described in the *Draft Hydrology & Water Resources Technical Report* (CUWCD 1998c, Page 3-1). Detailed tables supporting operation of the No Action Alternative in the *Hydrology and Water Resources Technical*

Memorandum (CUWCD 1999d) contain numbers that are rounded to the nearest 100 acre-feet, which means some total water volumes presented in this section may not exactly agree with the tables.

Strawberry Tunnel would release about 17,100 acre-feet of Strawberry Reservoir water (see Table 1-14) and 3,600 acre-feet of tunnel seepage per year. Strawberry Reservoir water from Strawberry Tunnel would primarily be released to meet minimum streamflows in Sixth Water Creek. The maximum rate of transbasin diversion from both Syar and Strawberry tunnels would be 632 cfs under operation of the No Action Alternative.

Water would be released from Strawberry Reservoir as necessary to maintain minimum streamflows for Sixth Water Creek as specified in Section 303(c) of CUPCA. These minimum flows are not less than 32 cfs from May through October and not less than 25 cfs from November through April for Sixth Water Creek in the 6-mile reach between the Strawberry Tunnel outlet and the Sixth Water Aqueduct outlet.

Table 1-14
Distribution of Transbasin Diversion From Strawberry Reservoir
Under the No Action Alternative

Component	Average Acre-Feet per Year
Distribution of Transbasin Diversion Between the Tunnels	
• Syar Tunnel release volume	141,200
• Strawberry Tunnel release volume	17,100
Total	**158,300**
Distribution of Transbasin Diversion in Diamond Fork Creek	
• Diamond Fork Creek conveyance volume[a]	45,600
• Diamond Fork Pipeline conveyance volume[b]	112,700
Total	**158,300**

[a]In addition to this Strawberry Reservoir water, 8,000 acre-feet of natural flow and 1,500 acre-feet of seepage from Strawberry Tunnel would be conveyed in Diamond Fork Creek.
[b]In addition to this Strawberry Reservoir water, 8,900 acre-feet of natural flow and 2,100 acre-feet of seepage from Strawberry Tunnel would be conveyed in Diamond Fork Pipeline.

The discharge from Strawberry and Syar tunnels, combined with the natural flow of Diamond Fork, Sixth Water and Cottonwood creeks, would flow into Three Forks Reservoir at the confluence of Diamond Fork, Sixth Water, and Cottonwood creeks. The total inflow to the reservoir would be 178,800 acre-feet, which would include 158,300 acre-feet of transbasin diversion from Strawberry Reservoir, Strawberry Tunnel seepage, and natural creek flow.

At Three Forks Dam, an average of 123,700 acre-feet of Bonneville Unit, Strawberry Project, and natural flow water would be released into Diamond Fork Pipeline and 55,100 acre-feet of Bonneville Unit, Strawberry Project, and natural flow water would be released into Diamond Fork Creek. The water in Diamond Fork Pipeline would be conveyed to the confluence of Diamond Fork Creek and Spanish Fork River, where it would be discharged into Spanish Fork River. As specified in CUPCA, minimum flows for Diamond Fork Creek below Monks Hollow would be maintained at 60 cfs from October through April and 80 cfs from May through September.

1.6.2.2 Maintenance Operations

Operation of the No Action Alternative would be subject to the following maintenance interruptions:

1.6.2.2.1 Annual Spring Shutdown of All Features Except Syar Tunnel. The Syar Tunnel guard gate (see Map A-1 and Section 1.9.3.2) would be closed annually during spring runoff to allow CUWCD to inspect all features (except Syar Tunnel) of the No Action Alternative, (i.e. pipelines, valves, dam outlet). This maintenance inspection is expected to take one week. The guard gate would back water up in Syar Tunnel and allow continuous releases for minimum streamflows through the clamshell valve to Strawberry Tunnel where it is connected to Syar Tunnel (Inset 1, Map A-1). The shutdown normally would be scheduled during spring runoff when water delivery to Utah Lake is at a minimum and natural flows in Diamond Fork Creek below Red Hollow would satisfy minimum streamflow requirements. These minimum flows would not be achieved in Diamond Fork Creek below Red Hollow under natural flow conditions plus Strawberry Tunnel flows in 7 dry years during the 44-year analysis period. Therefore, up to 35 cfs additional flow would be released from Strawberry Tunnel in April of these dry years to meet minimum streamflow requirements in Diamond Fork Creek below Red Hollow.

1.6.2.2.2 Periodic Inspection of Syar Tunnel Inlet Gates. The Syar Tunnel inlet gates would be inspected periodically during spring runoff on a schedule as determined by CUWCD, but not annually. When this inspection is scheduled, it would be in addition to the annual shutdown and inspection of the rest of the Diamond Fork System. The Syar Tunnel inlet gates would be closed for one day while the tunnel is drained and the inlet gates inspected to ensure proper operation. Minimum streamflows in Sixth Water Creek would be met through delivery of flows through Strawberry Tunnel using the new connection to the bypass pipe (see Inset 1, Map A-1, and Section 1.9.3.2). To the extent possible and if necessary, flows to meet minimum streamflows in Diamond Fork Creek would be released through Strawberry Tunnel.

1.6.2.2.3 Annual Fall Inspection of Sixth Water Aqueduct. Sixth Water Aqueduct would be inspected annually every October after irrigation season. The Syar Tunnel guard gate would be closed for two days to allow inspection of Sixth Water Aqueduct and other features. During this shutdown, minimum streamflows in Diamond Fork Creek would be released from Strawberry Tunnel to Sixth Water Creek.

1.6.2.2.4 Periodic Clamshell Valve Maintenance. The clamshell valve in the connection between Strawberry and Syar Tunnel (see Inset 1, Map A-1) would require periodic maintenance once every 5 to 7 years (period to be determined by CUWCD). The clamshell valve would be closed and Strawberry Tunnel would be dewatered to allow maintenance crews to move equipment through the tunnel to the valve. This maintenance shutdown would occur following the irrigation season; minimum streamflow requirements in Sixth Water Creek above Sixth Water Aqueduct would not be met during a two-day period.

1.6.2.2.5 Periodic Shutdown of Diamond Fork System Except for Syar Tunnel. The Diamond Fork System would be shut down below the Syar Tunnel guard gate for up to three weeks once every 5 to 7 years (period to be determined by CUWCD) for inspection and maintenance. During this three-week period, the Syar Tunnel inlet gates also would be closed for a two-day period to allow for inspection and maintenance. This system-wide shutdown would not be scheduled during the same year as the clamshell valve periodic maintenance. The Diamond Fork System shutdown would occur in April or May during high runoff years to the extent possible. Minimum streamflow requirements in Diamond Fork Creek would not be met during the two-day shutdown of the Syar

Tunnel inlet gates. During the rest of the shutdown period, the guard gate would back water up in Syar Tunnel and allow continuous releases of minimum stream flows through the clamshell valve and Strawberry Tunnel to Sixth Water and Diamond Fork creeks.

1.6.2.2.6 Three Forks Dam Sedimentation Management. Three Forks Dam and Reservoir would collect and store some sediment from Sixth Water Creek, Cottonwood Creek and Diamond Fork Creek inflows. The reservoir outlet to Diamond Fork Creek would be operated during runoff flows each spring to sluice collected sediment through the pool and into downstream reaches. The outlet also would be operated continuously throughout the year to release the minimum streamflows required in Diamond Fork Creek below Red Hollow. The large daily fluctuations in water surface elevation would help move finer sediments toward the dam and reservoir outlet. The spring runoff and daily operation scenarios would help prevent excessive sediment storage in the reservoir and continue the existing supply of sediment in Diamond Fork Creek downstream of Three Forks.

1.6.2.3 Emergency Operations

Emergency operations would involve release of additional water from Strawberry Tunnel. Emergency operations would be necessary in the unlikely event of a valve failure, pipeline rupture, or dam collapse. The No Action Alternative would be completed with safeguards in place to allow emergency operation until repairs could be made.

Up to 200 cfs would be released from Syar Tunnel into Strawberry Tunnel if Sixth Water Aqueduct became unusable, or emergency circumstances required use of Strawberry Tunnel to deliver contracted Bonneville Unit M&I water or SVP water as stipulated in Section 303(f) of CUPCA. Even though no such releases are anticipated or proposed, for purposes of worst-case impact analysis, a one-month release of 200 cfs is assumed.

Three Forks Dam could be operated to discharge up to 250 cfs from the outlet to Diamond Fork Creek below Red Hollow in an emergency if Diamond Fork Pipeline or Spanish Fork River Outlet from Diamond Fork Pipeline were down for maintenance or repairs.

1.6.3 Streamflows

This section describes streamflows and water volumes that would be conveyed through key reaches of Sixth Water Creek, Diamond Fork Creek and Spanish Fork River under the No Action Alternative. Two sets of numbers are shown on all of the tables to describe the flows in various ways. The first set shows monthly average flows in cfs and acre-feet when averaged over the entire 44-year analysis period. The second set shows monthly average flows from a single, extremely dry year and a single, extremely wet year. Additional water supply details are located in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d). The following section headings refer to a reach while the tables refer to a specific point.

The Mitigation Commission, under Title III of CUPCA, is authorized to perform stream channel restoration work along Diamond Fork and Sixth Water creeks. The minimum flows described above under the No Action Alternative would facilitate these efforts. The commission will conduct additional studies to determine optimal seasonal flows in cooperation with the U.S. Fish and Wildlife Service, Utah Division of Wildlife Resources, Forest Service and the CUWCD. Based on these studies the commission in the future will prepare a Sixth Water Creek and Diamond Fork Creek Restoration Plan (not part of this FS-FEIS), that could involve recommended changes to the Diamond Fork System operation plan. The commission will conduct additional NEPA compliance documentation on any plans that they develop.

1.6.3.1 Sixth Water Creek Between Strawberry Tunnel and Sixth Water Aqueduct

Under the No Action Alternative, flows in this stretch of Sixth Water Creek would normally consist of releases from Strawberry Tunnel of not less than 32 cfs in summer and not less than 25 cfs in winter to maintain minimum flows, plus natural inflow downstream of the tunnel. Total annual average volume of water above Sixth Water Aqueduct would be 23,200 acre-feet. This would consist of 14,900 acre-feet of Bonneville Unit Water, 2,200 acre-feet of SVP water, 3,600 acre-feet of Strawberry Tunnel Seepage, and 2,500 acre-feet of natural gains. Table 1-15 shows the estimated average monthly flows in Sixth Water Creek above Sixth Water Aqueduct.

Table 1-15
Estimated Streamflows in Sixth Water Creek Immediately Above Sixth Water Aqueduct
Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	34	27	26	26	26	27	33	48	37	34	33	34
Acre-feet[b]	2,100	1,600	1,600	1,600	1,500	1,700	2,000	2,900	2,200	2,100	2,100	2,000
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	33	26	26	26	26	26	27	35	32	32	32	33
Wet year[d]	34	27	27	27	27	27	58	87	52	36	35	34

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.2 Sixth Water Creek Between Sixth Water Aqueduct and Fifth Water Creek

Under the No Action Alternative the total annual average volume of water below Sixth Water Aqueduct would be 164,500 acre-feet. In addition to the 23,200 acre-feet annual average volume of water from above Sixth Water Aqueduct, this volume includes 141,200 acre-feet (annual average volume) of release from Syar Tunnel and Sixth Water Aqueduct. The release from Syar Tunnel and Sixth Water Aqueduct is comprised of 81,900 acre-feet of Bonneville Unit water and 59,300 acre-feet of SVP water. Table 1-16 shows the average monthly flows below Sixth Water Aqueduct.

Table 1-16
Estimated Streamflows in Sixth Water Creek Immediately Below Sixth Water Aqueduct Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	71	163	135	146	161	168	194	285	401	462	343	197
Acre-feet[b]	4,400	9,700	8,300	8,900	9,000	10,300	11,500	17,500	23,800	28,300	21,000	11,700
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	134	160	142	170	189	192	151	257	386	304	165	86
Wet year[d]	52	166	153	54	51	50	58	100	192	362	257	212

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.3 Sixth Water Creek Between Fifth Water Creek and Diamond Fork Creek

Table 1-17 shows the estimated average monthly flows in Sixth Water Creek below Fifth Water Creek. Total annual average volume of water below Fifth Water Creek would be 169,000 acre-feet. The only change from the annual average volume below Sixth Water Aqueduct would be the addition of 4,500 acre-feet of natural gains.

Table 1-17
Estimated Streamflows in Sixth Water Creek Below Fifth Water Creek Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	74	166	137	148	163	171	209	312	409	465	345	200
Acre-feet[b]	4,500	9,900	8,400	9,100	9,100	10,500	12,400	19,200	24,300	28,500	21,200	11,900
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	136	162	143	172	191	194	154	261	386	304	165	88
Wet year[d]	56	170	156	56	54	53	115	195	227	368	262	216

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.4 Diamond Fork Creek Between Three Forks and Red Hollow

Table 1-18 shows the estimated average monthly flows in Diamond Fork Creek below Three Forks. Total annual average volume of water in Diamond Fork Creek below Three Forks would be 55,100 acre-feet. This would include releases from Three Forks Dam to maintain the minimum streamflows in Diamond Fork Creek plus 9,800 acre-feet of natural gain.

Table 1-18
Estimated Streamflows in Diamond Fork Creek Below Three Forks
Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	60	60	60	60	60	60	85	139	87	80	80	80
Acre-feet[b]	3,700	3,600	3,700	3,700	3,400	3,700	5,000	8,600	5,200	4,900	4,900	4,800
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	60	60	60	60	60	60	60	80	80	80	80	80
Wet year[d]	60	60	60	60	60	60	239	389	162	80	80	80

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.5 Diamond Fork Creek Between Red Hollow and Spanish Fork River

Table 1-19 shows estimated flows in Diamond Fork Creek below Red Hollow (2.5 miles downstream of Three Forks Dam), which consist of releases from Three Forks Dam. These include minimum streamflows of 80 cfs in summer and 60 cfs in winter, plus natural flows in Diamond Fork Creek.

Table 1-19
Estimated Streamflows in Diamond Fork Creek Below Red Hollow
Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	60	60	60	60	60	60	85	139	87	80	80	80
Acre-feet[b]	3,700	3,600	3,700	3,700	3,400	3,700	5,000	8,600	5,200	4,900	4,900	4,800
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	60	60	60	60	60	60	60	80	80	80	80	80
Wet year[d]	60	60	60	60	60	60	239	389	162	80	80	80

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.6 Spanish Fork River Between Diamond Fork Creek and Spanish Fork Diversion Dam

Table 1-20 shows estimated flows in this stretch of Spanish Fork River, which consist of natural river flow plus the discharge of Diamond Fork Creek and Diamond Fork Pipeline. This stretch of the Spanish Fork River is defined as the section of river from the confluence of Diamond Fork Creek and Spanish Fork River to the Spanish Fork Diversion Dam near the mouth of Spanish Fork Canyon (see Map A-2). The total annual average volume of 248,700 acre-feet includes 61,500 acre-feet of SVP water, 96,800 acre-feet of Bonneville Unit water, Strawberry Tunnel seepage and natural flow from Diamond Fork Creek and Spanish Fork River.

Table 1-20
Estimated Streamflows in Spanish Fork River at Castilla Gage
Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	133	226	196	206	236	274	420	656	572	541	403	256
Acre-feet[b]	8,200	13,400	12,100	12,700	13,200	16,800	25,000	40,300	34,000	33,200	24,700	15,200
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	173	201	177	209	233	244	201	309	394	317	202	126
Wet year[d]	115	226	210	122	125	150	1,076	1,905	706	573	411	332

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.7 Spanish Fork River Between Spanish Fork Diversion Dam and East Bench Dam

Table 1-21 shows estimated flows in the Spanish Fork River immediately below Spanish Fork Diversion Dam, which consist of natural river flow, Bonneville Unit water and SVP water flowing to East Bench Canal. This reach of Spanish Fork River is defined as the section of river from below Spanish Fork Diversion Dam near the mouth of Spanish Fork Canyon to East Bench Dam (see Map A-2). The total annual average volume of 102,800 acre-feet includes 6,900 acre-feet of SVP water, 84,600 acre-feet of Bonneville Unit water and 11,300 acre-feet of natural flow in Spanish Fork River.

Table 1-21
Estimated Streamflows in Spanish Fork River Below Spanish Fork Diversion Dam
Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	34	157	129	140	154	161	193	275	164	127	97	76
Acre-feet[b]	2,100	9,300	7,900	8,600	8,600	9,900	11,500	16,900	9,800	7,800	6,000	4,500
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	113	153	136	164	183	186	163	130	102	39	25	12
Wet year[d]	10	158	146	47	44	42	576	1,402	191	79	53	34

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.8 Spanish Fork River Between East Bench Dam and Mill Race Diversion

Table 1-22 shows estimated flows in the Spanish Fork River between East Bench Dam and Mill Race Diversion (see Map A-2), which consist of natural river flow and Bonneville Unit water. These projected flows do not include water released to the river from the Power Canal. The total annual average volume of 89,500 acre-feet includes 84,600 acre-feet of Bonneville Unit water and 4,900 acre-feet of natural flow in Spanish Fork River.

Table 1-22
Estimated Streamflows in Spanish Fork River Below East Bench Dam
Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	28	157	129	140	154	161	184	226	108	81	63	57
Acre-feet[b]	1,700	9,300	7,900	8,600	8,600	9,900	10,900	13,900	6,400	5,000	3,900	3,400
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	107	153	136	164	183	186	144	92	45	20	11	6
Wet year[d]	6	158	146	47	44	42	576	1,364	110	13	9	0

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.9 Spanish Fork River From Mill Race Diversion to Lake Shore Diversion

Table 1-23 shows estimated flows in Spanish Fork River below Mill Race Diversion (see Map A-2), which consist of natural river flow and Bonneville Unit water. The total annual average volume of 135,800 acre-feet includes 83,100 acre-feet of Bonneville Unit water and 52,700 acre-feet of natural flow in Spanish Fork River.

Table 1-23
Estimated Streamflows in Spanish Fork River Below Mill Race Diversion
Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	72	226	196	206	236	272	354	327	136	89	74	69
Acre-feet[b]	4,400	13,400	12,100	12,700	13,200	16,700	21,000	20,100	8,100	5,500	4,600	4,100
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	136	201	177	209	233	244	156	92	42	15	11	10
Wet year[d]	39	226	210	122	125	150	1,076	1,626	199	36	17	14

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.3.10 Spanish Fork River From Lake Shore Diversion to Utah Lake

Table 1-24 shows estimated flows in Spanish Fork River at the Lake Shore gage, which consist of natural river flow and Bonneville Unit water. The total annual average volume of 133,300 acre-feet includes 86,100 acre-feet of Bonneville Unit water and 47,200 acre-feet of natural flow in Spanish Fork River.

Table 1-24
Estimated Streamflows in Spanish Fork River at Lake Shore Gage
Under the No Action Alternative

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average flows and discharges over the entire 44-year period of analysis												
cfs[a]	57	224	206	219	251	290	365	303	121	65	55	62
Acre-feet[b]	3,500	13,300	12,600	13,400	14,000	17,800	21,700	18,600	7,200	4,000	3,400	3,700
Representative dry-year and wet-year monthly average flows (cfs)												
Dry year[c]	125	204	193	224	247	253	160	96	41	0	2	1
Wet year[d]	50	226	217	132	142	187	1,108	1,540	281	0	4	40

[a]Rounded to nearest cfs.
[b]Rounded to nearest 100 acre-feet.
[c]The dry-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1961.
[d]The wet-year monthly average flows are based on natural runoff conditions that would have historically occurred in 1952.

1.6.4 Operating Entity

The CUWCD would operate and maintain the Diamond Fork System under the No Action Alternative (see Section 1.4.4).

1.6.5 Automated Control System

The control system under the No Action Alternative would be the same as described for the Proposed Action in Section 1.4.5 except the remote telemetry units would be located at the Syar Tunnel inlet, Sixth Water Aqueduct outlet, the Three Forks Dam connection to Diamond Fork Pipeline Extension, the Three Forks Dam outlet to Diamond Fork Creek, and Spanish Fork River Outlet.

1.7 Summary of Other Characteristics

This section summarizes other characteristics of the Proposed Action and No Action Alternative. Where these other characteristics are different, the descriptions are specific to either the Proposed Action or the No Action Alternative as indicated in the text.

1.7.1 Construction Schedule and Workers

1.7.1.1 Proposed Action

After obtaining the necessary approvals and federal funding, construction of the Proposed Action is projected to take 3 ½ years. Table 1-25 shows a construction summary and schedule, respectively. Table 1-25 includes the average number of construction personnel required per month for each project component. The schedule assumes a Record of Decision would be signed by midsummer 1999 and construction would begin in fall 1999. The projections are subject to change as the construction program is refined.

Table 1-25
Construction Summary for the Proposed Action

Diamond Fork System Feature	Segment Length (miles)	Average Production (feet/day)	Construction Duration (# work days)	Construction Schedule	Average Personnel (persons/month)
Sixth Water Connection to Tanner Ridge Tunnel and Tanner Ridge Tunnel	1.0	20	282	September 1999 to October 2000	20 to 30
Diamond Fork Siphon	1.2	53	152	March 2002 to October 2002	20 to 30
Red Mountain Tunnel	1.8	25	391	August 2000 to February 2002	20 to 30
Red Hollow Pipeline and connection to Diamond Fork Pipeline and Diamond Fork Creek Outlet[a]	2.2	65	174	October 2002 to June 2003	20 to 30
Spanish Fork River Outlet[b] from Diamond Fork Pipeline	0.5	53	174	October 1999 to June 2000	10 to 20

[a]Diamond Fork Creek Outlet would be located below Monks Hollow.
[b]Spanish Fork River Outlet would be located under the Highway 6 embankment.

1.7.1.2 No Action Alternative

After obtaining the necessary approvals and federal funding, construction of the No Action Alternative is projected to take three years. Table 1-26 shows a construction summary and schedule, respectively. It includes the average number of construction personnel required per month for each project component. The schedule assumes that a Record of Decision would be signed in 1999 and construction would begin in summer 2000. The projections are subject to change as the construction program is refined.

Table 1-26
Construction Summary for the No Action Alternative

Diamond Fork System Feature	Segment Length (miles)	Average Production (feet/day)	Construction Duration (# work days)	Construction Schedule	Average Personnel (persons/month)
Diamond Fork Pipeline Extension	2.7	65	220	July 2000 to December 2001	20 to 30
Three Forks Dam	0.1	NA[a]	310	October 2001 to June 2003	30 to 40
Spanish Fork River Outlet[b] from Diamond Fork Pipeline	0.5	53	174	October 2001 to June 2002	10 to 20

[a]NA means not applicable.
[b]Spanish Fork River Outlet would be located under the Highway 6 embankment.

1.7.2 Employment Opportunities Under the Proposed Action

Table 1-27 shows employment opportunities and estimated pay rates for construction and maintenance of the Proposed Action. Table 1-28 shows employment opportunities and estimated pay rates for construction and maintenance of the No Action Alternative. The project would employ both skilled and unskilled workers.

Table 1-27
Employment Opportunities and Estimated Pay Rates for Construction and Maintenance of the Proposed Action

Category	Compensation ($)	Work Months
Construction Contractor Forces		
Administrative	55,000/yr	33
Supervisory	45,000/yr	66
Skilled Labor	22.96/hr	290
Unskilled Labor	10.76/hr	436
Total Contractor Work Force[a]		**825**
Construction Management Staff		
Administrative	60,000/yr	33
Professional	80,000/yr	33
Technical	40,000/yr	120
Total Construction Management Work Force		186
Total Construction Work-Months		**1,011**
Maintenance Staff		
District Engineer	65,000/yr	0.25
Clerical	28,000/yr	0.25
Field Supervisor	50,000/yr	1.00
Field Operation and Maintenance (O&M) Laborer	35,000/yr	1.00
Annual O&M Work-Months		**2.50**

[a]Does not include off-site material hauling workforce time.

Table 1-28
Employment Opportunities and Estimated Pay Rates for Construction and Maintenance of the No Action Alternative

Category	Compensation ($)	Work Months
Construction Contractor Forces		
Administrative	55,000/yr	30
Supervisory	45,000/yr	45
Skilled Labor	22.96/hr	230
Unskilled Labor	10.76/hr	340
Total Contractor Work Force[a]		**645**
Construction Management Staff		
Administrative	60,000/yr	30
Professional	80,000/yr	30
Technical	40,000/yr	100
Total Construction Management Work Force		160
Total Construction Work-Months		**805**
Maintenance Staff		
District Engineer	65,000/yr	0.25
Clerical	28,000/yr	0.25
Field Supervisor	50,000/yr	1.00
Field Operation and Maintenance (O&M) Laborer	35,000/yr	1.00
Annual O&M Work-Months		**2.50**

[a]Does not include off-site material hauling workforce time.

1.7.3 Transportation Requirements

1.7.3.1 Proposed Action

Construction transportation requirements of the Proposed Action include a maximum of 416 trips per day for 1,032 work days, starting in September 1999 and ending in June 2003. Construction transportation routes would include I-15 to Highway 6, Highway 6 to Diamond Fork Road (Forest Route 029), Diamond Fork Road and Red Hollow Road (Forest Route 492), Highway 6 to Sheep Creek-Rays Valley Road (Forest Route 051), and Sheep Creek-Rays Valley Road to the Sixth Water Aqueduct road (Forest Route 622). Construction management staff and workers would use pickup trucks and other passenger vehicles to commute to the project site.

1.7.3.2 No Action Alternative

Construction transportation requirements of the No Action Alternative include a maximum of 150 trips per day for 704 work days, starting in July 2000 and ending in June 2003. Construction transportation routes would include I-15 to Highway 6, Highway 6 to Diamond Fork Road (Forest Route 029) and Diamond Fork Road to Three Forks. Construction management staff and workers would use pickup trucks and other passenger vehicles to commute to the project site.

1.7.4 Materials Used During Construction

Table 1-29 lists construction material requirements for the Proposed Action. Concrete for tunnel lining would be batched along the Spanish Fork River and trucked to each construction site. Gravel for pipe backfill would be imported from commercial sources in Utah County.

Table 1-29
Construction Material Requirements for the Proposed Action

Type of Material	Use of Material	Quantity
Concrete (cubic yards)	Tunnel Lining	32,000
	Pipe Lining, Coating and Bedding	6,000
	Pipeline Structures	1,000
	Flow Control Structures	1,000
	Total	**40,000**
Steel (pounds)	Concrete Reinforcing	6,318,000
	Pipe Cylinder	27,600,000
	Valves	38,000
	Total	**33,956,000**
Riprap (cubic yards)	Erosion Protection	600

Table 1-30 lists construction material requirements for the No Action Alternative. Concrete for the dam would be batched along the Spanish Fork River and trucked to the construction site. Gravel for pipe backfill would be imported from commercial sources in Utah County.

Table 1-30
Construction Material Requirements for the No Action Alternative

Type of Material	Use of Material	Quantity
Concrete (cubic yards)	Three Forks Dam	65,000
	Pipe Lining, Coating and Bedding	4,400
	Pipeline Structures	700
	Flow Control Structures	700
	Total	**70,800**
Steel (pounds)	Concrete Reinforcing	1,920,000
	Pipe Cylinder	20,000,000
	Valves	28,000
	Total	**21,948,000**
Riprap (cubic yards)	Erosion Protection	1,800

1.7.5 Projected Project Life and Costs

Table 1-31 shows the standard operational life of the major Proposed Action features. The typical operational life of projects of this type is at least 75 years before major rehabilitation work would be required. These features would be replaced as they wear out. Rehabilitation and ongoing maintenance would indefinitely prolong the operational life of the Diamond Fork System.

Table 1-31
Standard Operational Life of
Proposed Action Features

Feature	Standard Life (years)
Pipelines	75
Tunnels	75
Permanent Access Roads	35

Construction costs for completing the Diamond Fork System are estimated to be approximately $62 million.

Table 1-32 shows the standard operational life of the major No Action Alternative features. The typical operational life of projects of this type is at least 75 years before major rehabilitation work would be required. These features would be replaced as they wear out. Rehabilitation and ongoing maintenance would indefinitely prolong the operational life of the Diamond Fork System.

Table 1-32
Standard Operational Life of
No Action Alternative Features

Feature	Standard Life (years)
Pipelines	75
Dam	75
Permanent Access Roads	35

Construction costs for completing the No Action Alternative are estimated to be approximately $56 million.

1.7.6 Land Disturbance

Table 1-33 shows land disturbance that would result from construction and operation of the Proposed Action features. Table 1-34 shows land disturbance that would result from construction and operation of the No Action Alternative features.

Table 1-33
Land Disturbance Resulting From the Proposed Action (acres)

Project Feature	Land Area Disturbed During Construction	Land Area to be Revegetated	Land Area Permanently Disturbed
Sixth Water Connection to Tanner Ridge Tunnel	1.1[a]	0.2	0
Tanner Ridge Tunnel	8.8	7.8	1.0[b]
Diamond Fork Siphon	35.0	35.0	0
Red Mountain Tunnel	9.5	8.5	1.0[c]
Red Hollow Pipeline and connection to Diamond Fork Pipeline and Red Hollow Flow Control Structure	44.6	43.9	0.7[d]
Spanish Fork River Outlet from Diamond Fork Pipeline and Flow Control Structure	8.2	7.7	0.5
Access Roads	16.1	13.5	2.6[e]
Construction Staging Areas	15.0	15.0	0
Total	138.3	131.6	5.8

[a]Includes area already disturbed and water in Sixth Water Creek.
[b]Includes 0.5 acre each at Tanner Ridge Tunnel inlet and outlet.
[c]Includes 0.5 acre each at Red Mountain Tunnel inlet and outlet.
[d]Includes flow control facility, overflow structure and Diamond Fork Creek Outlet
[e]Includes Red Hollow Pipeline and Red Mountain Tunnel access road

Table 1-34
Land Disturbance Resulting From the No Action Alternative (acres)

Project Feature	Land Area Disturbed During Construction	Land Area to be Revegetated	Land Area Permanently Disturbed
Diamond Fork Pipeline Extension	49.1[a]	42.6	0
Three Forks Dam and Reservoir	17.0	1.5	15.5
Spanish Fork River Outlet from Diamond Fork Pipeline	8.2	7.7	0.5
Access Roads[b]	14.1	0	14.1
Construction Staging Areas	7.0	7.0	0
Total	95.4	58.8	30.1

[a]Includes existing Diamond Fork Road and adjacent area in the corridor along the road. The existing road surface would be restored to provide public access along the pipeline alignment to the new road located 2,000 feet downstream of the dam. The construction corridor along the existing road would be revegetated.
[b]Includes 4,500 feet of new public access road excavated in rock, with disposal of the rock near the main staging area in a 6.9-acre fill.

1.7.7 Construction Equipment, Noise Levels and Emissions

Table 1-35 shows required equipment and typical noise levels for construction of the Proposed Action and No Action Alternative. Table 1-36 shows monthly emission levels for equipment under the Proposed Action and No Action Alternative.

Table 1-35
Construction Equipment and Typical Noise Levels
for Construction of the Proposed Action and No Action Alternative
Page 1 of 2

Equipment	Horsepower	Fuel Type	Daily Usage	Range of Noise Levels at 50 Feet (in decibels [dBA])	Nominal Noise Level at 50 Feet (in dBA)
Backhoe	70	Diesel	8 hours	71-93	85
Boring and Jacking Equipment	60	Diesel	8 hours	68-81	76
Compactor (Dual Drum Asphalt)	80	Diesel	8 hours	71-93	85
Compactor (Cat 816)	210	Diesel	8 hours	72-96	84
Compactor (Padded Drum Vibratory)	200	Diesel	8 hours	75-84	80
Compactor (21" Whacker)	5	Diesel	8 hours	84-90	86
Compressor (Air)	85	Diesel	8 hours	68-87	78
Crane 60 ton (LinkBelt)	180	Diesel	8 hours	75-95	80
Dozer (Cat D4)	80	Diesel	8 hours	72-96	86
Dozer (Cat D6)	150	Diesel	8 hours	72-96	86
Dozer (Cat D8)	300	Diesel	8 hours	72-96	86
Excavator (Cat 235c)	250	Diesel	8 hours	71-93	85
Excavator (Cat 245c)	360	Diesel	8 hours	71-93	85
Generator	40	Diesel	8 hours	69-81	75
Grader (Cat 14G)	200	Diesel	8 hours	73-95	85
Loader (Bobcat Skid Steer)	40	Diesel	8 hours	69-81	75
Loader (Cat 966F)	220	Diesel	8 hours	71-96	82
Loader (Cat 988)	400	Diesel	8 hours	71-96	82

Table 1-35
Construction Equipment and Typical Noise Levels
for Construction of the Proposed Action and No Action Alternative
Page 2 of 2

Equipment	Horsepower	Fuel Type	Daily Usage	Range of Noise Levels at 50 Feet (in decibels [dBA])	Nominal Noise Level at 50 Feet (in dBA)
Loader (Cat 992)	690	Diesel	8 hours	71-96	82
Pump (Concrete)	100	Diesel	8 hours	74-84	82
Pump (Water)	70	Diesel	8 hours	69-80	74
Truck (10,000 lb., 4X4, Flatbed)	180	Gas	50 mi/day	70-92	82
Truck (4X2 Pickup)	130	Gas	50 mi/day	76-85	80
Truck (6x4 Dump)	235	Diesel	50 mi/day	70-92	85
Truck (Bottom Dump)	260	Diesel	50 mi/day	70-92	85
Truck (Concrete Mixer)	250	Diesel	50 mi/day	70-90	85
Truck (Grout)	180	Diesel	8 hours	70-92	82
Truck (On Hwy, 3,500 gal.)	250	Diesel	8 hours	70-92	85
Truck (Pipe Delivery)	260	Diesel	50 mi/day	70-92	85
Truck (Welding)	180	Gas	8 hours	70-92	82

Table 1-36
Monthly Equipment Emissions (lb/month)
for Construction of the Proposed Action and No Action Alternative
Page 1 of 3

Equipment	Hours of Use	CO[a]	Reactive Organic Gases	NO_x[b]	SO_2[c]	PM_{10}[d]
Backhoe	176	184.800	36.960	271.040	24.640	24.640
Boring and Jacking Equipment	176	211.200	31.680	253.440	21.120	31.680
Compactor (Dual Drum Asphalt)	176	98.560	28.160	281.600	28.160	28.160
Compactor (Cat 816)	176	258.720	73.920	739.200	73.920	73.920

Table 1-36
Monthly Equipment Emissions (lb/month)
for Construction of the Proposed Action and No Action Alternative
Page 2 of 3

Equipment	Hours of Use	CO[a]	Reactive Organic Gases	NO_x[b]	SO_2[c]	PM_{10}[d]
Compactor (Padded Drum Vibratory)	176	246.400	70.400	704.000	70.400	70.400
Compressor (Air)	176	9.680	1.760	15.840	1.760	1.760
Crane 60 ton (LinkBelt)	176	285.120	95.040	728.640	63.360	95.040
Dozer (Cat D4)	176	140.800	28.160	295.680	28.160	14.080
Dozer (Cat D6)	176	264.000	52.800	554.400	52.800	26.400
Dozer (Cat D8)	176	528.000	105.600	1108.800	105.600	52.800
Excavator (Cat 235c)	176	484.000	44.000	1056.000	88.000	132.000
Excavator (Cat 245c)	176	696.960	63.360	1520.640	126.720	190.080
Generator	176	77.440	0.000	126.720	14.080	14.080
Grader (Cat 14G)	176	281.600	105.600	739.200	70.400	70.400
Loader (Bobcat Skid Steer)	176	105.600	21.120	154.880	14.080	14.080
Loader (Cat 966F)	176	580.800	116.160	851.840	77.440	77.440
Loader (Cat 988)	176	1056.000	211.200	1548.800	140.800	140.800
Loader (Cat 992)	176	1821.600	364.320	2671.680	242.880	242.880
Pump (Concrete)	176	193.600	35.200	316.800	35.200	35.200
Pump (Water)	176	135.520	24.640	221.760	24.640	24.640
Truck (10,000 lb., 4X4, Flatbed)	176	158.400	15.840	15.840	0.000	2.218
Truck (4X2 Pickup)	176	114.400	11.440	11.440	0.000	1.602
Truck (6x4 Dump)	176	248.160	82.720	868.560	82.720	82.720
Truck (Bottom Dump)	176	274.560	91.520	960.960	91.520	91.520
Truck (Concrete Mixer)	176	264.000	88.000	924.000	88.000	88.000
Truck (Grout)	176	190.080	63.360	665.280	63.360	63.360

Table 1-36
Monthly Equipment Emissions (lb/month)
for Construction of the Proposed Action and No Action Alternative
Page 3 of 3

Equipment	Hours of Use	CO[a]	Reactive Organic Gases	NO_x[b]	SO_2[c]	PM_{10}[d]
Truck (On Hwy, 3,500 gal.)	176	264.000	88.000	924.000	88.000	88.000
Truck (Pipe Delivery)	176	274.560	91.520	960.960	91.520	91.520
Truck (Welding)	176	158.400	15.840	15.840	0.000	2.218

[a]Carbon monoxide
[b]Nitrogen oxides
[c]Sulfur dioxide
[d]Particulate matter less than 10 microns in aerodynamic diameter

1.7.8 Standard Operating Procedures (SOPs) During Construction

This section defines standard operating procedures (SOPs) for the Proposed Action. SOPs will be followed (not withstanding unforeseen conditions that would require modifications) during construction, operation and maintenance of the project to avoid or minimize adverse impacts on people and natural resources. Chapter 3 identifies mitigation measures designed to avoid or minimize impacts after SOPs have been successfully implemented.

1.7.8.1 Erosion Control

Erosion control procedures will be implemented in areas disturbed during construction of project components, including temporary access roads and access roads that are upgraded to construction traffic standards. The contractor will be required to restore disturbed surfaces to preconstruction conditions and avoid and minimize erosion.

Temporary slope breakers would be used to reduce runoff velocity and divert waste from the construction right-of-way. They will be constructed with materials such as soil, silt fence, staked hay or straw bales, or sandbags, using the written recommendations of local land managing agencies and soil conservation authorities. In the absence of these recommendations, temporary slope breakers will be installed at the following spacing:

Slope	Spacing
5 percent to 15 percent	300 feet
More than 15 percent to 30 percent	200 feet
More than 30 percent	100 feet

Slope breakers will be constructed with a 2 to 8 percent outslope to divert surface flow to stable, well-vegetated areas. Slope breakers would comply with all applicable survey requirements if they extend beyond the edge of the construction right-of-way. Appropriate energy-dissipating devices would be built in the absence of a stable area, or at the end of the slope breaker, if necessary.

Sediment barriers will be installed to keep wetlands and water bodies free of possible sedimentation resulting from construction. The barriers will be constructed of materials such as silt fence, staked hay or straw bales, or sandbags. They will be installed as necessary and maintained at the base of slopes adjacent to road crossings and at construction locations near water bodies or wetlands where siltation could occur.

Mulch will be used on sites with low annual precipitation or high erosion potential, on slopes exceeding 15 percent, or on windy sites. Mulch can consist of noxious weed-free straw or hay, erosion control fabric or a functional equivalent. It will be applied before seeding if final cleanup (including final grading and installation of permanent erosion control measures) is not completed in an area within 10 days after the trench has been backfilled or if construction or restoration activity is delayed for extended periods, such as a seeding period restriction.

Straw mulch will be applied at the following rates: 1 ton per acre on level ground; two tons per acre over at least 75 percent of the ground surface on all dry, sandy sites and sites with slopes greater than 8 percent; and three tons per acre if slopes are within 100 feet of water bodies and wetlands. When woodchips are used as a mulch, a maximum of 1 ton per acre along with 11 pounds per acre of available nitrogen (at least 50 percent of the nitrogen should be slow-release).

Mulch will be anchored to help stabilize erodible soils by using a mulch crimper or disk with notched coulters to crimp the mulch to a depth of 2 to 3 inches. If a blower is used, mulching materials should be at least 8 inches long to allow anchoring. Liquid mulch binders would be used at recommended manufacturer rates and would not be used within 100 feet of wetlands or water bodies.

Erosion control fabric such as jute thatching or bonded fiber blankets will be used on water body banks during final recontouring or on extremely steep slopes. The fabric will be anchored with staples or other anchoring devices.

1.7.8.2 Restoration

Existing topsoil will be carefully removed and stored during trenching operations and replaced after trenches are backfilled. Where drainage occurs, gaps will be left between topsoil piles to prevent increased water saturation. Topsoil stripping activities would cease during excessively wet weather, and topsoil will not be stockpiled for longer than 2 years. Additional topsoil will be added, if needed, to allow vegetation growth.

Waste material (tunnel muck) from tunneling operations will be disposed in areas near tunnel portals and graded and shaped to match the natural topography to the extent feasible. Spoil will be revegetated as described below.

Final cleanup of an area (including replacement of topsoil, final grading, and installation of permanent erosion-control structures) will be completed within 10 days after backfilling. If unavoidable delays occur, final cleanup will be completed as soon as possible and always before the end of the next recommended seeding season.

If necessary, a travel lane could be left open to allow access by construction traffic. When access is no longer required, the lane will be removed and the right-of-way restored.

After construction, soil will be replaced and worked with a disc, chisel plow, or other appropriate implement as practical to reduce compaction and leave soil in proper revegetation condition. Topsoil will be replaced with a minimum of handling.

Permanent trench breakers will be built to stop the flow of subsurface water along trenches. These would be constructed of such materials as concrete, sandbags or polyurethane foam. Trench breakers will also be installed a. the base of slopes adjacent to water bodies and wetlands. When necessary, an engineer or similarly qualified professional will determine the need for and spacing of trench breakers. Topsoil would not be used in trench breakers.

Seedbeds will be prepared in disturbed areas to a depth of 3 to 4 inches using appropriate equipment. If hydroseeding is used, the seedbed will be scarified to facilitate lodging and germination of seed. Seeding will be done in consultation with the Forest Service.

To maximize the success of revegetation, planting will occur during appropriate climatic periods in properly prepared soil. Planting and fertilizer application techniques will be chosen for specific conditions at each site and the needs of selected plant species. Temporary erosion control measures will be used at any site where seeding has been delayed.

Where possible, natural seed mixes of local origin will be used along with mulching and no, or low, amounts of fertilizer. The criteria for selecting species to plant in disturbed areas will include hardiness, compatibility with wildlife, capacity to self-perpetuate, and rooting characteristics that help stabilize soil.

All spoil piles resulting from construction of tunnels will be sloped to control erosion. Topsoil will be placed on the piles as necessary to provide suitable conditions for revegetation. Noxious weeds will be controlled as described in the Noxious Weed Control Plan presented in Appendix A.

Temporary traffic barriers will be placed as necessary to keep vehicles from traveling over areas that have been revegetated. Traffic barriers may include temporary fencing, concrete jersey barriers, berms and boulders.

1.7.8.3 Wetlands and Riparian Areas

Direct and indirect impacts on wetlands will be avoided, unless there are no other practical alternatives (as defined in 40 CFR 230.3). Procedures to avoid impacts will include protecting wetlands with silt fencing during construction and avoiding quantity and quality impacts on surface water and groundwater resources that serve as a source of water for wetlands.

The contractor will be required to prepare a road modification plan for approval by the CUWCD before starting any modifications on the Diamond Fork Road. The plan will document methods to protect wetlands adjacent to the road from construction and operational impacts.

Where impacts on wetlands cannot be avoided, they will be minimized to the extent possible. All mitigation approaches will be reviewed with the U.S. Army Corps of Engineers and the Utah Division of Water Quality. Heavy equipment in wetland areas will be operated on temporary earth fills placed on geotextile mats (or other appropriate measures) to minimize soil disturbance. Construction barriers will be installed to prevent unnecessary damage to adjacent wetlands.

Materials excavated from the pipeline trench will be placed on the adjacent roadway or in other upland areas. No excavated material will be placed in any wetlands. Wetland soils will be removed, segregated and stockpiled in upland areas. Wetland topsoil will be replaced in the top 6 to 12 inches of the pipeline trench, and the disturbed area will be graded to match previous contour elevations and revegetated with a mixture of desirable wetland plant species.

Pipelines will be installed using construction measures such as cutoff walls if a bedding material is used that could otherwise cause wetlands to be drained.

1.7.8.4 Aquatic Resources

To the extent feasible, heavy equipment use in streambeds and riparian areas during construction at stream crossings will be minimized.

Impacts on aquatic resources can be avoided and minimized by following hazardous materials procedures included under the health and safety SOPs, the restoration and erosion control SOPs, and wetlands SOPs.

1.7.8.5 Wildlife Resources

To the extent feasible, construction activities on or around important game or nongame species habitat (e.g., deer fawning areas) will be scheduled to avoid the periods of greatest use.

Impacts on wildlife resources also can be avoided and minimized by following hazardous materials procedures included under the health and safety SOPs, the restoration and erosion control SOPs, and wetlands SOPs.

Contractor personnel will not be allowed to have firearms in possession while on construction sites.

Trenches would be covered or backfilled at the completion of each day and no more than 600 feet of trench would be open at any one time.

1.7.8.6 Agricultural Resources

To minimize conflicts between pipeline construction and other land activities, the following will be done before construction begins: Owners, tenants, lessees and managers of public lands will be informed of the construction schedule; grazing permitees would be consulted and informed of fence openings, disturbances to range improvements and other range-related activities; and utilities will be contacted if their facilities would be crossed by features of the Proposed Action.

Fences along the right-of-way will be braced before they are opened. Access and livestock will be controlled with temporary fencing and gates during construction to reduce impacts on other land uses. If damaged, barriers (such as cattle guards) for livestock control would be replaced by measures that are equally effective. Construction will not inhibit existing livestock access to water and adjacent grazing areas unless agreed to by the owner and/or permittee in advance. Fences, gates and cattle guards will be restored to their original condition or replaced when construction is completed.

The construction contractor would work with the owner, Forest Service representative and livestock permittees to minimize conflicts with the annual entry and removal of livestock on the public lands.

1.7.8.7 Water Quality

Construction activities for the Proposed Action will be performed according to the Final Draft Nonpoint Source Water Pollution Control Plan of Hydrologic Modifications in Utah (Robinson 1994). The measures identified in this plan specify construction practices where there is potential for disturbing stream channels, riparian areas and floodplains. These practices are designated as Utah's Best Management Practices for nonpoint source water pollution control.

The possibility of accidental releases of materials into surface waters will be managed according to spill containment and countermeasure requirements of the CUWCD's construction specifications. Such specifications include worker education, incident reporting and remediation provisions in the event of a spill. The hazardous materials procedures included under the health and safety and erosion control SOPs also will help avoid and minimize adverse water quality impacts.

Construction workers will be careful to avoid the escapement of wet concrete into waterways and other sensitive fish and wildlife habitat.

Concrete trucks and equipment will be washed only in areas approved by the Contracting Officer that will not impact streams or sensitive fish and wildlife habitat.

Appropriate Utah water quality permits would be obtained prior to construction in or near water resources.

1.7.8.8 Cultural Resources

The CUWCD shall determine the Area of Potential Effect (APE) for the project in consultation with the Utah State Historic Preservation Officer (SHPO) in accordance with 36 CFR 800.2c.

The CUWCD will conduct a Class III cultural resources survey of the APE to identify historic properties in a manner consistent with the *Secretary of the Interior's Standards and Guidelines for Identification* (48 CFR 44720-23) and taking into account NPS publication, *The Archeological Survey: Methods and Uses* (1978 GPO stock #04-016-00091) and guided by *National Register Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties.*

The CUWCD, in consultation with the Utah SHPO, will evaluate properties identified in the survey in accordance with 36 CFR 800.4. If properties included in or eligible for the National Register of Historic Places or meeting the National Register Criteria (36 CFR 60.4) are identified, the CUWCD will comply with 36 CFR 800.5.

The CUWCD will develop Treatment Plans for the largest possible area affected by the project that is acceptable to the CUWCD and the Utah SHPO.

1.7.8.9 Visual Resources

In addition to restoration SOPs, the following visual resources SOPs will be implemented to minimize visual impacts.

Disturbed areas will be landscaped to match existing and characteristic land forms. When feasible, they will be recontoured and slopes rounded along maintenance roads, pipeline alignments and streambanks to blend with surrounding natural contours.

New plantings will be blended with natural vegetation at the edges, and configured to match existing vegetation patterns and provide horizontal and vertical diversity.

Existing vegetation that screens pipeline alignments, flow-control facilities, parking lots and other features from key viewing areas will be retained to the extent feasible. Indigenous trees will be planted to screen disturbed areas at gaps in existing vegetation where pipeline corridors, flow control facilities, parking lots and other features may be visible from key viewing areas.

Disturbed soils will be restored to match soil colors and textures of adjoining areas as closely as possible to reduce contrast in the landscape. Boulders may be placed in some areas to replicate the landscape character.

1.7.8.10 Health and Safety

The Utah Occupational Safety and Health Act and federal Occupational Safety and Health Standards will be followed during construction. Copies of these publications and the health and safety SOPs will be provided to project workers at construction sites.

Warning signs and temporary barriers will be provided in areas used by permitees and other public land users where construction activities are underway.

Onsite and offsite construction activities will fully conform with standards in the USBR safety and health standards manual (USBR 1993).

1.7.8.11 Transportation Networks

Staging areas for construction material and equipment will be sited to minimize or avoid traffic impacts in public access areas.

Traffic control and other safety measures will be followed in construction and maintenance areas to minimize the risk of vehicle and pedestrian accidents.

Roads damaged by project construction activities will be restored to at least preconstruction levels.

The shortest acceptable transportation routes will be used to dispose of spoil and waste.

Construction and traffic control procedures will be designed to minimize the length of delays and/or detours.

Trained project personnel will provide traffic control in affected areas.

If disturbed, all highway and road surfaces will be restored to their former condition.

Salt will not be used in snow removal efforts.

Snow, ice and debris will be removed from currently functioning culverts to keep the drainage system functioning efficiently. Ditches will be kept functional.

All debris, except snow and ice, that is removed from the road surface and ditches shall be deposited away from stream channels.

During snow removal operations, banks shall not be undercut and gravel or other selected surfacing material will not be bladed off the roadway surface.

Snow berms shall not be left on the road surface. Berms left on the shoulder of the road shall be removed and/or drainage holes shall be opened and maintained. Drainage holes shall be spaced as required to obtain satisfactory surface drainage without discharge on erodible fills.

Any damage resulting from snow removal will be repaired to at least the preconstruction condition.

1.7.8.12 Air Quality

CUWCD will follow, to the extent feasible, the EPA's recommendations for aggregate storage pile emissions (AP-42, Section 11.2.3) to minimize dust generation (i.e., periodic watering of equipment staging areas and dirt roads).

Construction machinery will be routinely maintained to ensure that engines remain tuned and emission-control equipment is properly functioning as required by law.

The contractor would follow Utah air quality regulations.

1.7.8.13 Noise

Mufflers on construction equipment will be checked regularly to minimize noise.

CUWCD's contractor will follow noise exposure and hearing conservation standards and practices in the USBR safety and health standards manual to protect workers and the public from potential harmful noise.

1.7.8.14 Energy Conservation

Standard energy conservation measures will be used during construction, operation and maintenance (e.g., avoiding unnecessary idling and keeping vehicles and equipment tuned and maintained).

The shortest possible transportation routes will be used during construction to conserve fuel.

1.7.9 Post-Construction Standard Operating Procedures

The following SOPs will be applied after construction is completed and during operation and maintenance of the project.

1.7.9.1 Monitoring and Follow-Up

Revegetation and erosion control areas will be monitored and repairs made as necessary. Revegetated areas will be monitored for invasion of noxious weeds and other weed species, as required by Section 4.17.3 of the Utah Noxious Weed Act, and appropriate weed control measures implemented. These measures will include establishing a cover of desirable plant species as quickly as possible after construction, interim seeding of topsoil stockpiles if they would remain barren for lengthy periods of time, conducting weed surveys during the fall and spring after initial seedings, applying herbicides or removing the weeds by mechanical or hand techniques before they develop seeds or spread roots, applying herbicides in accordance with federal application recordkeeping requirements, and washing equipment prior to arriving on the area. Monitoring for revegetation success will be conducted for a period of 3 years following completion of initial revegetation. Appendix A provides the details of a noxious weed control program.

Temporary fencing will be erected in areas where livestock or wildlife will likely interfere with successful revegetation and erosion control.

Revegetation will be considered successful if visual surveys indicate density and non-nuisance vegetation are similar in intensity and cover to adjacent, undisturbed lands and all temporary erosion control devices are no longer required and have been removed.

Restoration will be considered successful when revegetation is successful and the right-of-way surface condition is similar to surrounding undisturbed land.

During construction and for several years afterwards (until seeded areas are established) the effectiveness of culverts placed in drainage-ways as well as those used to drain access roads will be monitored. Drainage patterns and impacts resulting from culvert outflow also will be monitored.

1.7.9.2 Air Quality

Operation and maintenance vehicles will be routinely maintained to ensure that engines remain tuned and emission-control equipment is properly functioning as required by law.

1.7.9.3 Energy Conservation

Standard conservation measures will be used during the project's operation and maintenance (e.g., avoiding unnecessary idling and keeping vehicles and equipment tuned and maintained).

1.7.9.4 Health and Safety

The Utah Occupational Safety and Health Act and federal Occupational Safety and Health Standards will be followed during operation and maintenance. Copies of these publications and the health and safety SOPs will be provided to project workers.

Operation and maintenance activities will conform fully with the USBR safety and health standards manual.

1.7.9.5 Land Use

Existing land uses can continue in the rights-of-way of buried pipelines after construction, except trees and shrubs will not be allowed to re-grow above the pipelines.

1.8 Authorizing Actions, Permits and Licenses

Construction and operation of the proposed features to complete the Diamond Fork System would require various contracts and agreements, which would be negotiated by the CUWCD with federal agencies, local water companies and cities. The CUWCD also would need to obtain various permits and licenses from state and federal regulatory gencies. This section summarizes these requirements.

Table 1-37 lists the contracts and agreements needed for construction and operation of the Proposed Action. The first contract listed in this table is the DOI's authorization to complete construction of the Diamond Fork System, which is a federal project subject to federal oversight.

Table 1-38 lists the federal, state and local permits and licenses required and the agencies or departments that administer them.

Table 1-37
Contracts and Agreements Needed by CUWCD for the Proposed Action

Contract or Agreement	Purpose
DOI contracts made under the program guidelines of the Drainage and Minor Construction Act	To provide funding and the federal terms and conditions under which the CUWCD would construct the features of the Proposed Action
Cultural resources programmatic agreement	To provide for conservation of any cultural resources encountered during construction
Warranty deeds	To acquire permanent rights-of-way for Diamond Fork System features
Easement agreements	To provide temporary space for construction activities
Agreement with irrigation companies to modify diversion dams, if necessary	To modify Spanish Fork Diversion dams to pass and measure SVP and Bonneville Unit flows, if necessary
Construction and operation & maintenance agreement with the Forest Service	This would be needed if the land withdrawal is completed prior to start of construction and would cover construction and maintenance procedures

Table 1-38
Permits and Approvals Required by CUWCD for the Proposed Action
Page 1 of 2

Agency/Department	Permit/Approval	Required for
Federal Agencies		
Army Corps of Engineers	General Permit 40 (Clean Water Act, 33 USC 1341)	Discharge of dredge/fill into waters of the United States, including wetlands
U.S. Fish and Wildlife Service	Section 7 Consultation, Biological Opinion (Endangered Species Act, 16 USC 15311544)	Ensures Endangered Species Act compliance
	Fish and Wildlife Coordination Act	Ensures that fish and wildlife resources receive equal consideration with other environmental values
	Incidental take permit	Golden eagle nest protection
U.S. Forest Service	If lands are not withdrawn prior to construction a special-use permit (Federal Land Policy and Management Act, 43 USC 17011784; 16 USC 522 et seq.) would be required	Construction of tunnels, pipelines and access roads in the Diamond Fork Drainage
	Cultural resource use permit (16 USC 470 et seq.)	Survey/excavation on USFS-managed lands
	Conditional use permit	Activities on wildlife resources lands
Bureau of Land Management	Withdrawal application with DOI and USFS	Construction of tunnels, pipelines and access roads in the Diamond Fork Creek drainage
Federal Highway Administration	Encroachment permits (23 USC 109, 116, 123)	Encroachments of federal highway rights-of-way

Table 1-38
Permits and Approvals Required by CUWCD for the Proposed Action
Page 2 of 2

Agency/Department	Permit/Approval	Required for
State Agencies		
Department of Natural Resources Division of Water Rights	Water rights filed but not yet approved	Perfecting water rights for operation of the Diamond Fork System
	Stream channel alteration permit (Utah Code Annotated Section 73329)	Change in river or stream (includes road or pipeline construction across a streambed)
Division of Wildlife Resources	Certificate of Registration	Golden eagle nest protection
		Reptile protection
Department of Environmental Quality, Division of Water Quality	General construction activity stormwater permit	Stormwater discharges associated with construction activity
	401 Certification (Clean Water Act, 33 USC 1341, if the project requires Army Corps of Engineers 404 permit)	Discharge into waters and wetlands (see U.S. Army Corps of Engineers Section 404 Permit)
	Section 402 Permit (Clean Water Act)	Discharge of water
Utah State Historic Preservation Office	Section 106 Consultation (National Historic Preservation Act, 16 USC 470)	Historic, architectural, archaeological or cultural characteristics of properties that meet National Register criteria (State Historic Preservation Officer responsible for administration). Note: Also refer to National Landmarks Program (36 CFR and National Historic Landmarks Program [36 CFR 65])
	Cultural resource use permit (Utah Code Annotated Section 631825)	Surveys or disturbance to archaeological or paleontological sites on state lands
Utah Department of Transportation	Right-of-way and encroachment permit	Using state highway land encroachment on state highway rights-of-way
Occupational Safety and Health Administration	Construction permit	Worker safety and health
Utah Department of Public Safety Utah Highway Patrol	Transportation permit (Utah Code Annotated Section 2712155)	Transporting overloads
Local Agencies		
County Planning Department, Utah County	Use permit	Activities where use is conditional in a particular zone
County Public Works Department Utah County	Grading permit	Excavation and fill activities
	Road encroachment	Activities within county rights-of-way
	Transportation permit	Transport of overloads on county road rights-of-way

1.9 Interrelated Projects

This section describes projects that could cause cumulative impacts from construction and operation of the proposed completed Diamond Fork System. These projects are referred to as interrelated projects.

The NEPA and the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 15001508) require federal agencies to consider the cumulative impacts of their actions. These are defined as the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from actions that are individually minor but collectively significant over a period of time (40 CFR 1508.7).

Cumulative impacts are based on net impacts (i.e., impacts left after mitigation has been applied), not gross impacts. If the Diamond Fork System would not impact a resource, there would be no potential for cumulative impacts to that resource. Basing the cumulative impact analysis on gross impact would have resulted in a misrepresentation of the actual cumulative impact.

The following entities were contacted to develop a list of projects with potential cumulative impacts: U.S. Fish and Wildlife Service, USFS, Utah Division of Wildlife Resources, Utah Department of Transportation, Strawberry Water Users Association, planning and public works departments of the cities of Springville and Spanish Fork, Utah County, local utilities, and railroads.

Section 1.9.2 describes possible future actions that are not included in the cumulative impact analysis and the reasons for not being included. Section 1.9.3 describes projects that have been included in the cumulative impact analysis. These interrelated projects could combine with the actions proposed for completing the Diamond Fork System to create a cumulative impact on the environment. A discussion of the cumulative impacts that these projects may cause in conjunction with the Diamond Fork System is presented in Section 3.22 of Chapter 3 of this FS-FEIS.

1.9.1 Past Projects

Following are some major projects that have been completed within the impact area of influence of this FS-FEIS that fit the CEQ definition of cumulative impacts: Syar Tunnel Inlet, Syar Tunnel, Sixth Water Aqueduct and Diamond Fork Pipeline. The impact of these projects was included in the 1984 Diamond Fork Power System FEIS and the 1990 Diamond Fork System FS-FEIS. Some key impacts of these projects involved removal of vegetation, riparian and wildlife habitat and reduction of flows. All disturbed vegetative and riparian habitats have been reclaimed and restored. Reduced flows in Sixth Water Creek from the Strawberry Tunnel outlet to the Sixth Water Aqueduct have resulted in improved riparian habitat along Sixth Water Creek. The USBR mitigated wildlife habitat impacts by purchasing and improving 4,100 acres of privately owned wildlife habitat. Other past projects or activities in the impact area of influence include Diamond Fork Road, Diamond Fork campgrounds, dispersed camping, recreation, livestock grazing, sand extraction, development of private homes and ranches, and bridge construction.

Changes resulting from construction and operation of these past projects and activities have been included in the baseline conditions being used to measure impacts of proposed construction to complete the Diamond Fork System. Therefore, since impacts are measured from a baseline (i.e., existing conditions), impacts from past projects are not included as a separate item in the cumulative impact analyses in Chapter 3.

1.9.2 Possible Future Actions Not Included in Cumulative Impact Analysis

The following actions were not included in the cumulative impact analysis.

Diamond Fork Power Plants. These hydroelectric plants were not included in the cumulative impact analysis because they are no longer part of the Diamond Fork System, there are no definite plans or designs, and it is not known if or by whom they may be developed. If any power plant proposals are considered for funding or construction in the future, additional NEPA compliance would be required.

Central Valley Water Reclamation Facility. The planning of this project is on indefinite hold. The Salt Lake County Water Conservancy District and the CUWCD have been jointly planning the Central Valley Water Reuse Project, which could affect Utah Lake. The project would provide facilities to conserve, treat and reuse treatment plant wastewater effluent for irrigation needs in Salt Lake County in exchange for providing Utah Lake water for instream flows in the Jordan River. Preliminary planning has been completed and several draft studies have been conducted for use in preparing an EIS.

SFN System. As described in Section 1.1.4, planning on the SFN System has been discontinued. Therefore, any potential impacts from construction and operation of the SFN System are not included in the cumulative impact analysis. The SFN System would provide supplemental irrigation water to southern Utah and eastern Juab counties. It also would provide additional M&I water to Utah Lake for exchange to communities in southern Utah County for future growth.

CUWCD Utah Lake Water Rights Acquisition. The impact of the use of this water has not been included in the cumulative impact analysis because the CUWCD currently has no plans to use it. The CUWCD has acquired 82,000 acre-feet of Utah Lake water rights, which include 25,000 acre-feet of rights from Salt Lake City and about 57,000 acre-feet of secondary rights from Kennecott Copper Corporation. These water rights are expected to have an average annual yield of 53,300 acre-feet, which could be sold later to the Department of the Interior for uses to be determined at that time.

1.9.3 Future Projects Included in the Cumulative Impact Analysis

The following projects have been evaluated for potential cumulative impacts associated with the Diamond Fork System Proposed Action. The cumulative impact analysis for each resource topic is presented in Chapter 3 of this document. The level of detail to which a project is analyzed within each resource section corresponds with the amount of information available for the project and the significance of potential cumulative impacts.

1.9.3.1 Utah Lake Wetlands Preserve

The Mitigation Commission has been acquiring land and developing a management plan for a Utah Lake Wetland Preserve. The commission received a Finding of No Significant Impacts pursuant to the Final Environmental Assessment prepared for establishment of the preserve. Land and water acquired for the preserve would be managed for the protection of migratory birds, wildlife habitat and wetland values, and would be compatible with surrounding agricultural land uses. Under the Mitigation Commission's Proposed Action, private property would be acquired in the Goshen Bay and Benjamin Slough areas along the southern end of Utah Lake. About 4,041 and 17,754 acres have been identified for preservation within Benjamin Slough and Goshen Bay, respectively.

1.9.3.2 Syar Tunnel Guard Gate and Cross-Connection Modifications

The DOI is planning to install a guard gate at the Syar Tunnel outlet. The gate would allow full charging of the Syar Tunnel to back water up into the Strawberry Tunnel to maintain minimum instream flows when the Sixth Water Aqueduct needs to be inspected and maintained. Construction of the guard gate would involve constructing a short access road from the existing Syar Tunnel portal curving around to the top of the portal. A building housing the guard gate mechanism would be constructed on the area immediately on top of the existing tunnel portal.

At the same time the guard gate is under construction, modifications would also be made to the cross-connection between the Syar Tunnel and Strawberry Tunnel (Inset 1, Map A-1). A pipeline, capable of passing 32 cfs would be connected to the existing 24-inch bypass piping. The existing bypass piping is connected to Syar Tunnel immediately upstream of the inlet gates. The new piping would have a shutoff valve installed just downstream of where it is connected to the existing 24-inch bypass pipe. The new pipe would then enter Syar Tunnel downstream of the inlet gates and be attached to the ceiling of Syar Tunnel. It would proceed downstream until it reaches the area of the existing Strawberry Tunnel cross-connection where a new hole would be bored through the concrete adjacent to the existing cross-connection pipe supplying the clamshell valve. It would then proceed downstream and terminate below the existing clamshell valve. This modification would allow flows to bypass the Syar Tunnel inlet gates and clamshell valve during required inspection and maintenance work.

The DOI will prepare appropriate NEPA documentation for this work, which is expected to be completed concurrent with construction of the features proposed for completion of the Diamond Fork System.

1.9.3.3 Diamond Fork Campground Modifications

The Spanish Fork Ranger District of the U.S. Forest Service and the Mitigation Commission have completed an Environmental Assessment and issued a decision to rehabilitate the Diamond and Palmyra campgrounds. The plan would combine the campgrounds into one with a single entrance, and eliminate the group sites from these campgrounds. Some campground loops and facilities within the 100-year flood plain or in environmentally sensitive areas would be closed, reclaimed and replaced with new facilities in more favorable locations. Construction would begin in the summer to fall of 1999 and would last 10 to 12 months.

The modifications would decrease the current capacity of the campgrounds from 580 persons at one time (PAOT) to 390. Single-family sites would drop from 43 to 38; double-family sites would increase from 3 to 20; and the three group sites (one 125-unit, one 50-unit, one 35-unit), would be eliminated. Relocation of some of the campground loops would result in a net gain of about 2.7 acres of riparian vegetation (USFS 1998).

The impacts of this project are included in the cumulative impact analysis in Chapter 3.

1.9.3.4 Recreation Development and Sixth Water Creek and Diamond Fork Creek Restoration Plan

The Mitigation Commission 5-year plan included a proposal to study the potential for restoring Diamond Fork Creek and developing recreation facilities. However, details of these developments are not known, so only generalities were included in the cumulative impact analysis. When this plan is developed by the Mitigation Commission it will prepare appropriate NEPA compliance documentation.

1.9.3.5 Relocation and Improvement of Springville Crossing-Rays Valley Road

The Forest Service is planning the relocation and improvement of the Springville Crossing-Rays Valley Road (from Springville Crossing to the end of the Sheep Creek-Rays Valley Road). This project is planned to take place in the near future. The proposed reconstructed, relocated road would be about 3.6 miles in length, gravel surfaced, and about 24 feet in width. Much of the proposed realignment would be within 0.25 mile of the existing road alignment. However, about 1.3 miles of the realignment would be beyond 0.25 mile of the existing road. The proposed relocation alignment would be located over more stable soils and in the uplands, away from riparian zones. There would be no net impact to inventoried roadless areas, though the boundaries of the roadless area would be shifted to follow the new road alignment. The existing road would be closed and obliterated and rehabilitated upon completion of the realignment. The reconstruction of this road would meet two of the Forest Service's four Natural Resource

Agenda items: Watershed Health and Restoration and National Forest Roads. Relocation and improvement of this road would address existing safety and resource concerns with this section of road.

Details of the relocation and improvement are not known, so only generalities were included in the cumulative impact analysis. Appropriate NEPA documentation on the project will be prepared by the Forest Service.

1.9.3.6 Diamond Fork Dispersed Camping Management Plan

The Forest Service, Spanish Fork District is proposing a management plan for dispersed (undeveloped) camping sites in the Diamond Fork drainage including Wanrhodes Canyon and Halls Fork. The plan would involve leaving some sites open, closing some, and imposing management restrictions on others. In the Wanrhodes area of the 21 inventoried sites 4 would be closed, 8 modified, and 9 left as they presently occur. Of the 85 sites along Diamond Fork, 37 would be closed, 42 modified, and 6 left as they presently occur. Of the 19 sites in Halls Fork, 8 would be closed, 4 modified, and 7 left as they are. In the entire area 49 sites would be closed, 54 sites modified, and 22 left as they are.

Implementation of the plan could begin in August or September of 1999. Implementation of modifications would occur over time as funding permits. Closure and modifications would improve riparian and wetland vegetation, reduce erosion and sedimentation, and improve water quality. Closure could also increase use in other areas, creating new dispersed camping sites with a resultant increase in resource impacts. Appropriate NEPA documentation will be prepared by the Forest Service during the summer of 1999.

1.10 Alternatives Considered But Eliminated from Detailed Analysis

When the Proposed Action was formulated, other alternatives to complete the Diamond Fork System were examined but found to be infeasible and thus eliminated from detailed analysis. This section summarizes these alternatives and the reasons for their elimination, as required by 40 CFR 1502.14(a).

Generally, they were eliminated because they would result in one or more of the following: 1) they would cause severe environmental impacts, 2) they would not meet the purposes and needs of the Diamond Fork System (see Section 1.2) and 3) they are not economically viable.

Five alternatives that were examined to determine their feasibility and practicality in meeting the operational objectives of the Diamond Fork System are summarized in the following sections. They were eliminated from further consideration for reasons described in each section. Three of these alternatives included direct pipeline and/or tunnel connections to the Sixth Water Aqueduct outlet to divert water into Diamond Fork Pipeline features described in the Proposed Action. The other two included a diversion dam on Diamond Fork Creek at Three Forks.

1.10.1 Connecting Diamond Fork Pipeline Directly to Sixth Water Aqueduct with a Pipeline Along Sixth Water Creek

This alternative was eliminated because there is insufficient space in Sixth Water Creek canyon between Sixth Water Aqueduct and Three Forks to build a large-diameter pipeline without excessive environmental damage and construction costs. The winding canyon is narrow, with steep hillside slopes rising from both sides of the creek bottom. Construction of a 96-inch-diameter pipeline would require excavating benches into a side of the canyon for pipe burial and construction equipment access.

Under this alternative, the 96-inch-diameter pipeline would convey water from the Sixth Water Aqueduct outlet to Diamond Fork Pipeline. It would begin at the Sixth Water Aqueduct outlet, proceed down Sixth Water Creek to Three Forks, then along Diamond Fork Creek to Monks Hollow, where it would connect to the upstream end of the existing Diamond Fork Pipeline. The 660-cfs pipeline would be about 6.7 miles long.

A 60 cfs turnout would be constructed at the Sixth Water Aqueduct outlet to release flows that exceed the capacity of the additional pipeline. A 90 cfs turnout would be constructed at the end of the pipeline to release flows that exceed Diamond Fork Pipeline capacity to Diamond Fork Creek at Monks Hollow.

To meet summer water demand, the transbasin diversion through Syar Tunnel and Sixth Water Aqueduct would be supplemented with the transbasin diversion of water through the existing Strawberry Tunnel. The Strawberry Tunnel, which is in poor condition because of its advanced age, would be rehabilitated to provide 200 cfs of capacity from Strawberry Reservoir to Sixth Water Creek. Use of Strawberry Tunnel in this manner would require Congressional modification of provisions of CUPCA that prohibit such use.

1.10.2 Connecting Diamond Fork Pipeline Directly to Sixth Water Aqueduct with a Pipeline Along Upper Diamond Fork Creek and a Tunnel Under Tanner Ridge

This alternative was eliminated because there is insufficient space in the upper Diamond Fork Canyon between the tunnel outlet and Three Forks to build a large-diameter pipeline without excessive environmental damage. The winding canyon has a narrow "V"-shaped bottom with steep slopes rising from both sides of the creek. Construction of a 96-inch-diameter pipeline would require total disruption and rechannelization of the creek for construction equipment access and pipe burial.

Under this alternative, water from Sixth Water Aqueduct would be conveyed about 1.2 miles in a 96-inch-diameter tunnel under Tanner Ridge to the tunnel outlet about 3.7 creek-miles upstream of Three Forks in upper Diamond Fork Canyon; then a 96-inch-diameter pipeline would convey water about 6.4 miles along upper Diamond Fork Creek to the existing Diamond Fork Pipeline. Both the tunnel and the pipeline would have a maximum flow rate of 660 cfs. A turnout to Diamond Fork Creek would be constructed where the pipeline connects to the existing Diamond Fork Pipeline to maintain minimum flows in Diamond Fork Creek and release irrigation water in excess of the capacity of Diamond Fork Pipeline.

1.10.3 Connecting Diamond Fork Pipeline Directly to Sixth Water Aqueduct with a Single Long Tunnel

This alternative was eliminated because of the high cost of tunnel construction and frequent flows of 200 cfs in Sixth Water Creek, which would reduce the creek's improvement from a lower flow regime.

Under this alternative, water from the Sixth Water Aqueduct outlet would be conveyed directly to Diamond Fork Pipeline through a 96-inch-diameter, 5.1-mile-long tunnel. The 660 cfs tunnel would begin along Sixth Water Creek opposite the Sixth Water Aqueduct outlet and terminate near the upstream end of the existing Diamond Fork Pipeline. A 500-foot-long siphon would be constructed under Sixth Water Creek to connect the tunnel to the Sixth Water Aqueduct outlet, and a 500-foot-long pipeline would be constructed to connect the end of the tunnel to the start of Diamond Fork Pipeline.

A 60 cfs turnout would be constructed at the Sixth Water Aqueduct outlet to release flows that exceed tunnel capacity. A 90 cfs turnout would be constructed at the end of the tunnel to release flow that exceeds Diamond For Pipeline capacity to Diamond Fork Creek at Monks Hollow.

To meet summer water demand, the transbasin diversion through Syar Tunnel and Sixth Water Aqueduct would be supplemented with the transbasin diversion of water through the existing Strawberry Tunnel. The Strawberry Tunnel would be rehabilitated to provide 200 cfs of capacity from Strawberry Reservoir to Sixth Water Creek. Use of Strawberry Tunnel in this manner would require Congressional modification of CUPCA that prohibits such use.

1.10.4 Completing the Diamond Fork System with a Diversion Dam at Three Forks Having Zero Active Capacity and 2,000 Acre-Foot Inactive Capacity

This alternative was eliminated for the following reasons:

- The transbasin diversion of 200 cfs through the Strawberry Tunnel on a more frequent basis during the irrigation season would preclude restoration of upper Sixth Water Creek as required in Section 307 of CUPCA.

- The 800 cfs that would be conveyed in Sixth Water Creek would exceed stream channel capacity. Initially, the flow would scour the creek channel and pick up sediment that would cause deposits in Diamond Fork Pipeline and Diamond Fork Creek. Sediment pickup would decrease after the initial scouring, but would continue to be a problem because of reduced reservoir retention time.

Under this alternative the dam at Three Forks would divert flows released from Strawberry Reservoir into a 120-inch-diameter, 2.7-mile-long pipeline to convey water from the dam to the Diamond Fork Pipeline. The diversion dam elevation would provide a hydraulic gradient elevation of 5,555 feet at Monks Hollow. Three Forks Dam would be 105 feet high, with a 500-foot-long crest. The reservoir would have about 40 to 50 surface acres, and the diversion pool behind the dam would have an inactive capacity of about 2,000 acre-feet. This smaller reservoir would reduce the amount of sediment trapped in the reservoir and increase sediment in Diamond Fork Pipeline and in Diamond Fork Creek.

Maximum flow rate through Syar Tunnel and Sixth Water Aqueduct under this alternative would be 660 cfs. That rate, together with the release through Strawberry Tunnel for streamflow maintenance, would not meet peak summer water delivery requirements, which would require additional facilities to increase the delivery rate. Strawberry Tunnel would be rehabilitated to deliver 200 cfs.

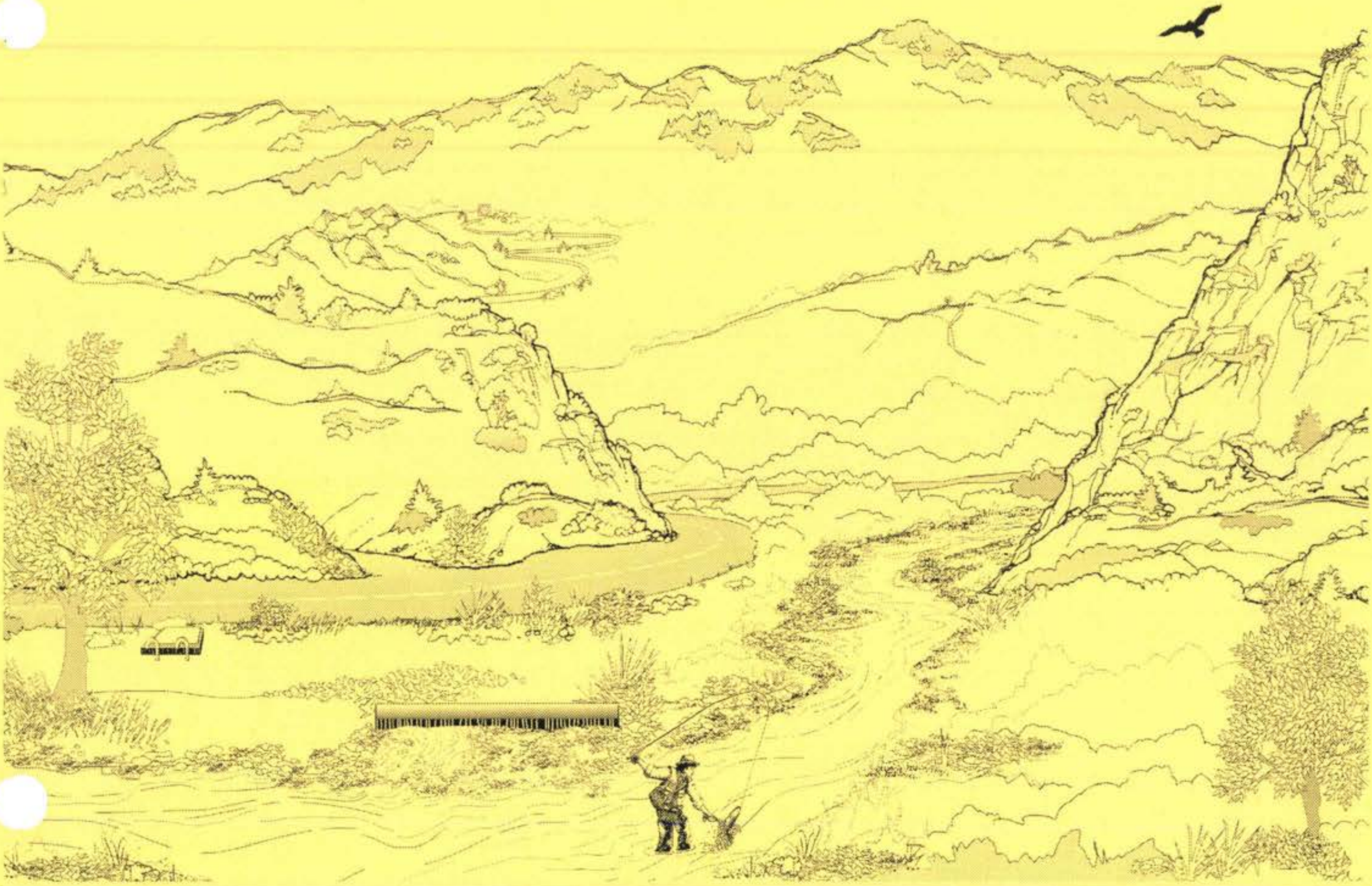
1.10.5 Completing the Diamond Fork System with a Dam and Reservoir at Three Forks, Consisting of a 2,000 Acre-Foot Inactive Pool and an 11,000 Acre-Foot Active Pool

This alternative was eliminated for the following reasons:

- The reservoir, inundation and operational impacts with the Three Forks Dam and Reservoir would be similar to those of a dam and reservoir at the Monks Hollow site with reduced operational flexibility.

- The 800 cfs that would be conveyed in Sixth Water Creek under this alternative would exceed stream channel capacity. Initially, the flow would scour the creek channel and pick up sediment, some of which would pass through the small reservoir at Three Forks and cause deposits in Diamond Fork Pipeline and Diamond Fork Creek.

This alternative would replace the proposed Monks Hollow Dam and Reservoir with a smaller dam and reservoir upstream of Monks Hollow on Diamond Fork Creek at Three Forks (Three Forks Reservoir). The dam would be 225 feet high with a reservoir surface area of 325 acres. The reservoir would have an active capacity of 11,000 acre-feet and sediment storage capacity of 2,000 acre-feet. The 11,000 acre-foot active capacity is the distinguishing difference from the No Action Alternative. This alternative is useful because Three Forks Reservoir would provide a hydraulic head and peaking capacity similar to Monks Hollow Reservoir. This alternative would require an additional 2.7-mile pipeline connecting Three Forks Dam with Diamond Fork Pipeline.



Diamond Fork System

Final Supplement to the Final Environmental Impact Statement

Chapter 2
Comparative Analysis of Impacts of the Proposed Action and No Action Alternative

Chapter 2
Comparative Analysis of Impacts of the Proposed Action and No Action Alternative

2.1 Introduction

This chapter provides a summary comparison of all adverse and beneficial significant impacts of the Proposed Action and No Action Alternative after mitigation measures have been implemented. Detailed impact analyses are presented in Chapter 3 of this document.

2.2 Comparison of Impacts

Table 2-1 compares the quantified significant impacts on applicable resources between the Proposed Action and No Action Alternative. Where possible the table shows changes from baseline conditions and percent change for impacts under the Proposed Action and No Action Alternative. Sections 2.2.1 through 2.2.4 compare nonquantifiable impacts of the Proposed Action and No Action Alternative on applicable resources.

Table 2-1
Summary of Impacts of Proposed Action and No Action Alternative

Page 1 of 3

Resource Topic	Proposed Action	No Action Alternative
Water Resources		
• Change in annual average flows: Sixth Water Creek above Sixth Water Aqueduct	+24 cfs (+279%)	+24 cfs (+279%)
• Change in annual average flows: Sixth Water Creek below Sixth Water Aqueduct	-54 cfs (-63%)	+141 cfs (+163%)
• Change in annual average flows: Sixth Water Creek below Fifth Water Creek	-54 cfs (-59%)	+141 cfs (+152%)
• Change in annual average flows: Diamond Fork Creek below Three Forks	-54 cfs (-51%)	-30 cfs (-28%)
• Change in annual average flows: Diamond Fork Creek below Diamond Fork Creek Outlet	-30 cfs (-28%)	-30 cfs (-28%)
• Change in annual average flows: Spanish Fork River at Castilla gage	+126 cfs (+62%)	+141 cfs (+69%)
• Change in annual average flows: Spanish Fork River below Spanish Fork Diversion Dam	+121 cfs (+526%)	+119 cfs (+519%)
• Change in annual average flows: Spanish Fork River below East Bench Diversion Dam	+120 cfs (+2,120%)	+118 cfs (+2,090%)
• Change in annual average flows: Spanish Fork River below Mill Race Diversion	+120 cfs (+167%)	+116 cfs (+162%)
• Change in annual average flows: Spanish Fork River at Lake Shore gage	+119 cfs (+168%)	+114 cfs (+160%)

Table 2-1
Summary of Impacts of Proposed Action and No Action Alternative
Page 2 of 3

Resource Topic	Proposed Action	No Action Alternative
Water Quality		
• Change in selenium concentration in Sixth Water Creek below Strawberry Tunnel Outlet	-12.3 ppb (-90%)	-12.3 ppb (-90%)
• Change in dissolved oxygen (mixed) concentration in Sixth Water Creek below Sixth Water Aqueduct	+2.7 ppm (+33%)	+2.7 ppm (+33%)
• Change in phosphorus concentration in Diamond Fork Creek below Three Forks	-0.025 ppm (-26%)	+0.473 ppm (+488%)
• Change in sediment transport for Sixth Water and Diamond Fork creeks and Spanish Fork River	-52,764 tons/year (-29%)	+118,936 tons/year (+66%)
Wildlife Resources		
• Temporary change in critical big-game winter range habitat	-53.3 acres	-63.3 acres
Aquatic Resources		
• Change in trout biomass for Sixth Water and Diamond Fork creeks and Spanish Fork River	+15,949 pounds (218%)	+13,084 pounds (179%)
Special Status Species		
• Area of high potential for effect on Ute ladies'-tresses habitat along Diamond Fork Creek	9.69 acres	9.69 acres
• High potential for effect on numbers of Ute ladies'-tresses along Diamond Fork Creek and Spanish Fork River	2,087 plants (7%)	2,087 plants (7%)
• Change in main channel leatherside chub habitat in Diamond Fork Creek	+24 to +25%	+24 to +25%
Soils		
• Permanent change in vegetated land	-6.0 acres	-29.6 acres
Recreation and Special Status Areas		
• Temporary change in dispersed camping sites	-76 sites (-61%)	-50 sites (-40%)
• Permanent change in dispersed camping sites	0 sites	- unknown number of sites
• Change in angler days per year use (an increase could result in significant increases in fishing and camping use) in Sixth Water and Diamond Fork creeks	+33,286 angler days (+676%)	+29,663 angler days (+602%)
• Change in available stream fishing along Diamond Fork Creek	0 feet	-2,400 feet

Table 2-1
Summary of Impacts of Proposed Action and No Action Alternative
Page 3 of 3

Resource Topic	Proposed Action	No Action Alternative
Recreation and Special Status Areas (continued)		
• Change in available stream fishing along Sixth Water Creek	0 feet	-2,700 feet
• Change in available stream fishing along Cottonwood Creek	0 feet	-1,600 feet
• Possible change in acreage classified as Red Mountain Roadless Area	-4.1 acres (-0.0004%)	0 acre
• Possible change in acreage classified as Diamond Fork Roadless Area	-1.3 acres (<-0.0001%)	-29.6 acres (<-0.0008%)
Public Health and Safety		
• Change in emergency vehicle response time during construction	+ > 15 minutes	+ > 15 minutes
Transportation		
• Change in AADT on Diamond Fork Road during construction	+ > 10%	+ > 10%
• Change in AADT on Sheep Creek-Rays Valley Road during construction	+ > 10%	+ > 10%
<u>Notes</u>: cfs = cubic feet per second ppb = parts per billion ppm = parts per million		

2.2.1 Special Status Species

Construction of some of the Proposed Action features, including the Red Mountain Tunnel Outlet Portal, Red Hollow Pipeline, and Diamond Fork Siphon, could potentially indirectly affect the golden eagle by causing nest abandonment, loss of eggs and young, and a short-term decline in recruitment of a localized population. The No Action Alternative would potentially indirectly affect fewer golden eagle nests than the Proposed Action.

2.2.2 Visual Resources

The No Action Alternative would have greater impacts on visual resources compared to the Proposed Action. Higher streamflows in Sixth Water Creek below Sixth Water Aqueduct would result in increased streambank erosion, increased turbidity and increased sediment transport compared to the Proposed Action. These visual impacts would create more contrast with the surrounding environment under the No Action Alternative. The visual quality would improve under the Proposed Action.

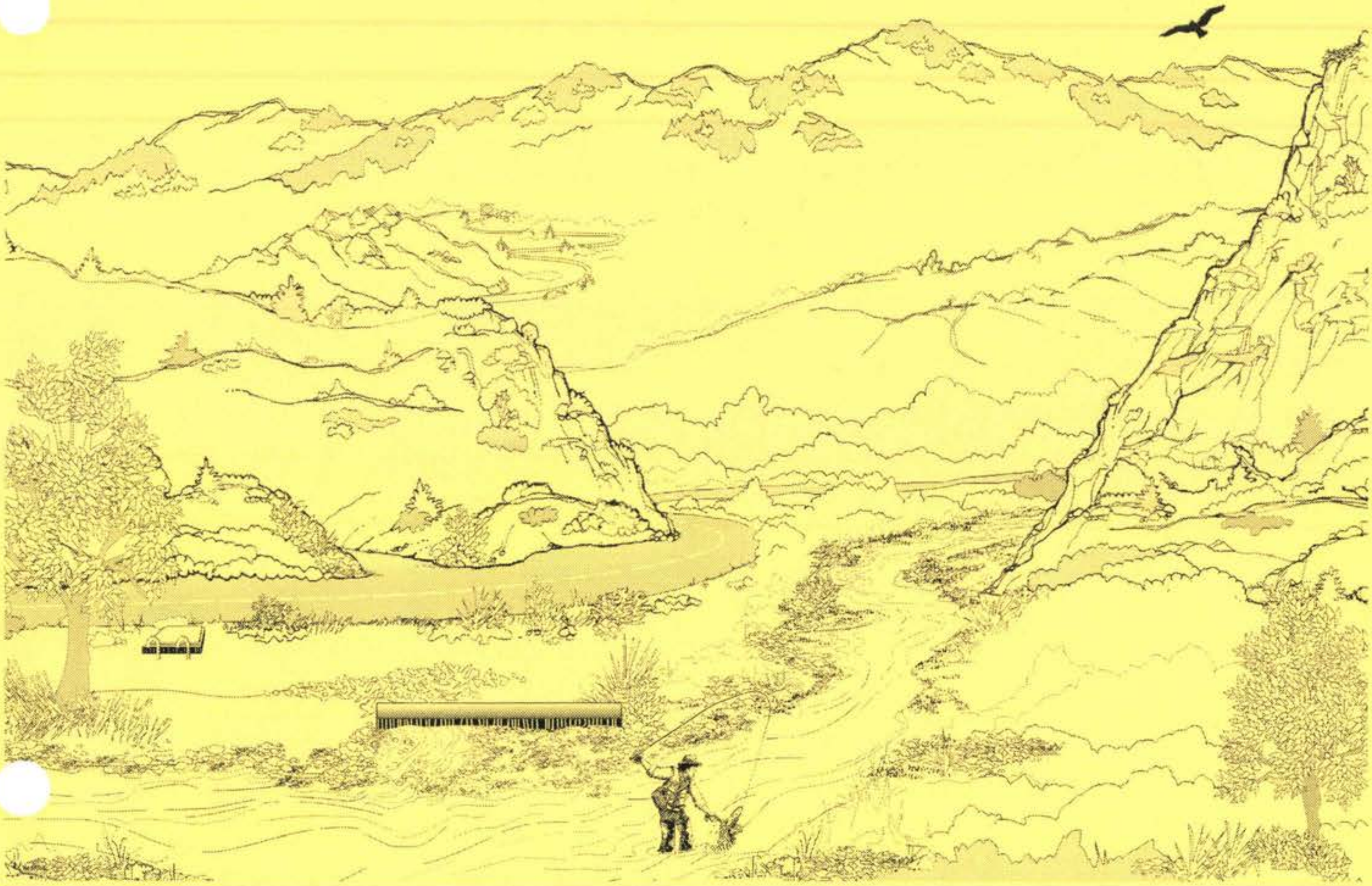
Compared to the Proposed Action, the No Action Alternative would cause greater changes in form, color and texture that are not subordinate to the characteristic landscape. These significant permanent visual impacts would result from the 0.9 mile of new access road, 6.9-acre spoil pile, permanent concrete and rock structures along Diamond Fork Creek Road, and Three Forks Dam and Reservoir.

2.2.3 Transportation

The Proposed Action and the No Action Alternative would increase average annual daily traffic (AADTs) on Diamond Fork Road, but the No Action Alternative would result in a smaller increase in AADTs on Sheep Creek-Rays Valley Road than under the Proposed Action.

2.2.4 Land Use Plans

The Proposed Action would require construction of a permanent road in Red Hollow, which in turn would require revision of the Red Hollow Resource Management Plan. The No Action Alternative would not impact the Red Hollow Resource Management Plan.



Diamond Fork System

Final Supplement to the
Final Environmental Impact Statement

Chapter 3
Affected Environment and Environmental Consequences

Chapter 3
Affected Environment and Environmental Consequences

3.1 Introduction

This chapter describes the affected environment (baseline conditions) of resources of the human environment that would be impacted by the Proposed Action and No Action Alternative as described in Chapter 1. It also documents the environmental consequences to the quality of the human environment.

Baseline conditions are the physical conditions of the impacted resources, currently existing in the impact area of influence. The human environment is defined in this study as all of the environmental resources, including the social and economic conditions occurring in the impact area of influence.

The impact analysis presented in this chapter focuses only on the impacts that would occur from construction and operation of the features required to complete the Diamond Fork System. The Proposed Action analysis deals with delivering water to Utah Lake for exchange to Jordanelle Reservoir for M&I use in Salt Lake and northern Utah counties. The No Action Alternative analysis deals with delivery of water to Utah Lake for the same purpose as the Proposed Action. In addition, the No Action Alternative deals with delivery of some supplemental irrigation and M&I water for use in the Spanish Fork area of southern Utah County.

This chapter is organized by resource topic. Each topic includes a list of the issues addressed in the impact analysis, describes the specific impact area of influence, identifies baseline conditions, establishes significance criteria and documents impacts that are predicted to occur under the Proposed Action and No Action Alternative. The assumptions and methodology used to analyze impacts are also documented. The last five sections of this chapter describe the following:

- Measures that would be used to mitigate significant impacts
- Unavoidable adverse impacts
- Net cumulative impacts
- Short-term use of the human environment versus maintenance of long-term productivity
- Irreversible and irretrievable commitment of resources

The impact analysis incorporates the Standard Operating Procedures (SOPs) described in Chapter 1, Section 1.7.8 and Section 1.7.9 that would be implemented during construction and operation to protect environmental resources. Significant impacts on resources are discussed in detail, while insignificant impacts are briefly summarized.

The primary impact area of influence is located in the Diamond Fork Canyon area and a corridor along the Spanish Fork River from the junction of Diamond Fork Creek to Utah Lake (see Map S-1). The issues dealt with in Diamond Fork Canyon are construction and operation of the tunnels, pipelines, and related facilities. The issues in the Spanish Fork River Corridor are those involving stream flow, diversion structure improvements that may be necessary to pass increased flows, and resulting impacts on aquatic life. Socioeconomic impacts are analyzed on a county-wide basis.

Maps A-1 and A-2 (in pocket at back of document) show the location of major project features. Where appropriate the impact analysis described impacts on the following stream reaches:

Sixth Water Creek
- Strawberry Tunnel to Sixth Water Aqueduct
- Sixth Water Aqueduct to Fifth Water Creek
- Fifth Water Creek to Three Forks

Diamond Fork Creek
- Upstream of Three Forks
- Three Forks to Red Hollow (Diamond Fork Creek Outlet)
- Diamond Fork Creek Outlet to Brimhall Canyon
- Brimhall Canyon to Spanish Fork River Outlet

Spanish Fork River
- Diamond Fork Creek to Spanish Fork Diversion Dam
- Spanish Fork Diversion Dam to East Bench Dam
- East Bench Dam to Mill Race Diversion
- Mill Race Diversion to Lake Shore Diversion
- Lake Shore Diversion to Utah Lake

The impact analysis presented in this chapter is supported by five technical memoranda that provide detailed information on Hydrology and Water Resources, Water Quality, Aquatic Resources, Wetland Resources and Angler Day Methodology. These are available from the Central Utah Water Conservancy District (CUWCD) upon request at the following address:

Nancy Hardman
Central Utah Water Conservancy District
355 West University Parkway
Orem, Utah 84058
Telephone: (801) 226-7187
Fax: (801) 226-7150

3.2 Water Resources

3.2.1 Introduction

This section addresses the potential impact on surface and groundwater quantity that would result from construction and operation of the Proposed Action and No Action Alternative. The analysis presented in this section also provides the hydrological basis for evaluation of impacts related to aquatic resources, threatened and endangered species, wetland resources, and water quality. The information and analysis provided in this section was summarized from the draft *Hydrology and Water Resources Technical Report* for the Spanish Fork-Nephi Irrigation System Draft Environmental Impact Statement(CUWCD 1998c) and the *Hydrology and Water Resources Technical Memorandum* for the 1999 Diamond Fork System FS-FEIS (CUWCD 1999d).

Surface and groundwater quantities can vary over time as a result of the natural variations in precipitation and water supply. To reflect this variability, impacts of the Proposed Action and No Action Alternatives were evaluated for a 44-year period (from project year 1 through project year 44) . This analysis assumed that the precipitation and water supply conditions that occurred from 1930 to 1973 would be repeated, but the water demands would reflect current levels of development.

3.2.2 Issues Eliminated From Further Analysis

Some issues raised during the scoping process for the SFN System were related to operation of Strawberry Reservoir. These issues have been excluded from this analysis of the Diamond Fork System because the operation of Strawberry Reservoir was previously described in the *1964 Bonneville Unit Definite Plan Report* (USBR 1964) and the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984). There would be no significant change in the impacts on Strawberry Reservoir from those addressed in the previous documents. Strawberry Reservoir storage volumes under the Proposed Action have been evaluated and documented in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d).

3.2.3 Issues Addressed in the Impact Analysis

The following issues were identified in the SFN scoping process:

- Impacts on flows in creeks and rivers
- Impacts of streamflow rate changes on groundwater levels

Surface water quantities for rivers and creeks are addressed by quantifying the monthly flows for the analysis period.

Impacts on use of groundwater resources in the Sixth Water and Diamond Fork creek drainages are not addressed because no direct uses of groundwater resources have been identified. Changes in groundwater table levels resulting from changes in surface-flow rates and streamflow stages could affect wetland and riparian vegetation within the impact area of influence. Within the Spanish Fork River corridor, land use could be affected if large increases in groundwater table elevation resulted in flooding of basements or other subsurface structures.

3.2.4 Description of Impact Area of Influence

The impact area of influence for water quantity covers surface water features in the Diamond Fork drainage and Spanish Fork River corridor, as well as lands located immediately adjacent to those features.

Operation of the Proposed Action and No Action Alternative would affect flows in Sixth Water Creek, Diamond Fork Creek, Spanish Fork River from its confluence with Diamond Fork Creek to Spanish Fork Diversion Dam, and Spanish Fork River from Spanish Fork Diversion Dam to Utah Lake as a result of changes in releases from Strawberry Reservoir. Additional inflow to Utah Lake would be derived from delivery of Bonneville Unit water via the Diamond Fork System and Spanish Fork River. However, with the additional delivery of Bonneville Unit water to Utah Lake by way of Spanish Fork River, an equal and simultaneous diversion would occur on the Provo River. Therefore, Utah Lake levels would remain unchanged and the lake is not included in the impact area of influence.

3.2.5 Affected Environment (Baseline Conditions)

The affected environment is defined by the baseline conditions for the hydrologic features within the impact area of influence. The baseline conditions reflect historical precipitation and Strawberry Valley Project (SVP) water supply conditions, but consider the present level of development of facilities, water demands and operating criteria. The only exception to this is the baseline for Sixth Water Creek above Sixth Water Aqueduct. The baseline used for this reach of Sixth Water Creek reflects conditions that have been in effect since 1996 when the Syar Tunnel and Sixth Water Aqueduct were placed into operation.

3.2.5.1 Surface Water Quantity

Table 3-1 shows the average monthly baseline streamflows (and selected wet and dry years) for the 44-year analysis period for the rivers and creeks in the impact area of influence for which flow data were available. The table shows the point where the flow was quantified. Tables of average monthly flows for each year are available in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d). Table 3-1 also presents flows for the driest year (1961) during the 44 year period of record and the wettest year (1952) during the 44 year period of record. Flows downstream of reservoirs and transbasin diversions (such as Strawberry Reservoir and the Diamond Fork System) may not accurately reflect the wet or dry nature of the year because of the regulation of these flows. The wet- and dry-year flows are included to allow comparison with similar flows presented in the *Final Supplement to the FEIS, Diamond Fork System* (USBR 1990). Baseline flows, if available, were derived from gaged flows presented in the 1988 Supplement to the *1964 Definite Plan Report, Volume III, Water Supply Appendix* (USBR 1988b). Rough estimates were made of the average annual flows at ungaged locations to provide an overall understanding of baseline conditions.

The monthly variations in these flows reflect changes in supplies during the year. Snowmelt provides large quantities of flows that build during the spring (peaking in late spring) and then decline rapidly during the summer. Diamond Fork Creek, Sixth Water Creek and Spanish Fork River receive a substantial portion of their flows from snowmelt. In addition, Diamond Fork Creek, Sixth Water Creek, and Spanish Fork River are currently used to convey SVP water for irrigation. Strawberry Reservoir releases to Diamond Fork Creek generally occur from about May to September, and supplement available flows from snowmelt, particularly during the summer, when available snowmelt is declining. This results in peak flows in late spring and early summer and relatively low flows in late fall and winter.

Strawberry Tunnel has not been used for irrigation diversions from Strawberry Reservoir since spring of 1996 (after Syar Tunnel was completed). Since then, flows in Sixth Water Creek from Strawberry Tunnel to Sixth Water Aqueduct have been substantially smaller than the historical flows. Therefore the baseline flows in this reach of Sixth Water Creek do not include historical transbasin SVP diversions.

Flows on the Spanish Fork River from Spanish Fork Diversion Dam to Utah Lake are complicated because of the numerous diversions (see Map A-2 in back pocket). The flows for Spanish Fork River at Lake Shore gage shown in Table 3-1 are based on gaging station records. The following discussion of the five major diversions on Spanish Fork River (Spanish Fork, East Bench, Mill Race, Lake Shore and Huff Dam) provides a general understanding of

Table 3-1
Baseline Streamflows

Monthly Flows (cfs)

Feature	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Range of Monthly Flows	Annual Flow (ac-ft/yr)
Sixth Water Creek above Sixth Water Aqueduct														
Average Flow	6	6	6	6	6	7	14	21	11	7	6	6	0 - 61	6,100
Wet Year	7	7	7	6	7	7	38	61	27	11	9	9		11,800
Dry Year	6	6	6	6	6	6	7	9	5	5	5	6		4,400
Sixth Water Creek below Sixth Water Aqueduct														
Average Flow	31	7	6	6	6	7	20	94	233	284	223	119	3 - 421	62,900
Wet Year	34	7	7	6	7	7	38	61	104	242	182	193		53,800
Dry Year	16	6	6	6	6	6	7	222	320	191	96	41		55,900
Sixth Water Creek below Fifth Water Creek														
Average Flow	34	10	9	8	9	11	35	121	242	288	225	122	3 - 421	67,400
Wet Year	37	11	10	9	10	10	95	156	139	249	187	197		67,200
Dry Year	18	9	7	8	8	8	10	227	320	191	96	43		57,100
Diamond Fork Creek below Three Forks														
Average Flow	39	16	14	12	14	18	67	180	260	295	230	128	3 - 422	77,200
Wet Year	44	20	16	15	16	18	219	363	214	264	197	205		96,300
Dry Year	23	13	10	13	11	11	17	236	320	191	96	47		59,800
Diamond Fork Creek below Red Hollow														
Average Flow	39	16	14	12	14	18	67	180	260	295	230	128	3 - 422	77,200
Wet Year	44	20	16	15	16	18	219	363	214	264	197	205		96,300
Dry Year	23	13	10	13	11	11	17	236	320	191	96	47		59,800
Spanish Fork River at Castilla Gage														
Average Flow	93	70	68	67	82	113	247	465	405	363	283	178	34 - 1,866	147,100
Wet Year	97	67	64	75	81	107	1,056	1,866	617	453	336	313		310,600
Dry Year	55	48	41	45	51	58	57	275	327	204	133	82		83,000
Spanish Fork River below Spanish Fork Diversion Dam														
Average Flow	5	0	0	0	0	0	25	100	54	42	32	17	0 - 1,366	16,800
Wet Year	5	0	0	0	0	0	556	1,366	117	64	43	33		132,700
Dry Year	5	0	0	0	0	0	19	32	34	17	12	5		7,600
Spanish Fork River below East Bench Dam														
Average Flow	0	0	0	0	0	0	17	50	1	0	0	0	0 - 1,328	4,100
Wet Year	0	0	0	0	0	0	556	1,328	37	0	0	0		116,700
Dry Year	0	0	0	0	0	0	0	0	0	0	0	0		0
Spanish Fork River below Mill Race Diversion														
Average Flow	44	69	68	67	81	111	187	153	34	19	17	14	0 - 1,590	52,000
Wet Year	34	68	64	75	81	108	1,056	1,590	127	31	13	14		197,300
Dry Year	30	48	41	45	51	58	12	0	0	6	5	8		18,200
Spanish Fork River at Lake Shore Gage														
Average Flow	30	67	77	79	97	129	199	138	22	3	3	8	0 - 1,517	51,200
Wet Year	46	68	70	85	98	144	1,088	1,517	279	2	4	40		208,000
Dry Year	21	51	57	60	64	66	16	5	1	0	2	1		20,600

Notes:

The dry-year monthly average flows are based on natural runoff conditions that occurred in 1961 and represent the average driest year that occurred during the 44 year period of record.
The wet-year monthly average flows are based on natural runoff conditions that occurred in 1952 and represent the average wettest year that occurred during the 44 year period of record.

the Spanish Fork River between the Castilla and Lake Shore gages (see Map A-2) and is based on discussions with the Spanish Fork River Commissioner John Mendenhall (Barnes 1994).

The first diversion is Spanish Fork Diversion Dam, which diverts water to the Power Canal. During winter, all of the flow is diverted for power generation, except for about 5 cubic feet per second that leaks past the diversion dam. During summer, 20 to 50 cfs are released from the diversion dam to supply the East Bench Canal. The Power Canal delivers water to the High Line, Salem and South Field canals (which deliver water south of Spanish Fork River) and to Mapleton Lateral (which crosses and delivers water north of the river). Also, some water, including the supply for Mill Race and Lake Shore canals, is released from the Power Canal to Spanish Fork River.

The second diversion is for East Bench Canal, which conveys water to lands north of Spanish Fork River. Essentially all available flows are diverted to East Bench Canal during the summer. About 300 yards below the dam, the river receives approximately 5 cfs of spring flows.

The third diversion is for Mill Race Canal, which also conveys water to land north of Spanish Fork River. Flows at this diversion point include releases from the Power Canal, in addition to the outflow from springs and flows that bypass the East Bench Canal diversion. These releases consist of flows to meet water rights of the canal companies and flows diverted for power generation in excess of the water rights of the canals that receive water directly from the Power Canal. During the irrigation season, all but 10 to 40 cfs of the riverflow at this point is diverted into Mill Race Canal. No diversions are made after the irrigation season.

The fourth diversion is for Lake Shore Canal, which delivers water to land south of Spanish Fork River. During the irrigation season, all available water is diverted except for spills in years with unusually high flows. All flows bypass this diversion in the winter.

The last diversion is at Huff Dam, located downstream of the Lake Shore gaging station. All but 1 to 2 cfs are diverted during the irrigation season. All flows bypass the diversion in the winter.

3.2.5.2 Groundwater Levels

Groundwater in the impact area of influence is contained primarily in the shallow alluvial sedimentary deposits, which consist of sands, gravels, cobbles and silts. Groundwater occurs under unconfined conditions in which water can travel freely from the surface to the groundwater. Relatively little information has been developed for groundwater systems in the Diamond Fork drainage below Three Forks, for Sixth Water Creek drainage, or for the shallow groundwater system associated with the Spanish Fork River corridor.

3.2.5.2.1 Sixth Water Creek Drainage. The stream channel in Sixth Water Creek has been deeply cut into bedrock throughout most of Sixth Water Creek. Little or no soil is present in the narrow canyon. Seeps are observed in places in deeply incised canyon walls, and some small springs flow from bedrock in the canyon. Sixth Water Creek gains from groundwater seepage throughout much, if not all, of the reach from Syar Tunnel to Three Forks. However, it is likely that only a small amount of groundwater flows into Sixth Water Creek relative to total flow in the creek, given the small seeps and steep terrain with little soil overlying bedrock in the Sixth Water Creek watershed.

Groundwater flows from areas with relatively high groundwater elevations to areas with relatively low groundwater elevations. It is used by vegetation where the water table is close to the ground surface, and outflow from springs occurs in areas where the water table intersects the ground surface.

3.2.5.2.2 Diamond Fork Creek Drainage. The following description is based upon field observations of existing conditions.

A broad floodplain with very shallow groundwater dominates the riparian area for approximately ½ mile upstream from Highway 6. Groundwater is at or very near the surface in this area. A large pond just upstream of the highway is probably the result of runoff and groundwater discharge. Along the upstream margins and for about ½ mile upstream from the pond, standing water occurs in pockets or in broad sheets below the grasses and other vegetation. Groundwater is typically within a few inches of the surface where there is no standing water. Soil at the surface is primarily fine-grained with abundant organic material.

From ½ mile to about 1 mile upstream of the highway, the broad floodplain with shallow groundwater and standing water is still present in places, but with deeper cuts and more channel braiding. This area is terraced in steps of 2 to 10 feet. Groundwater is typically within 0 to 2 feet of the surface in the lowest terrace. Soils in this reach of the stream channel include topsoil and fines, but include more cobble, gravel and sand than further downstream.

It appears that the saturation of the shallow soil does not depend primarily on the groundwater table elevation. Soil moisture probes (Black 1998) indicate that saturated or nearly-saturated soil conditions are common above the water table in some locations, even if the water table is 2 or more feet below the surface. While not conclusive, this is probably due to the presence of fine-grained soil (silt and clay) within the sand and gravel matrix in some locations, as well as periodic or seasonal inundation from high water flows. When saturated by bank overflow or precipitation, fine-grained soils are likely to drain more slowly than coarse-grained soils, thus holding moisture longer. Even sand and gravel will hold soil moisture longer if the matrix includes a substantial proportion of silt or clay.

The corridor from about 1 to 3 miles upstream of Highway 6 is dominated by braided stream channel and coarse soil (sand, gravel and some cobbles) overlain by a thin veneer of topsoil and two to three terraced levels, with each level typically 2 to 6 feet higher than the next. The lowest terrace, which varies from 50 to 250 feet wide in most locations, features braided channels and narrow channel bars or periodically-inundated floodplain flats, with groundwater often a few inches below the surface near the stream channels. Further from the stream channels, the lower terrace tends to slope upward, and groundwater becomes gradually deeper toward the terrace margins. Shallow test pits show that the water table typically slopes toward the stream channels in this reach of the stream, indicating a gaining stream for part of the year, if not year-round. Dry soil and upland vegetation on the upper terraces suggest that groundwater is several feet beneath these terraces.

From about 3 to 5 miles upstream of Highway 6, braided stream channels occur but are less dominant. Soil is increasingly sandy. Terracing and incised channels are common, but fewer terrace steps occur.

From about 5 to 7 miles upstream of the highway (upstream of Red Hollow), streamflow occurs mostly in a single, narrow channel. This channel is often bounded by deep bank cuts on one or both sides, and flow is typically faster as the gradient steepens. Terracing is no longer dominant. Streamflow stage is usually from 2 to 8 feet below the banks, although in some places the banks slope down to the stream. More upland vegetation and dry test pits suggest deeper groundwater, probably near the elevation of the streamflow stage.

The stream reach from Red Hollow to the Three Forks area is steep and narrow, and the canyon narrows considerably. Soil, where present, is typically sand, gravel and cobble. Banks are mostly well above streamflow stage, and groundwater is several feet below the surface. The stream has cut into bedrock in places.

3.2.5.2.3 Spanish Fork River Corridor. To understand the shallow alluvial groundwater system associated with the Spanish Fork River corridor, the system has been divided into three reaches (see Map A-2). The first reach is from the confluence of Diamond Fork Creek with Spanish Fork River to Spanish Fork Diversion Dam. The second is from Spanish Fork Diversion Dam to about 1 mile upstream of the Power Plant. The third is from 1 mile upstream of the Power Plant to Utah Lake. The following descriptions are based on field observations.

In the first reach, the river channel is typically steep and narrow with steep banks. Alluvial deposits consist primarily of narrow point bars and sand or gravel bars, with narrow, steep terraces limited by the width of rock outcrops in the canyon walls. Alluvium consists of gravels, sands and silts. Seeps and springs are visible along both banks during low-flow baseline conditions.

In the second reach, the canyon is considerably wider as it makes a transition at the canyon mouth from the mountains to the valley floor. The stream channel is less steep, but the banks continue to be relatively steep. Much of the alluvium adjacent to the channel is composed of sand and gravel bars and bank terracing, but alluvial deposits extend much further from the river on each bank. Springs and seeps continue to discharge to the channel during low-flow baseline conditions, and baseflow is noticeably higher than in the first reach.

The third reach, which is much longer than the others, conveys discharge across the broad, relatively flat valley floor to Utah Lake. Most of the unconsolidated shallow aquifer is composed of valley floor alluvium in the form of lacustrine deposits (sand, silt and clay), although coarser deposits of sand and gravel occur in the floodplain of the river channel. Seeps and springs are visible at low flow only along the northeast side of the channel below the Salem-South Field Diversion Dam, but not beyond about 1 mile downstream from the diversion. Some portions of the channel have been observed to be dry during the summer when irrigation diversions upstream cut off the surface water supply (CUWCD 1998c). Irrigation of crops in the valley between April and October results in elevated groundwater table elevations in the valley during those months (CUWCD 1998c) and may contribute to baseline flow in the channel during peak irrigation season in July and August.

3.2.6 Impact Analysis

3.2.6.1 Methodology

Surface water impacts were estimated by comparing the average monthly flows predicted under the Proposed Action or No Action Alternative with baseline average monthly flows. Average flows and flow changes from baseline conditions were quantified at the following 10 locations(with stream segments representing each point in parentheses):

- Sixth Water Creek immediately above Sixth Water Aqueduct (between Strawberry Tunnel and Sixth Water Aqueduct)
- Sixth Water Creek immediately below Sixth Water Aqueduct (between Sixth Water Aqueduct and Fifth Water Creek)
- Sixth Water Creek Below Fifth Water Creek (between Fifth Water Creek and Diamond Fork Creek)
- Diamond Fork Creek Below Three Forks (between Three Forks and Red Hollow)
- Diamond Fork Creek below Red Hollow (between Red Hollow and Spanish Fork River)
- Spanish Fork River At Castilla Gage (between Diamond Fork Creek and Spanish Fork Diversion Dam)
- Spanish Fork River below Spanish Fork Diversion Dam (between Spanish Fork Diversion Dam and East Bench Dam)

- Spanish Fork River below East Bench Dam (between East Bench Dam and Mill Race Diversion)
- Spanish Fork River Below Mill Race Diversion (between Mill Race Diversion and Lake Shore Diversion)
- Spanish Fork River At Lake Shore Gage (between Lake Shore Diversion and Utah Lake)

Groundwater table measurement data was compared to modeled changes for known streamflow rates on specific dates to quantitatively estimate the relationship between surface water and groundwater table elevation changes. Groundwater table measurements in five piezometers installed at Ute Ladies'-tresses colonies in the Diamond Fork drainage (Black 1998) were compared with measured streamflow rates at the U.S. Geological Service gaging station below Red Hollow. These were compared using both the daily mean streamflow rates on the dates of groundwater level measurement and the average of the daily mean streamflow rates for the seven days prior to and including the date of groundwater level measurement. This latter approach was used to moderate the extremes of variation in surface water elevations as opposed to the less volatile groundwater elevation changes. The streamflow rate measurements were compared with projected streamflow elevations developed from HEC-RAS modeling for comparable streamflows (CUWCD 1999d).

3.2.6.2 Significance Criteria

Groundwater-level impacts are considered significant if wetland and riparian vegetation cannot obtain enough water to sustain existing populations, as defined elsewhere in Chapter 3. They also are considered significant if there is a measurable increase in the frequency or extent of basement or other subsurface structure flooding or if water levels in groundwater production wells are lowered enough to reduce groundwater production or increase pumping costs.

Significance criteria for surface-water flows were not formulated because surface waters support various other environmental resources such as aquatic resources, and special status species in the impact area of influence. Significance criteria using streamflow parameters were used as appropriate for other resources, (for example to determine effect on Ute ladies'-tresses) which are described in other sections of Chapter 3.

3.2.6.3 Potential Impacts Eliminated From Further Analysis

Impacts on Utah Lake and the Jordan River were excluded from this analysis. Operation of the Proposed Action or the No Action Alternative would not adversely affect the level or water quality of the lake or flows in Jordan River because the water delivered to Utah Lake would be exchanged for inflow reductions to the lake. Utah Lake storage volumes under the Proposed Action have been evaluated and documented in the *Hydrology and Water Resources Technical Memorandum* (CUWCD 1999d).

3.2.6.4 Proposed Action

3.2.6.4.1 Impacts During Construction. The potential construction impact on surface water quantities and long-term groundwater levels would not be significant based on the limited need for construction water and the requirement to acquire water rights for this supply. Water required for construction activities (less than 1,000 acre-feet) could potentially impact surface water quantities if pits and trenches are excavated below the water table. Although information about groundwater conditions is insufficient to quantify any loss from dewatering, it is unlikely that levels would be significantly affected except within a few feet of the dewatered excavations. These impacts would be small and temporary, and would be reversed shortly after dewatering is discontinued. The contractor also would be required to obtain water only from approved sources.

Jo other impacts were identified for construction activities.

3.2.6.4.2 Impacts During Operation. Operation impacts would result from interim operation of the Proposed Action to convey and deliver water to Utah Lake while meeting minimum flows mandated by law. The impact of operations on surface water quantities and groundwater levels are addressed in the following sections.

3.2.6.4.2.1 Surface Water Quantity. Changes in flows would result from normal operations and from releases during Diamond Fork System emergency shutdowns as described below.

Normal Operation Flow Changes: Table 3-2 shows monthly flows for streams that have quantified monthly baseline flows. Monthly flows also are shown that would occur under the historical wettest and driest year conditions of 1952 and 1961.

Release of the CUPCA mandated minimum instream flows from Strawberry Tunnel would increase flows in Sixth Water Creek over baseline. Conveyance of flows in the Proposed Action features instead of in Sixth Water Creek below Sixth Water Aqueduct and Diamond Fork Creek would result in reduced flows. Peak flows in late spring and early summer in Sixth Water and Diamond Fork creeks would be less than under baseline conditions. The average annual flow in these streams would be decreased from baseline.

Flow in all segments of the Spanish Fork River would increase over baseline flow in all months due to the conveyance of Bonneville Unit water to Utah Lake for M&I exchange purposes.

Diamond Fork System Emergency Shutdown Flow Changes: Flows resulting from any emergency shutdown of the system would be lower than high flows that have occurred under historical high spring runoff events. Emergency shutdown flows below Diamond Fork Creek Outlet would last no longer than several hours, until the valves at Sixth Water Aqueduct flow control facility can be closed and water drains from the system.

3.2.6.4.2.2 Groundwater Levels. Groundwater levels would tend to rise and fall in relation to the surface water levels in the stream channels, depending on the flow rates in the channels. In the Sixth Water Creek, Diamond Fork Creek, and most of the Spanish Fork River drainages, groundwater within the alluvium flows toward the streams. As water levels rise or fall within the stream channels, the slope of groundwater toward the channel decreases or increases. A lower stream level increases the water table slope and lowers the groundwater table, while a higher stream level has the opposite effect. Therefore, the effect on the groundwater table would be greatest close to the stream and less further from the stream. Also, higher streamflow rates (due to releases from Strawberry Reservoir) would occur than under baseline conditions during winter months. In the lower reaches of Spanish Fork River, where little or no streamflow occurs under baseline conditions, this higher flow may result in recharge to groundwater because of losses from the stream channel. The volume that would seep into the subsurface is not quantifiable, but likely would be small relative to total streamflow and confined to areas next to the river channel. Groundwater table elevation changes associated with increased streamflow in the Spanish Fork River drainage below Spanish Fork Diversion Dam are not likely to result in flooding of basements or other underground structures.

3.2.6.4.3 Impact Summary

Table 3-2 summarizes changes from baseline for surface water quantities under the Proposed Action. Monthly average flows in Sixth Water Creek and Diamond Fork Creek above Red Hollow would be constant under the Proposed Action. Except for peak natural runoff conditions, flows would be near the minimum flow levels (25 cfs in winter and 32 cfs in summer on Sixth Water Creek; and 60 cfs in winter and 80 cfs in summer on Diamond Fork Creek). Compared to baseline flows, winter and early spring flows in Sixth Water Creek above Sixth Water Aqueduct would increase a maximum of 333 percent, or 21 cfs. Below Sixth Water Aqueduct, late spring and summer flows in Sixth Water Creek would decrease a maximum of 88 percent, or 250 cfs compared to baseline.

Table 3-2
Streamflows Resulting From the Proposed Action

Monthly Flows (cfs)

Feature	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Range of Monthly Flows	Annual Flow (ac-ft/yr)
Sixth Water Creek Above Sixth Water Aqueduct														
Change*	28	21	20	20	20	20	19	27	26	27	27	28		17,100
Average Flow	34	27	26	26	26	27	33	48	37	34	33	34		23,200
Wet Year	34	27	27	27	27	27	58	87	52	35	35	34	25 - 87	28,300
Dry Year	33	26	26	26	26	26	27	35	32	32	32	33		21,400
Sixth Water Creek Below Sixth Water Aqueduct														
Change*	3	20	20	20	20	20	13	-46	-196	-250	-190	-85		(39,700)
Average Flow	34	27	26	26	26	27	33	48	37	34	33	34		23,200
Wet Year	34	27	27	27	27	27	58	87	52	35	35	34	25 - 87	28,300
Dry Year	33	26	26	26	26	26	27	35	32	32	32	33		21,400
Sixth Water Creek Below Fifth Water Creek														
Change*	2	20	20	20	20	20	13	-46	197	-251	-189	-86		(39,700)
Average Flow	36	30	29	28	29	31	48	75	45	37	36	36		27,700
Wet Year	37	31	30	29	29	31	115	182	86	42	40	38	25 - 182	41,700
Dry Year	35	29	27	28	27	28	30	39	32	32	32	35		22,600
Diamond Fork Creek Below Three Forks														
Change*	3	20	19	20	20	20	13	-46	-196	-250	-188	-86		(39,600)
Average Flow	42	36	33	32	34	38	80	134	64	45	42	42		37,600
Wet Year	44	40	36	34	35	37	239	389	162	59	51	47	25 - 389	70,900
Dry Year	41	34	29	33	31	31	37	49	32	33	33	39		25,300
Diamond Fork Creek Below Diamond Fork Creek Outlet														
Change*	22	44	46	48	46	42	18	-40	-171	-213	-149	-48		(21,800)
Average Flow	61	60	60	60	60	60	85	140	89	82	81	80		55,400
Wet Year	61	60	60	60	59	60	239	389	162	82	81	80	60 - 389	84,200
Dry Year	61	60	60	60	60	60	60	81	80	81	81	80		49,600
Spanish Fork River at Castilla Gage														
Change*	42	100	113	126	139	146	160	202	178	132	97	71		90,800
Average Flow	135	170	181	193	221	259	407	667	583	496	380	249		237,900
Wet Year	115	139	161	191	203	246	1,081	1,912	686	502	366	330	89 - 1,912	358,900
Dry Year	163	203	123	146	174	191	175	295	347	266	233	147		148,500
Spanish Fork River Below Spanish Fork Diversion Dam														
Change*	38	101	113	126	140	146	155	192	168	123	87	64		87,400
Average Flow	43	101	113	126	140	147	180	292	222	165	119	81		104,200
Wet Year	15	72	97	116	122	138	581	1,412	186	68	45	34	4 - 1,412	174,900
Dry Year	113	155	83	101	124	133	137	116	76	75	101	60		76,600
Spanish Fork River Below East Bench Dam														
Change*	37	101	113	126	140	146	154	193	164	118	85	62		86,700
Average Flow	37	101	113	126	140	146	171	243	165	118	85	62		90,800
Wet Year	11	72	97	116	122	138	581	1,374	106	1	1	0	0 - 1,374	158,700
Dry Year	107	155	83	101	124	133	118	79	19	56	88	54		67,200
Spanish Fork River Below Mill Race Diversion														
Change*	38	101	113	126	140	147	154	192	165	118	84	62		86,600
Average Flow	82	170	181	193	221	258	341	345	199	137	101	76		138,600
Wet Year	45	139	161	191	203	246	1,081	1,636	196	32	14	14	0 - 1,636	239,300
Dry Year	138	203	123	146	174	191	130	79	19	62	93	62		85,400
Spanish Fork River at Lake Shore Gage														
Change*	38	101	113	126	139	147	153	184	167	117	83	62		86,100
Average Flow	68	168	190	205	236	276	352	322	189	120	86	70		137,300
Wet Year	56	140	168	201	221	282	1,114	1,551	281	2	4	40	0 - 1,551	245,100
Dry Year	127	207	139	161	187	199	134	82	20	55	88	55		87,400

* Change is equal to Proposed Action Average Flow minus Baseline Average Flow

Notes:

The dry-year monthly average flows are based on natural runoff conditions that occurred in 1961 and represent the average driest year that occurred during the 44 year period of record.

The wet-year monthly average flows are based on natural runoff conditions that occurred in 1952 and represent the average wettest year that occurred during the 44 year period of record.

The Proposed Action would increase winter flows and decrease summer flows in Diamond Fork Creek. Monthly average flows under the Proposed Action in Diamond Fork Creek below Diamond Fork Creek Outlet would increase a maximum of 400 percent, or 48 cfs during the winter, and decrease a maximum of 72 percent, or 213 cfs, during the summer compared to baseline.

Monthly average flows in Spanish Fork River would be higher in all months under the Proposed Action – most significantly during the winter. Average increases also would be significant below the Spanish Fork, East Bench, Mill Race and Lake Shore diversion dams, where Bonneville Unit water being conveyed to Utah Lake would bypass the diversion dams and remain in the river. Under baseline conditions, essentially all of the water in Spanish Fork River is diverted out during the summer irrigation season.

3.2.6.5 No Action Alternative

3.2.6.5.1 Impacts During Construction. The potential construction impact on surface water quantities and long-term groundwater levels would not be significant (See Section 3.2.6.4.1).

3.2.6.5.2 Impacts During Operation. Impacts would result from operation of the No Action Alternative to convey and deliver water for M&I exchange in Utah Lake, and for delivery of supplemental irrigation and M&I water. These impacts on surface water quantities and groundwater levels are addressed in the sections that follow.

3.2.6.5.2.1 Surface Water Quantity. Changes in flows would result from normal operations and from releases during Diamond Fork System emergency shutdowns as described below.

Normal Operation Flow Changes: Table 3-3 shows monthly flows for streams that have quantified monthly baseline flows. Monthly flows that would occur under the historical wet and dry year conditions of 1952 and 1961 are also shown.

Release of the CUPCA mandated minimum instream flows from Strawberry Tunnel would increase flows in Sixth Water Creek above Sixth Water Aqueduct over baseline. Conveyance of SVP and Bonneville Unit water flows in Sixth Water Creek below Sixth Water Aqueduct would increase, resulting in increased flows over baseline. Conveyance of flows in the No Action Alternative features instead of in Diamond Fork Creek below Three Forks would result in reduced flows in the creek. Peak flows in late spring and early summer in Sixth Water Creek above Sixth Water Aqueduct and Diamond Fork Creek below Three Forks would be less than under baseline conditions.

Flow in all segments of the Spanish Fork River would increase over baseline flow in all months due to the conveyance of Bonneville Unit water to Utah Lake for M&I exchange purposes.

Diamond Fork System Emergency Shutdown Flow Changes: Flows resulting from any emergency shutdown of the system would be lower than high flows that have occurred under historical high spring runoff flow events. Emergency shut down flows below Three Forks Dam would last no longer than several hours, until the valves at Sixth Water Aqueduct flow control facility can be closed. Flows exceeding the dam outlet pipe capacity would flow over the spillway.

3.2.6.5.2.2 Groundwater Levels. As discussed in Section 3.2.6.4.2.2, existing data are insufficient to reliably quantify the relationship between projected changes in groundwater elevation levels and changes in surface water streamflow rate or elevation changes. In general, however, the data suggest there is a relationship.

Groundwater table elevations below the new Three Forks Reservoir would fluctuate, but would rise overall when much of the flatter ground upstream of Three Forks is submerged. This would engulf much of the Three Forks area and reduce the total area currently associated with shallow alluvial groundwater available for riparian habitat. It is

Table 3-3
Streamflows Resulting From the No Action Alternative

Monthly Flows (cfs)

Feature	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Range of Monthly Flows	Annual Flow (ac ft/yr)
Sixth Water Creek above Sixth Water Aqueduct														
Change*	28	21	20	20	20	20	19	27	26	27	27	28		17,100
Average Flow	34	27	26	26	26	27	33	48	37	34	33	34		23,200
Wet Year	34	27	27	27	27	27	58	87	52	36	35	34	25 - 87	28,400
Dry Year	33	26	26	26	26	26	27	35	32	32	32	33		21,400
Sixth Water Creek below Sixth Water Aqueduct														
Change*	40	156	129	140	155	161	174	191	168	178	120	78		101,600
Average Flow	71	163	135	146	161	168	194	285	401	462	343	197		164,500
Wet Year	52	166	153	54	51	50	58	100	192	362	257	212	34 - 639	103,300
Dry Year	134	160	142	170	189	192	151	257	386	304	165	86		140,700
Sixth Water Creek below Fifth Water Creek														
Change*	40	156	128	140	154	160	174	191	167	177	120	78		101,600
Average Flow	74	166	137	148	163	171	209	312	409	465	345	200		169,000
Wet Year	56	170	156	56	54	53	115	195	227	368	262	216	46 - 649	116,600
Dry Year	136	162	143	172	191	194	154	261	386	304	165	88		141,900
Diamond Fork Creek below Three Forks														
Change*	21	44	46	48	46	42	18	-41	-173	-215	-150	-48		(22,100)
Average Flow	60	60	60	60	60	60	85	139	87	80	80	80		55,100
Wet Year	60	60	60	60	60	60	239	389	162	80	80	80	60 - 389	84,000
Dry Year	60	60	60	60	60	60	60	80	80	80	80	80		49,500
Diamond Fork Creek below Red Hollow														
Change*	21	44	46	48	46	42	18	-41	-173	-215	-150	-48		(22,100)
Average Flow	60	60	60	60	60	60	85	139	87	80	80	80		55,100
Wet Year	60	60	60	60	60	60	239	389	162	80	80	80	60 - 389	84,000
Dry Year	60	60	60	60	60	60	60	80	80	80	80	80		49,500
Spanish Fork River at Castilla Gage														
Change*	40	156	128	139	154	161	173	191	167	178	120	78		101,600
Average Flow	133	226	196	206	236	274	420	656	572	541	403	256		248,700
Wet Year	115	226	210	122	125	150	1,076	1,905	706	573	411	332	94 - 1,905	360,100
Dry Year	173	201	177	209	233	244	201	309	394	317	202	126		167,800
Spanish Fork River below Spanish Fork Diversion Dam														
Change*	29	157	129	140	154	161	168	175	110	85	65	59		86,000
Average Flow	34	157	129	140	154	161	193	275	164	127	97	76		102,800
Wet Year	10	158	146	47	44	42	576	1,402	191	79	53	34	5 - 1,402	168,800
Dry Year	113	153	136	164	183	186	163	130	102	39	25	12		84,300
Spanish Fork River below East Bench Dam														
Change*	28	157	129	140	154	161	167	176	107	81	63	57		85,400
Average Flow	28	157	129	140	154	161	184	226	108	81	63	57		89,500
Wet Year	6	158	146	47	44	42	576	1,364	110	13	9	0	0 - 1,364	152,600
Dry Year	107	153	136	164	183	186	144	92	45	20	11	6		74,900
Spanish Fork River below Mill Race Diversion														
Change*	28	157	128	139	155	161	167	174	102	70	57	55		83,800
Average Flow	72	226	196	206	236	272	354	327	136	89	74	69		135,800
Wet Year	39	226	210	122	125	150	1,076	1,626	199	36	17	14	0 - 1,626	232,200
Dry Year	136	201	177	209	233	244	156	92	42	15	11	10		91,600
Spanish Fork River at Lake Shore Gage														
Change*	27	157	129	140	154	161	166	165	99	62	52	54		82,100
Average Flow	57	224	206	219	251	290	365	303	121	65	55	62		133,300
Wet Year	50	226	217	132	142	187	1,108	1,540	281	0	4	40	0 - 1,540	237,300
Dry Year	125	204	193	224	247	253	160	96	41	0	2	1		92,600

* Change is equal to No Action Average Flow minus Baseline Average Flow

Notes:

The dry-year monthly average flows are based on natural runoff conditions that occurred in 1961 and represent the average driest year that occurred during the 44 year period of record.

The wet-year monthly average flows are based on natural runoff conditions that occurred in 1952 and represent the average wettest year that occurred during the 44 year period of record.

reasonable to assume that the long-term increase in surface-water elevation would result in a roughly proportional increase in groundwater elevation upstream of the dam and in the area submerged by the reservoir.

3.2.6.5.3 Impact Summary. Table 3-3 summarizes changes from baseline for surface water quantities under the No Action Alternative. Monthly average flows vary little in Sixth Water Creek above Sixth Water Aqueduct and in Diamond Fork Creek below Red Hollow . Except for variations caused by natural runoff, flows would be maintained at the minimum levels (25 cfs in winter and 32 cfs in summer on Sixth Water Creek; and 60 cfs in winter and 80 cfs in summer on Diamond Fork Creek). Compared to baseline flows, winter and early spring flows in Sixth Water Creek above Sixth Water Aqueduct would increase a maximum of 333 percent, or 21 cfs. Below Sixth Water Aqueduct, monthly average flows in Sixth Water Creek would increase in all months, ranging from 40 cfs in October up to 191 cfs in May compared to baseline.

The No Action Alternative would increase winter flows and decrease summer flows in Diamond Fork Creek. Monthly average flows in Diamond Fork Creek below Three Forks Dam would increase a maximum of 400 percent, or 48 cfs, during the winter, and decrease a maximum of 73 percent, or 215 cfs, during the summer compared to baseline.

Flows in Spanish Fork River would be higher in virtually all months under the No Action Alternative – most significantly during the winter. Average flow increases also would be significant below the Spanish Fork, East Bench, Mill Race and Lake Shore diversion dams, where Bonneville Unit water being conveyed to Utah Lake would bypass the diversion dams and remain in the river.

No impacts caused by changes in groundwater levels are anticipated because groundwater is not used directly as a resource in the Sixth Water Creek and Diamond Fork Creek drainages and groundwater table elevation changes in the Spanish Fork River drainage are expected to be small.

3.3 Water Quality

3.3.1 Introduction

This section addresses the potential impact on surface water and groundwater quality that would result from construction and operation of the Proposed Action and No Action Alternative. The impacts on water quality would result from the transbasin diversion of water from Strawberry Reservoir into Sixth Water and Diamond Fork creeks and Spanish Fork River. The information and analysis provided in this section was summarized from the Spanish Fork-Nephi Irrigation System Draft Environmental Impact Statement Draft *Hydrology and Water Resources Technical Report* (CUWCD 1998c), *Sediment Study for the No Monks Hollow Alternative–SFN System EIS* (CUWCD 1997b), and the *Water Quality Technical Memorandum for the 1999 Diamond Fork System FS-FEIS (CUWCD* 1999f*)*.

The following issues raised during the public scoping process for the Spanish Fork-Nephi (SFN) Irrigation System were eliminated from further analysis:

- **Drinking water standards for Diamond Fork System water delivered for M&I exchange.** This issue was eliminated because local entities are responsible for meeting applicable water quality standards.

- **Strawberry Reservoir operational issues.** These issues were eliminated because there would be no significant change in the impacts on Strawberry Reservoir from those addressed in the previous documents. The water quality of Strawberry Reservoir was previously described in the *Bonneville Unit Definite Plan Report* (USBR 1964) and the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984). Those documents indicated that Strawberry Reservoir water quality was good before it was enlarged, except for high nutrient concentrations and resulting eutrophication (USBR 1964, 1984). After the enlargement, water quality was improved by high nitrate concentrations being diluted from increased inflow to the reservoir and increased storage volume. The enlargement had varied effects on other nutrients, reducing concentrations during some months and increasing them during others (CUWCD 1998b).

- **Thistle Creek Water Quality**. The issue of water quality problems in Thistle Creek that could limit the potential for improvement of Spanish Fork River below Spanish Fork Diversion Dam was not directly addressed, as Thistle Creek is not included in the impact area of influence. However, the effects that Thistle Creek's water quality has on Spanish Fork River were indirectly addressed since baseline flows and water quality data incorporate inflow from Thistle Creek.

3.3.2 Issues Eliminated from Further Analysis

This section does not address drinking water standards for Diamond Fork System water delivered for M&I exchange because local entities are responsible for meeting applicable standards. Strawberry Reservoir operational issues raised during the SFN public scoping process also were excluded from this analysis. The water quality of Strawberry Reservoir was previously described in the *Bonneville Unit Definite Plan Report* (USBR 1964) and the *Diamond Fork Power System Final Environmental Impact Statement* (USBR 1984). These documents indicate that, before Strawberry Reservoir was enlarged, it had good water quality, except for high nutrient concentrations and resulting eutrophication. The enlargement improved water quality in Strawberry Reservoir by diluting the high nitrate concentrations from increased inflow to the reservoir. The effect of enlargement on other nutrients varies, with reduced concentrations during some months and increases during others.

The effects of the enlarged Strawberry Reservoir and inlet bay restructuring on temperatures of water releases also were evaluated. Due to the position of the rehabilitated inlet structure and the Bryant's Fork Bay configuration, it is unlikely that water releases would include warmer thermocline water, although the potential for a mixed condition still exists. These impacts are the result of Strawberry Reservoir operations and, as discussed in Section 3.2.2, interim operations for the Proposed Action and No Action Alternative are essentially unchanged from operations described previously.

Water quality problems in Thistle Creek that could limit the potential for improving Spanish Fork River below Spanish Fork Diversion Dam were not directly addressed since Thistle Creek is not included in the impact area of influence. However, the impacts of Thistle Creek's water quality on Spanish Fork River were indirectly addressed since baseline flows and water quality data incorporate inflow from Thistle Creek.

3.3.3 Issues Addressed in the Impact Analysis

The following surface and groundwater quality issues were identified in the SFN scoping process and are included in the analysis:

- Potential sediment load in Diamond Fork System water
- Impacts on water quality of releases from Strawberry Reservoir

3.3.4 Description of Impact Area of Influence

The impact area of influence for water quality includes hydrologic features in southern Utah County that would convey water under the Proposed Action or No Action Alternative. This includes the same major hydrologic features considered for water quantity (See Section 3.2.4).

3.3.5 Affected Environment (Baseline Conditions)

The affected environment is defined by the existing water quality in the hydrologic features in the impact area of influence. The surface water and groundwater quality of the hydrologic features identified in the impact area of influence could be affected by the construction and operation of the Proposed Action and No Action Alternative. Water from Strawberry Reservoir is included in the discussion of surface water quality because it would mix with natural flows while being conveyed through the Proposed Action and No Action Alternative features.

Several key parameters were used to assess water quality: salinity (as measured by total dissolved solids [TDS], which is a measurement of the quantity of minerals dissolved in the water), pH, dissolved oxygen, temperature, biochemical oxygen demand [BOD], nitrate, total ammonia, total phosphorus, total coliforms, turbidity and selenium. These parameters are included in the water quality standards set by the State of Utah and were selected to provide information used to evaluate related impacts on other resources.

Both the average level and maximum level of the key parameters are presented in this section (except dissolved oxygen, which considers minimums). Average levels of these parameters indicate whether water generally meets water quality standards, while the maximum levels show whether there are occasional exceedances of standards. A separate sedimentation evaluation (CUWCD 1998e) was limited to the Diamond Fork drainage.

Table 3-4 summarizes key Utah water quality standards by key parameters and water use classifications. Water quality was evaluated in relation to the *Standards of Quality for Waters of the State* (Utah Department of Environmental Quality 1997). The standards vary by the uses of water. Table 3-5 summarizes Utah water use classifications of the major hydrologic features in the impact area of influence.

3.3.5.1 Surface Water Quality

Water quality for each surface-water feature depends on several processes. These include the blend of the various source waters that contribute flows to each feature. Temperatures, dissolved oxygen (DO), and phosphorus in waters receiving Strawberry Reservoir releases would be influenced by a thermocline, a temperature stratification in the reservoir that may be present from about May to October (USBR 1988b).Water from above the thermocline has warmer temperatures and lower phosphorus concentrations than water from below. Cooler temperatures allow more oxygen to be dissolved, but the thermocline prevents vertical mixing so available DO can be consumed without replenishment.

Water quality can also be influenced by the rate of flow. Stagnant pools of water exhibit higher summer temperatures and lower levels of dissolved oxygen. Higher flow rates produce greater aeration. Turbidity and total phosphorus can also increase as a result of increased erosion. In Spanish Fork River (from Diamond Fork confluence to Spanish Fork Diversion Dam), high turbidity is associated with high flows resulting from spring runoff, heavy rainstorms and irrigation releases. During storm events, turbid water from Halls Fork, Diamond Fork, Soldier Creek and Thistle Creek slide area also can result in turbidity problems in this segment of Spanish Fork River (Sakaguchi 1993).

Table 3-4
State of Utah Water Quality Standards by Key Parameters and Water Use Classification

Key Water Quality Parameters	Units	Water Use Classification 1C Domestic	2B Recreation (Secondary Contact)	3A Coldwater Game Fishery	3B Warmwater Game Fishery	3C Non-Game Fishery	3D Waterfowl Fishery	4 Agriculture
Total Dissolved Solids[a] (TDS)	ppm	No standard	No standard	No standard	No standard	No standard	No standard	1,200
Minimum pH		6.5	6.5	6.5	6.5	6.5	6.5	6.5
Maximum pH		9.0	9.0	9.0	9.0	9.0	9.0	9.0
Minimum Dissolved Oxygen[b] (30-day average)	ppm	No standard	5.5	6.5	5.5	5.0	5.0	No standard
Maximum Temperature	°F	No standard	No standard	68	81	81	No standard	No standard
Biologic Oxygen Demand (BOD)	ppm	No standard	5	6.5	5	5	5	5
Nitrate as N	ppm	No standard	4	4	4	4	No standard	No standard
Total Ammonia as N[c] (4-day average)	ppm	No standard	No standard	c	c	No standard	No standard	No standard
Phosphate as Phosphorus (streams)	ppm	No standard	0.05	0.05	0.05	No standard	No standard	No standard
Phosphate as Phosphorus (lake and reservoirs)	ppm	0.025	0.025	0.025	0.025	0.025	0.025	No standard
Maximum Total Coliforms	count	5,000	5,000	No standard	No standard	No standard	No standard	No standard
Maximum Fecal Coliforms	count	2,000	200	No standard	No standard	No standard	No standard	No standard
Turbidity Increase	NTU	No standard	10	10	10	15	15	No standard

NOTES:

Selenium water quality standards (State of Utah) are 10 ppb for domestic use, 50 ppb for agricultural use, 5.0 ppb for chronic aquatic life support and 20 ppb for acute aquatic life support (*Final Environmental Contaminants Study Technical Report SFC/NIS*, CUWCD 1997a)

[a]Limits may be adjusted if such adjustment does not impair the designated beneficial use of the receiving water.

[b]These limits are not applicable to lower water levels in deep impoundments. The 30-day standard is used in this FS-FEIS as it corresponds with the monthly time step used for analysis.

[c]Temperature- and pH-dependent.

Source: *Standards of Quality for Waters of the State* (Utah Department of Environmental Quality 1997)

Table 3-5
State of Utah Water Use Classification of Hydrologic Features in the Impact Area of Influence

Affected Water Features	Water Use Classification[a]						
	1C Domestic	2B Recreation (Secondary Contact)	3A Coldwater Game Fishery	3B Warmwater Game Fishery	3C Non-Game Fishery	3D Waterfowl Fishery	4 Agriculture
Sixth Water Creek		X	X				X
Diamond Fork Creek		X	X				X
Spanish Fork River from confluence of Diamond Fork Creek to Spanish Fork Diversion Dam		X	X				X
Spanish Fork River from Spanish Fork Diversion Dam to Utah Lake		X		X		X	X

[a]Source: SFN Draft *Hydrology and Water Resources Technical Report* (CUWCD 1998c)

Table 3-6 summarizes baseline water quality conditions (arithmetic and flow-weighted average) for the various surface water features in the impact area of influence. These conditions are based on water quality data from the *1988 Supplement to the 1964 Definite Plan Report, Water Quality Appendix, Vol. III* (USBR 1988b); *Utah Lake Phase 1, Report 26* (Miller 1980); basic data from the Utah Department of Environmental Quality (1997); *Final Report Jordan River and Tributary System Water Quality Data Update and Study* (Eckhoff, Watson, and Preator Engineering 1986); *Water Quality Technical Memorandum (CUWCD 1999f);* and basic data from the U.S. Geological Survey and USBR. Modifications were made to account for new data and changes in conditions (see Section 3.3.6.1 Methodology).

Baseline water quality conditions were examined to determine compliance with existing standards. Average water quality conditions were used to determine general compliance with the standards, and maximum (minimum for dissolved oxygen) concentrations were used to determine periodic exceedances of the standards. The average water quality conditions generally meet all standards except for the following key parameters:

Phosphorus: Maximum total phosphorus concentrations exceed the standard in all areas, except for Spanish Fork River (below Spanish Fork Diversion Dam to Utah Lake) where there is no set standard. Maximum concentrations generally occur during peak spring runoff and snowmelt, when winter accumulations of phosphorus would be carried with suspended solids. High concentrations also occur during the irrigation season when water from Strawberry Reservoir is released from below the thermocline.

Dissolved Oxygen: The entire system meets minimum DO standards on average, but periodically exceeds standards for Sixth Water Creek from Sixth Water Aqueduct to Three Forks. Low DO levels typically occur during periods of warm temperatures because of reduced saturated oxygen concentration, increased biochemical demand for oxygen, and higher releases of low DO Strawberry Reservoir water for irrigation. Water flowing downstream is re-aerated and meets all DO standards by the time it reaches the Lake Shore Diversion.

Table 3-6
Surface Water Quality Baseline Conditions for Diamond Fork and Sixth Water Creeks, and Spanish Fork River

	Sixth Water Creek			Diamond Fork Creek		Spanish Fork River	
Key Water Quality Parameters	**Below Strawberry Tunnel Outlet**	**Below Sixth Water Aqueduct**	**Below Fifth Water Creek**	**Below Three Forks**	**Below Red Hollow**	**At Castilla Gage**	**At Lake Shore**
TDS (ppm)							
Average	306	267	306	306	290	385	440
Flow Weighted Average	302	162	220	230	235	335	459
Maximum	454	454	454	454	379	500	532
pH							
Average	8.4	8.2	8.4	8.4	8.3	8.1	8.4
Flow Weighted Average	8.4	8.2	8.3	8.3	8.3	8.1	8.6
Maximum	8.5	8.5	8.5	8.5	8.5	8.6	9.2
Dissolved Oxygen (ppm)							
(deep) Average	10.4	8.9	9.0	9.5	10.0	9.8	10.0
Flow Weighted Average	12.0	6.1	9.1	9.1	9.4	9.5	10.4
Minimum	9.1	3.5	5.6	7.1	8.5	8.5	8.0
Dissolved Oxygen (ppm)							
(mixed) Average	10.4	9.9	9.0	9.5	10.0	9.8	10.0
Flow Weighted Average	10.5	8.2	9.1	9.1	9.4	9.5	10.4
Minimum	9.1	6.8	5.6	7.1	8.5	8.5	8.0
Temperature (degrees F)							
(mixed) Average	47	46	47	47	46	47	50
Flow Weighted Average	46	51	52	52	52	50	45
Maximum	66	62	66	66	57	56	62
BOD (ppm)							
Average	3.2	2.4	1.2	1.6	1.6	3.0	[a]
Flow Weighted Average	[b]	[b]	1.2	1.6	1.6	3.0	[a]
Maximum	[b]	[b]	1.3	2.0	2.0	4.5	[a]
Nitrate as N (ppm)							
Average	0.227	0.166	0.238	0.238	0.284	0.354	0.567
Flow Weighted Average	0.270	0.116	0.208	0.223	0.328	0.330	0.371
Maximum	0.733	0.559	0.733	0.733	1.035	1.557	3.300
Total Ammonia as N (ppm)							
Average	0.035	0.046	0.036	0.036	0.020	0.039	0.189
Flow Weighted Average	0.038	0.052	0.042	0.042	0.022	0.040	0.283
Maximum	0.121	0.258	0.121	0.121	0.056	0.234	0.776
Total Phosphorous (ppm)[c]							
(deep) Average	0.066	0.085	0.072	0.072	0.081	0.106	0.152
Flow Weighted Average	0.083	0.127	0.096	0.097	0.116	0.137	0.130
Maximum	0.189	0.180	0.189	0.189	0.221	0.273	0.593
Coliforms (count)							
Total	[a]	[a]	[a]	476	476	280	[a]
Fecal	[a]	[a]	[a]	[a]	[a]	23	[a]
Selenium (ppb)[d]	[e]						
Average	13.5	2.5	1.2	1.2	0.7	0.7	1.4
Flow Weighted Average	13.7	2.0	0.8	0.8	0.5	0.6	1.4
Maximum	20.0	4.3	3.8	3.8	1.4	1.2	1.6
Turbidity (NTU)							
Average	17.3	4.7	17.3	17.3	22.0	80.6	137.1
Flow Weighted Average	21.0	2.9	33.8	32.5	51.3	97.1	112.4
Maximum	75.3	25.1	75.3	75.3	100.5	300.4	755.0

Notes:
Temperature data are not directly comparable with Table 3-7 since values presented here are weighted for the amount of flow occuring during each month.
[a]No data were available.
[b]Based on one sample only.
[c]Concentration below 33-ft depth (potential thermocline).
[d]Based on May through October values, and less than detection limit replaced with 1/2 detection limit
[e]Values in this column are for Strawberry Tunnel outlet and not actual instream values

Selenium: Selenium exceeds the chronic aquatic life-support standard at the Strawberry Tunnel Outlet. Exceedances occur only from seepage and groundwater flow conditions. On two sampling dates, the Strawberry Tunnel exceedance contributed to instream exceedance of standards in Sixth Water Creek below the Strawberry Tunnel Outlet.

Ammonia: Total ammonia-N remains within the 4-day average (chronic) temperature- and pH-dependent standard throughout the system except for periodic exceedances in Spanish Fork River from the Spanish Fork Diversion Dam to Utah Lake, when peak ammonia concentrations occur at the same time when peak temperatures and pH occur. All of the peak ammonia concentrations meet the 1-hour average (acute) standard. Although unionized ammonia is the stream-based standard, values for unionized ammonia are not available, therefore total ammonia standards and concentrations were used.

pH: Spanish Fork River below Spanish Fork Diversion Dam periodically exceeds the standard in summer during periods of high irrigation diversions and return flows.

State water quality temperature standards are for high temperatures. The effects of winter temperatures on freezing potential at Spanish Fork Diversion Dam were analyzed using a temperature mixing model (see Section 3.3.6.1). Table 3-7 shows climate data and historical Strawberry Reservoir temperature data. Data were only available to assess freezing potential above the Spanish Fork Diversion Dam. However, data were not available to determine how often freezing occurs under baseline conditions. Equilibration with ambient temperatures occurs within 20 feet of the confluence of Diamond Fork Creek where Strawberry Reservoir water releases enter Spanish Fork River because of high flow volumes.

Sedimentation studies (CUWCD 1998b) were limited to Sixth Water Creek and Diamond Fork Creek. These data provide the relationship between discharge and amount of sediment transported along the creeks. Diamond Fork Creek values were extrapolated to provide estimates of Spanish Fork sediment transport. Where reach discharges were beyond the limits of these relationships, relationships generated from historic data were used (CUWCD 1997b). A 10 percent bedload adjustment for transported sediments was used in all calculations (CUWCD 1998b).

The historic transbasin diversion of irrigation water has resulted in dramatic changes in the character of Sixth Water and Diamond Fork creeks. Since most of the sediment has been historically eroded from Sixth Water Creek, Diamond Fork Creek gains little sediment above the confluence. This increase in velocity scours any previously deposited sediment and eroded particles. The load eventually becomes too much for the stream to carry and is deposited in the lower reaches of Diamond Fork Creek, which has become an unstable braided stream environment. Table 3-8 shows the baseline sediment budget for Sixth Water and Diamond Fork creeks, and Spanish Fork River (from Diamond Fork confluence to Spanish Fork Diversion Dam).

Table 3-7
Monthly Temperatures
Under Baseline Conditions

Month	Strawberry Reservoir Releases Using Average Below 33-ft Depth Temperature				Strawberry Reservoir Releases Using Minimum Below 33-ft Depth Temperature			
	Sixth Water Creek (F)		Diamond Fork Creek below Red Hollow (F)	Spanish Fork River at Castilla Gage (F)	Sixth Water Creek (F)		Diamond Fork Creek below Red Hollow (F)	Spanish Fork River at Castilla Gage (F)
	Below Strawberry Tunnel Outlet	Below Sixth Water Aqueduc t			Below Strawberry Tunnel Outlet	Below Sixth Water Aqueduct		
October	51	46	51	49	51	47	51	49
November	66	62	66	41	66	63	66	41
December	37	37	37	41	37	37	37	41
January	36	36	36	36	36	36	36	36
February	36	36	36	39	36	36	36	39
March	37	37	37	34	37	37	37	41
April	38	38	38	48	38	38	38	48
May	45	48	45	47	45	48	45	47
June	54	58	54	54	54	49	54	54
July	55	67	55	56	55	44	55	56
August	55	67	55	55	55	48	55	55
September	53	62	53	51	53	45	53	51

NOTES:

These data cannot be directly compared with Table 3-6. Table 3-6 uses a weighted average based on amount of flow occurring each month.
Based on average monitored data (STORET database), results presented in the *Draft Hydrology and Water Resources Technical Report* (CUWCD 1998c), and *Water Quality Technical Memorandum (CUWCD* 1999f)
Temperatures based on releases from below potential thermocline depth (33 feet)

Table 3-8
Baseline Sediment Budget

Location	Sediment Transport (tons/year)	Total Suspended Solids (ppm)
Sixth Water Creek above Sixth Water Aqueduct	4.4	0.2
Sixth Water Creek below Sixth Water Aqueduct	35,300	274
Sixth Water Creek below Fifth Water Creek	37,700	297
Diamond Fork Creek below Three Forks	36,200	183
Diamond Fork Creek at Mouth[1]	28,760	129
Spanish Fork River at Castilla Gage	42,200	141

[1]Values are average of Diamond Fork Creek below Red Hollow and Diamond Fork Creek at mouth.

3.3.5.2 Groundwater Quality

No baseline groundwater quality data are available for the Sixth Water or Diamond Fork creek drainages, or for the Spanish Fork River drainage in the immediate vicinity of the river. However, monitoring of the Strawberry Tunnel outlet revealed that during times of seepage flow (groundwater) alone, selenium concentrations can exceed chronic aquatic life-support standards in this area. In southern Utah Valley, through which the Spanish Fork River flows and in which diverted Spanish Fork River water is used for irrigation, groundwater is typically a bicarbonate type (bicarbonate constitutes over 50 percent of the reactive value of the anions dissolved within the groundwater). Shallow groundwater tends to be higher in salinity than surface water entering the valley, but is generally of good quality (CUWCD, 1998c).

3.3.6 Impact Analysis

3.3.6.1 Methodology

Impacts were estimated using a quantitative mixing analysis for Sixth Water Creek, Diamond Fork Creek and Spanish Fork River. This analysis used weighted average concentrations to determine impacts of Strawberry Reservoir water additions on river water quality for the parameters shown in Table 3-6. Basic data from the USBR from 1988 to 1998 were used for Strawberry Reservoir and Spanish Fork River (below Spanish Fork Diversion Dam to Utah Lake) averages. Data from 1995 through 1998 were used to assess other portions of the system. Where data were insufficient or incomplete, historical data (1978 to 1982; CUWCD 1998b) were used or combined with new data to complete the analysis. Data were not available for Fifth Water Creek, therefore values for Sixth Water Creek were used. The water quality impact analysis is based on flow-weighted averages where available.

An air temperature and climate mixing model analysis (see *Water Quality Technical Memorandum* CUWCD 1999f) was conducted to determine the potential for freezing conditions that might result in flooding above the Spanish Fork Diversion Dam. The temperature mixing model is limited in its ability to predict when freezing may occur and does not take into account effect of flow volume on water temperature equilibration with ambient air temperature. Spanish Fork Diversion Dam was chosen for this analysis due to completeness of available data and because this location provides a boundary condition for assessing potential impacts on downstream dams. This analysis used historical minimum monthly average air temperatures, and 1997 and 1998 maximum daily wind speed and minimum relative humidity to determine whether river water would cool to below freezing during the winter. These data were obtained from the Utah Climate Center.

Water releases occur from below the potential thermocline depth throughout the year because the Syar Tunnel inlet is positioned at the bottom of Bryant's Fork Bay, with a designed full-storage capacity depth of approximately 90 feet below the reservoir surface. Actual depth would vary depending on the water level in Strawberry Reservoir. Analysis of historical data shows that the maximum sampled depth of Bryant's Fork Bay was at least 26 feet and averaged at least 44 feet. Thus, it is reasonable to expect that Bryant's Fork Bay releases would be from below 33 feet deep, on average (thus below the thermocline if stratification occurs). A thermocline is likely to form in a water body this deep during the early summer lasting until early fall (May to October, USBR 1988c).

In previous studies it was determined that releases would occur from both above and below the Strawberry Reservoir thermocline because the cofferdam between Bryant's Fork Bay and Strawberry Reservoir was at a fixed location. This cofferdam has been partially removed, and now water flow between the two systems is continuous for the upper 90 feet. Consequently, water releases would be from below the thermocline when Strawberry Reservoir is stratified, or from mixed conditions when the reservoir is not stratified.

The impact analysis also examines phosphorus concentrations and temperature variations, depending on whether releases only would be made from deep water that may be below the thermocline or from mixed waters within

Strawberry Reservoir. Both temperature and phosphorous concentrations may depend on the presence of reservoir stratification in distinct layers (formation of a thermocline). In deep water bodies this stratification can occur seasonally. If stratification occurs, water drawn from above the thermocline would have a different temperature and phosphorous concentration than water drawn from below; above-thermocline temperatures would be more influenced by ambient air temperatures. Lack of thermocline formation or natural mixing during spring and fall result in a more uniformly mixed condition.

Two scenarios were analyzed for stratification-dependent parameters: Below a depth of 33 feet (average of values below the potential thermocline during stratification) and mixed conditions (average of all depths). The potential range of phosphorus, dissolved oxygen and temperature impacts is thus defined by presenting two "end-points," which assume that all water would be either released from below the potential thermocline depth or from mixed water.

Low DO concentrations associated with releases of water from below a thermocline may result in low instream DO. However, this effect may be minimized or reduced by re-aeration within the stream channel. A simple model was used to determine the effect of re-aeration on stream dissolved oxygen for baseline, Proposed Action, and No Action Alternative flow regimes. The model uses a logarithmic model with a re-aeration rate coefficient, flow velocity, and initial conditions to calculate the DO at any location along the reach. The re-aeration coefficient was obtained from empirical relationships based on temperature, velocity and flow depth. This model was used to calculate distance-weighted average DO for each stream reach.

The impact tables present the estimated worst cases for ammonia. Baseline ammonia decreases downstream are partially attributable to aeration, however no attempt was made to correlate increased future flow aeration with reduced ammonia under the Proposed Action or No Action Alternative. Increases in ammonia in Spanish Fork River (from Spanish Fork Diversion Dam to Utah Lake) could be attributed to nonpoint sources of nitrogen entering the river system. Although no measurable changes in ammonia are estimated for any of the locations, lowering the water temperature in some locations could reduce some baseline ammonia exceedances of standards.

Sediment transport for Diamond Fork and Sixth Water Creeks was the subject of a recent study by the CUWCD (CUWCD 1997b, 1998e). Mean monthly sediment loads, and sediment loads as a function of Strawberry Tunnel discharge and river flow, were measured. Regression analysis was used to determine the relationship between sediment load and concentration as a function of flow. These data were then used to estimate sediment impacts at selected locations based on a regression analysis relating sediment load to flow conditions.

3.3.6.2 Significance Criteria

Significance of water quality impacts are determined by whether or not water quality standards (shown previously in Table 3-4) that are currently met would be exceeded; whether standards that are exceeded would be improved; or whether exceeded standards would be further degraded. The standard for turbidity (in which changes in turbidity should be less than 10 NTUs) strictly applies to point sources of turbidity and generally is not applicable to the nonpoint changes expected under the Proposed Action and No Action Alternative. Changes in turbidity are directly related to changes in flow. Turbidity significance cannot be quantified based on average data. The significance of water quality impacts with respect to related resource areas are evaluated in the sections that deal with these related resources.

3.3.6.3 Potential Impacts Eliminated From Further Analysis

The *Water Quality Technical Memorandum*, Attachment H (CUWCD 1999f) covers the transfer of Bonneville Unit water to Utah Lake for exchange to Jordanelle Reservoir. These data indicate the TDS levels in Utah Lake ar less than or equal to baseline conditions. Therefore there would be no impact on TDS in Utah Lake.

Operation of blow-off vaults and discharge pipes would not cause any water quality impacts. The discharge would be regulated to avoid impacts (see Chapter 1, Section 1.4.2.2).

The No Action Alternative would not have any significant impacts on water quality in Utah Lake. It is estimated that each acre-foot of irrigation water return flow adds 0.34 ton of salt to Utah Lake (CUWCD 1998f). The No Action Alternative delivery of 14,700 acre-feet of supplemental irrigation water would result in about 4,200 acre-feet of return flow, which would add 1,428 tons of salt a year over baseline to Utah Lake. This would only be a 0.3 percent increase over a baseline of 443,400 tons of salt annually (CUWCD 1998f). This is not considered a significant impact requiring analysis.

3.3.6.4 Proposed Action

3.3.6.4.1 Impacts During Construction.

3.3.6.4.1.1 Surface Water Quality. Construction impacts on surface water quality could result from activities that disturb the soil, accidental spills of fuels or other liquids, or instream activities that would affect the hydraulics of river and stream crossings.

Construction for the Proposed Action would include Sixth Water Connection to Tanner Ridge Tunnel, Tanner Ridge Tunnel, Diamond Fork Siphon, Red Mountain Tunnel, and Red Hollow Pipeline and the connection to Diamond Fork Pipeline, which would have minor impacts on water quality. The portals for Tanner Ridge Tunnel and Red Mountain Tunnel would be located far enough from the creek to not directly impact the flows or water quality with the use of proper construction precautions as described in Section 1.7.8.1. Construction of Sixth Water Connection and Diamond Fork Siphon would require short-term diversion of streamflows and produce a short-term increase in turbidity when the diverted flow is returned to the channel.

Construction would not cause significant impacts on surface water quality at other locations for the following reasons:

- Construction activities with a potential for disturbing stream channels, riparian areas and floodplains would be performed in accordance with *Nonpoint Source Water Pollution Control Plan for Hydrology Modifications in Utah* (Robinson 1994). These practices are designated as the State of Utah's Best Management Practices for nonpoint source water pollution control and are included as Standard Operating Procedures (see Chapter 1, Section 1.7.8.7).

- Spill prevention, containment and countermeasure requirements would be included in CUWCD's construction specifications, which would minimize the potential for adverse impacts of a spill (see Chapter 1, Section 1.7.8.7).

- Construction activities would be minimized in riparian stream crossings and seep and spring areas during periods of unstable soil and streambank conditions caused by high soil moisture, snowmelt runoff or extended periods of rain. This would improve the effectiveness of management measures to minimize the impacts of construction activities and accidental spills (see Chapter 1, Sections 1.7.8.1, 1.7.8.3, and 1.7.8.4).

3.3.6.4.1.2 Groundwater Quality. Construction impacts on groundwater quality could be caused by accidental releases of fuels or other liquids. Such contamination would likely be significant only if the spills occurred over shallow groundwater (such as in or near the canyon floors) or within areas of substantial groundwater recharge. Contamination could occur by either direct infiltration to groundwater or by leaching of spill-contaminated soil overlying shallow groundwater. The potential for adverse impacts from spills would be minimized through spill containment and countermeasure requirements of the SOPs (see Chapter 1, Section 1.7.8.7).

3.3.6.4.2 Impacts During Operation.

3.3.6.4.2.1 Surface Water Quality. Table 3-9 shows the average and maximum (except dissolved oxygen, which considers minimums) water quality conditions of affected water features that would likely occur under the Proposed Action.

In Sixth Water Creek below Sixth Water Aqueduct and in Diamond Fork Creek, the average salinity (TDS) under the Proposed Action would not change much. Small differences in Table 3-9 are mostly caused by use of estimated concentrations based on flow-weighted averages being compared with measured concentrations for baseline conditions. Under both the Proposed Action and baseline conditions, flows along Sixth Water Creek and Diamond Fork Creek include a mixture of Strawberry Reservoir water and natural flows. Most natural flow has higher salinity than the water released from Strawberry Reservoir. Fifth Water Creek, which feeds into Sixth Water Creek, is particularly saline, however, water quality data were not available for Fifth Water Creek. Addition of Strawberry Reservoir water to maintain minimum streamflows in Sixth Water Creek would not significantly impact salinity along this reach. In Spanish Fork River, the average and maximum salinity under the Proposed Action would generally decrease by about 100 to 200 ppm TDS. This reduction would be from dilution by relatively low salinity Strawberry Reservoir water conveyed to the Spanish Fork River in the Proposed Action features instead of in the creeks and rivers. Average and maximum salinity concentrations would result in TDS levels that remain within state standards.

Flows in Sixth Water (below Sixth Water Aqueduct) and Diamond Fork creeks would be substantially decreased during the irrigation season and substantially increased during low-flow months, which would cause turbidity impacts. Reduction of peak flows would reduce erosion, while the increase of minimum flows to about 25 cfs in Sixth Water Creek above Sixth Water Aqueduct would only slightly increase erosion. Any increase in erosion caused by higher flows would be alleviated as Sixth Water Creek equilibrates with the new flow regime. Overall turbidity would be reduced by the changed flow regime, and maintaining minimum flows during non-irrigation season would reduce the number of stagnant pools that enhance algal growth. Turbidity would also likely decrease in Spanish Fork River (from Spanish Fork Diversion Dam to Utah Lake) compared to baseline.

Flow changes would slightly increase total ammonia concentrations within most of the system, but concentrations would still remain below state standards. Increased flows in low-flow months would increase aeration that may enhance ammonia dissipation, but not to the extent that measurable impacts are expected. In addition, lower temperatures discussed below would make ammonia less of a critical parameter, but the impact has not been quantified.

Phosphorus loads would vary, depending on the timing of spring runoff and snowmelt and on whether Strawberry Reservoir releases would be made from below a potential thermocline or from mixed water. Releases from mixed water would generally reduce phosphorus concentrations below the confluence with Fifth Water Creek, therefore partially reducing baseline exceedances (a significant impact). Periodic exceedances would still occur along the entire system, but these would be at generally lower levels than baseline.

Releases from below a potential thermocline would generally increase average phosphorus concentrations compared to baseline in Sixth Water and Diamond Fork creeks. This would result in a higher exceedance of the standard, which would be a significant impact. Compared to mixed conditions, concentrations would be increased in Spanish Fork River, but compared to baseline, concentrations would be reduced in this section. Periodic exceedances would be generally lower than baseline throughout the system.

Table 3-9
Water Quality Resulting From the Proposed Action

		TDS (ppm)	pH (ppm)	DO (ppm)[2]		Temp.[1] (F)	BOD (ppm)	Nitrate (ppm)	Ammonia (ppm)	Phosphorus (ppm)[2]		Selenium[4] (ppb)	Total Coliforms (counts)	Fecal Coliforms (counts)	Turbidity (NTU)
				Mixed	Deep[3]					Mixed	Deep				
Annual Average Water Quality															
Sixth Water Creek below Strawberry Tunnel Outlet[5]	Change	-118	-0.3	-1.2	-3.7	0	nm	-0.088	0.059	-0.023	0.039	-12.3	nm	nm	D
	Value	184	8.1	9.3	8.3	46	3.2	0.182	0.097	0.060	0.122	1.4	NQ	NQ	NQ
Sixth Water Creek below Sixth Water Aqueduct	Change	22	-0.1	2.7	4.3	-14	nm	0.066	0.045	0.015	-0.005	-0.6	nm	nm	nm
	Value	184	8.1	10.9	10.4	46	2.4	0.182	0.097	0.060	0.122	1.4	NQ	NQ	NQ
Sixth Water Creek below Fifth Water Creek	Change	-17	-0.2	1.8	1.5	-6	nm	-0.005	0.046	-0.030	0.022	0.6	nm	nm	D
	Value	203	8.1	10.9	10.6	46	1.2	0.203	0.088	0.066	0.118	1.4	NQ	NQ	NQ
Diamond Fork Creek below Three Forks	Change	-15	-0.2	1.7	1.5	-6	nm	-0.001	0.028	-0.025	0.014	0.3	nm	nm	D
	Value	215	8.1	10.8	10.6	46	1.6	0.222	0.070	0.072	0.111	1.1	NQ	NQ	NQ
Diamond Fork Creek below Diamond Fork Creek Outlet	Change	-33	-0.2	1.0	0.4	-6	nm	-0.108	0.053	-0.060	0.002	0.7	nm	nm	D
	Value	202	8.1	10.4	9.8	46	4.6	0.220	0.086	0.072	0.118	1.2	NQ	NQ	NQ
Spanish Fork River at Castilla Gage	Change	-118	0.0	-0.8	-1.8	-4	nm	-0.112	0.036	-0.059	-0.005	0.4	nm	nm	D
	Value	217	8.1	8.7	7.7	46	3.0	0.218	0.076	0.078	0.132	1.0	NQ	NQ	NQ
Spanish Fork River at Lake Shore	Change	-148	-0.5	-0.4	0.2	0	nm	-0.076	-0.190	-0.034	-0.006	-0.6	nm	nm	D
	Value	311	8.1	10.0	10.6	45	NQ	0.295	0.093	0.096	0.124	0.8	NQ	NQ	NQ
Maximum Levels				(Minimum)											
Sixth Water Creek below Strawberry Tunnel Outlet[5]	Change	-208	-0.2	-0.8	-3.1	-11	nm	-0.341	0.389	-0.074	0.004	-17.3	nm	nm	D
	Value	246	8.3	8.3	6.0	55	3.2	0.392	0.510	0.115	0.193	2.7	NQ	NQ	NQ
Sixth Water Creek below Sixth Water Aqueduct	Change	-208	-0.2	3.0	5.5	-12	nm	-0.167	0.252	-0.024	0.013	-1.6	nm	nm	nm
	Value	246	8.3	9.8	9.0	55	2.4	0.392	0.510	0.115	0.193	2.7	NQ	NQ	NQ
Sixth Water Creek below Fifth Water Creek	Change	-180	-0.2	4.4	3.9	-11	nm	-0.242	0.353	-0.052	-0.012	-1.0	nm	nm	D
	Value	274	8.3	10.0	9.5	55	1.3	0.491	0.474	0.137	0.177	2.8	NQ	NQ	NQ
Diamond Fork Creek below Three Forks	Change	-178	-0.2	3.0	2.5	-11	nm	-0.244	0.295	-0.025	-0.001	-1.3	nm	nm	D
	Value	276	8.3	10.1	9.6	55	2.0	0.489	0.416	0.164	0.188	2.5	NQ	NQ	NQ
Diamond Fork Creek below Diamond Fork Creek Outlet	Change	-124	-0.2	0.2	-2.8	-2	nm	-0.404	-0.075	-0.051	-0.029	0.9	nm	nm	D
	Value	255	8.3	8.7	5.7	55	2.0	0.631	0.211	0.170	0.192	2.3	NQ	NQ	NQ
Spanish Fork River at Castilla Gage	Change	-204	-0.4	-1.3	-4.6	-2	nm	-0.971	0.211	-0.139	-0.099	0.9	nm	nm	D
	Value	296	8.2	7.2	3.9	54	4.5	0.586	0.445	0.134	0.174	2.1	NQ	NQ	NQ
Spanish Fork River at Lake Shore	Change	-139	-0.8	0.9	-0.7	-7	nm	-2.051	-0.484	-0.390	-0.369	-0.1	nm	nm	D
	Value	393	8.4	8.9	7.3	55	NQ	1.249	0.292	0.203	0.224	1.5	NQ	NQ	NQ

Notes:
Temperature data is not directly comparable with table 3-7 since values presented here are weighted for the amount of flow occuring during each month.
[1]This value reflects temperature of water from below the thermocline (>33 ft depth), since temperature depends on where water is drawn from in the reservoir.
[2]Phosphorus concentrations depend on where water is drawn from in the reservoir. Water is drawn from below the thermocline but a mixed, average concentration condition is also supplied.
[3] Contributions from Strawberry Reservoir use DO concentrations at deep depths as opposed to mixed conditions
[4]Based on May through October values, and less than detection limit replaced with 1/2 detection limit
[5]Selenium values in this reach are for Strawberry Tunnel Outlet and not actual instream values
NQ= not quantified
nm = no measurable change
D = non quantified potential decrease

Temperatures also would vary, depending on whether releases from Strawberry Reservoir are made from the relatively cool water below a thermocline or from more uniformly mixed waters. State water quality standards set maximum allowable temperatures to support the water body use (Table 3-4), but it also is important to consider the effects of minimum temperatures. Large releases of cold water during the winter could possibly lead to ice and flooding concerns. Table 3-9 shows annual average and maximum water temperatures resulting from the Proposed Action. Table 3-10 shows the estimated monthly average and minimum monthly temperature for releases made from depths greater than 33 feet, which is below a potential thermocline if stratification occurs between May and October. These temperatures are not directly comparable with Table 3-9, which uses an average weighted by amount of flow occurring during each month.

Proposed Action releases from below a potential thermocline would generally reduce both average and minimum monthly average temperatures within the river system. Average temperatures during July and August in Sixth Water Creek below Sixth Water Aqueduct would be reduced to about 53°F and minimum monthly temperatures in July and August would be increased.

Temperature mixing model analyses indicate that, compared to baseline, Proposed Action temperature reductions would have little additional effect on icing potential during cold and dry climate conditions. For both baseline and Proposed Action conditions, water temperatures above Spanish Fork Diversion Dam can reach freezing conditions during cold years from November to March. Mixing model analysis shows that baseline water temperature equilibrium with ambient air can occur within 3 to 13 feet of the Spanish Fork River Outlet from Diamond Fork Pipeline and Proposed Action equilibrium can occur within 2 to 7 feet, although this model does not analyze the effect of water volume thermal mass. The short mixing distance is largely caused by high turbulence associated with fast water velocity.

Because there is potential for freezing at the Spanish Fork Diversion Dam, it can be expected that this potential als exists at the other Spanish Fork River diversions, depending on ambient climate conditions. Regardless of freezing location, the significance of freezing impacts with the Proposed Action would be greater than with baseline conditions because of higher flows that could be blocked by ice.

Dissolved oxygen impacts depend on whether Strawberry Reservoir stratification occurs or whether releases are from mixed conditions. Formation of a thermocline would result in lower DO concentrations at depths greater than 33 feet, near the Syar Tunnel inlet. However, re-aeration would partially reduce the effect of low DO releases from the reservoir. Table 3-9 shows the effect of change in flow regime on DO for both mixed conditions and releases from below 33 feet under stratified conditions.

Average DO would meet state standards for all sections of the system and would be generally higher for Proposed Action compared to baseline, except for Sixth Water Creek from Strawberry Tunnel to Sixth Water Aqueduct and the Spanish Fork River. Proposed Action conditions would reduce periodic baseline exceedance of standards in Sixth Water Creek from Sixth Water Aqueduct to Three Forks. However, periodic exceedance of standards under Proposed Action conditions would occur in Diamond Fork Creek from Diamond Fork Creek Outlet to Spanish Fork River and in Spanish Fork River from the confluence of Diamond Fork Creek to Spanish Fork Diversion Dam. Lowest DO concentrations would occur during late summer when Strawberry Reservoir releases are from below a thermocline (low DO) and warm waters would result in low saturated potential DO. These periodic exceedances would not significantly impact water quality since the DO values do not reflect potential re-aeration at the Spanish Fork River Outlet from Diamond Fork Pipeline and within the vented Diamond Fork Pipeline System. Additional turbulence at the outlet configuration could contribute additional re-aeration, thus reducing periodic exceedances.

The Proposed Action would not cause measurable changes to pH, BOD or coliforms. The pH would not be measurably changed because of the similarity in pH of the various source waters and buffering in the system that limit pH changes. BOD and coliforms would not be measurably impacted because the additional water from

Table 3-10
Estimated Monthly Average and Minimum Temperatures Under the Proposed Action

Month	Strawberry Reservoir Releases Using Average Below 33-ft Depth Temperature								Strawberry Reservoir Releases Using Minimum Below 33-ft Depth Temperature							
	Sixth Water Creek (°F)				Diamond Fork Creek below Diamond Fork Creek Outlet (°F)		Spanish Fork River at Castilla Gage (°F)		Sixth Water Creek (°F)				Diamond Fork Creek below Diamond Fork Creek Outlet (°F)		Spanish Fork River at Castilla Gage (°F)	
	Below Strawberry Tunnel Outlet		Below Sixth Water Aqueduct						Below Strawberry Tunnel Outlet		Below Sixth Water Aqueduct					
	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline
October	50	-1	50	+4	50	-1	50	+1	47	-4	47	0	47	-4	48	-1
November	51	-15	51	-11	49	-17	46	+5	51	-15	51	-12	49	-17	46	+5
December	36	-1	36	-1	36	-1	38	+3	36	-1	36	-1	36	-1	38	-3
January	36	0	36	0	36	0	36	0	36	0	36	0	36	0	36	0
February	36	0	36	0	36	0	37	-2	36	0	36	0	36	0	34	-5
March	37	0	37	0	37	0	39	+5	36	-1	36	-1	37	0	38	-3
April	39	+1	39	+1	42	+6	44	-4	39	+1	39	+1	42	+4	44	-4
May	48	+3	48	0	46	+1	48	+1	48	+3	48	0	46	+1	48	+1
June	50	-4	50	-8	50	-4	52	-2	52	-2	50	+1	50	-4	50	-4
July	53	-2	53	-14	53	-2	53	-3	46	-9	46	+2	47	-8	46	-10
August	54	-1	54	-13	54	-1	54	-1	49	-6	49	+1	49	-6	49	-6
September	55	+2	55	-7	55	+2	54	+3	46	-7	46	-1	46	-7	46	-5

Notes:
These data cannot be directly compared with Table 3-6. Table 3-6 uses a weighted-average based on amount of flow occurring each month.
Based on average monitored historical data (STORET database), results presented in the Draft *Hydrology and Water Resources Technical Report* (CUWCD 1998c), and *Water Quality Technical Memorandum* (CUWCD 1999f)
Estimates based on releases from below potential thermocline depth (33 feet) during periods of stratification

Strawberry Reservoir is similar to other source waters, and the Proposed Action would not result in additional sources of these key parameters.

Dilution of Strawberry Tunnel seepage by Strawberry Reservoir waters would reduce baseline exceedance of selenium standards (a significant impact) from Strawberry Tunnel to Sixth Water Aqueduct under the Proposed Action. Reduced flows in Sixth Water Creek below Sixth Water Aqueduct and Diamond Fork Creek would result in increased selenium concentration, but standards would not be exceeded.

Table 3-11 shows estimated tons of sediment transported as bedload and suspended sediment through each reach, along with the concentration of total suspended solids in ppm. Bedload adjustments were assumed to be 10 percent of total transported sediments (CUWCD 1998b). In all reaches, except Sixth Water Creek from Strawberry Tunnel to Sixth Water Aqueduct, less sediment would be transported compared to baseline conditions with an associated reduction in concentration. This reduction in sediment transport would be caused by removal of high flows from Sixth Water Creek below Sixth Water Aqueduct and from Diamond Fork Creek. Higher loads with the Proposed Action in Sixth Water Creek above Sixth Water Aqueduct are compared with baseline sediment transport because of natural flows only. Both channels would undergo a period of adjustment to the new flows with proposed changes in operation. Qualitative estimates have been made of the impacts for the channels of Diamond Fork and Sixth Water creeks under the Proposed Action (Table 3-11).

Emergency operations release of 200 cfs from Strawberry Tunnel would temporarily increase turbidity, TSS, and sediment transportation in Sixth Water Creek. These increases would not exceed baseline standards below Sixth Water Aqueduct.

3.3.6.4.2.2 ***Ground Water Quality***. No significant impacts on groundwater quality associated with operations of the Proposed Action have been identified for Sixth Water or Diamond Fork creek drainages. If recharge of groundwater occurs within the Spanish Fork River drainage (from Spanish Fork Diversion Dam to Utah Lake) due to increased streamflow rates below the diversion dams during the summer irrigation season, some minor changes in groundwater quality could occur in the vicinity of the recharge. Because little, if any, groundwater recharge is expected to occur in these areas, such changes would be immeasurable within the shallow alluvial aquifer and are not likely to have any significant impact on groundwater quality.

3.3.6.4.3 Impact Summary. Construction is not expected to cause any significant, long-term impacts on surface water or groundwater quality.

Project operation would not cause any significant groundwater quality impacts, but would affect surface water quality by reducing TDS, phosphorus and temperatures. It would cause only minor changes in dissolved oxygen levels, and sediment load would be significantly reduced. Reduction of selenium concentrations in Sixth Water Creek above Sixth Water Aqueduct would be a significant impact.

3.3.6.5 No Action Alternative

3.3.6.5.1 Impacts During Construction.

3.3.6.5.1.1 ***Surface-Water Quality***. Construction impacts on surface water quality could result from activities that disturb the soil, accidental spills of fuels or other liquids, or instream activities that would affect the hydraulics of river and stream crossings.

The No Action Alternative would involve construction of Three Forks Dam and Reservoir, extension of Diamond Fork Pipeline, and Spanish Fork River Outlet from Diamond Fork Pipeline. Construction of the No Action

Table 3-11
Sediment Budget and Impacts Resulting from the Proposed Action

Location		Sediment Transport (tons/year)	Total Suspended Solids (ppm)	Impacts
Sixth Water Creek above Sixth Water Aqueduct	Change[1]	+5,015.6	+152.8	No significant impacts compared to historical transport
	Value[2]	5,020	153	
Sixth Water Creek below Sixth Water Aqueduct	Change[1]	-29,720	-145	Reduced sediment loading and gradual stabilization by vegetation; reduced bank erosion
	Value[2]	5,580	129	
Sixth Water Creek below Fifth Water Creek[3]	Change[1]	-26,700	-123	Reduced sediment loading and gradual stabilization as described for the previous reach
	Value[2]	11,000	174	
Diamond Fork Creek below Three Forks	Change[1]	-29,760	-145	Reduced sediment loading and gradual stabilization as described for the previous reach
	Value[2]	6,440	38	
Diamond Fork Creek at Mouth[4]	Change[1]	-7,400	-2	Decreased bank erosion; gradual narrowing of channel; braided sections would become more stable and develop a single, dominant channel
	Value[2]	21,360	127	
Spanish Fork River at Castilla Gage Estimate	Change[1]	+35,800	+115	Increased bank erosion; gradual widening of channel; increased transport of accumulated sediments
	Value[2]	78,000	256	

[1]Changes are based on the relative reduction from baseline conditions and are generally valid for either monthly or daily flows.
[2]Tons per year of sediment transport based on the application of the prediction equation to monthly flows. This underestimates the sediment transported based on daily flows by about 10 to 15 percent.
[3]No sediment data collected for this reach. It is assumed that this reach responds in the same manner as Sixth Water Creek from Sixth Water Aqueduct to Fifth Water Creek.
[4]Values are average of Diamond Fork Creek below Diamond Fork Creek Outlet and Diamond Fork Creek at mouth.

Alternative would not cause significant impacts on surface water quality at other locations for the following reasons:

- Construction activities with potential for disturbing stream channels, riparian areas and floodplains would be performed in accordance with *Nonpoint Source Water Pollution Control Plan for Hydrology Modifications in Utah* (Robinson 1994). These practices are designated as the State of Utah's Best Management Practices for nonpoint source water pollution control and are included as Standard Operating Procedures (see Chapter 1, Section 1.7.8.7).

- Spill prevention, containment and countermeasure requirements would be included in CUWCD's construction specifications, which would minimize the potential for adverse impacts of a spill.

- Construction activities would be minimized in riparian stream crossings and seep and spring areas during periods of unstable soil and streambank conditions caused by high soil moisture, snowmelt runoff or extended periods of rain. This would improve the effectiveness of management measures to minimize the impacts of construction activities and accidental spills.

3.3.6.5.1.2 Ground Water Quality. Same as for Proposed Action, see Section 3.3.6.4.1.2.

3.3.6.5.2 Impacts During Operation.

3.3.6.5.2.1 Surface-Water Quality. Table 3-12 shows the average and maximum (except dissolved oxygen, which considers minimums) water quality conditions of affected water features by the key water quality parameters that would likely occur as a result of the No Action Alternative.

The average salinity under the No Action Alternative would be slightly reduced in Sixth Water Creek and Diamond Fork Creek. Under both the No Action Alternative and baseline conditions, flow along Sixth Water Creek and Diamond Fork Creek includes a mixture of Strawberry Reservoir water and natural flows. Most natural flow has higher salinity than the water released from Strawberry Reservoir. Water quality data were not available for Fifth Water Creek, which is particularly saline and feeds into Sixth Water Creek. Addition of enough Strawberry Reservoir water to provide minimum instream flows in Sixth Water Creek would reduce salinity along this reach. In Spanish Fork River, the average and maximum salinity under the Proposed Action would generally decrease by about 100 to 200 ppm TDS. This reduction would be from dilution by relatively low-salinity Strawberry Reservoir water withdrawn at the Three Forks Dam and conveyed to the Spanish Fork River in the Diamond Fork Pipeline instead of in Diamond Fork Creek. Average and maximum salinity concentrations would result in TDS levels that remain within state standards.

Under the No Action Alternative, flow in Sixth Water Creek below Sixth Water Aqueduct would be substantially increased during the entire year. Diamond Fork Creek flows would be substantially decreased during the irrigation season and slightly increased during low-flow months, which would impact turbidity. Reduction of peak flows would significantly reduce erosion in Diamond Fork Creek. Overall turbidity would be reduced by the changed flow regime, and maintaining minimum flows during non-irrigation season would reduce the number of stagnant pools that enhance algal growth. Turbidity also would likely decrease in Spanish Fork River (from Spanish Fork Diversion Dam to Utah Lake) compared to baseline because of the introduction of low-turbidity Strawberry Reservoir water.

Flow changes would slightly increase average total ammonia concentrations, but there would be no significant impacts; all concentrations would remain below state standards. Periodic exceedances, a significant impact, would occur in Sixth Water Creek below Sixth Water Aqueduct and Diamond Fork Creek. Increased flows during low-flow months would increase aeration that may enhance ammonia dissipation, but not to the extent that measurable

Table 3-12
Water Quality Resulting From the No Action Alternative

		TDS (ppm)	pH (ppm)	DO (ppm)[2] Mixed	DO (ppm)[2] Deep[3]	Temp.[1] (F)	BOD (ppm)	Nitrate (ppm)	Ammonia (ppm)	Phosphorus (ppm)[2] Mixed	Phosphorus (ppm)[2] Deep	Selenium[4] (ppb)	Total Coliforms (counts)	Fecal Coliforms (counts)	Turbidity (NTU)
Annual Average Water Quality															
Sixth Water Creek below Strawberry Tunnel Outlet[5]	Change	-117	-0.3	-1.2	-3.7	0	nm	-0.088	0.059	-0.023	0.039	-12.3	nm	nm	D
	Value	185	8.1	9.3	8.3	46	3.2	0.182	0.097	0.060	0.122	1.4	NQ	NQ	NQ
Sixth Water Creek below Sixth Water Aqueduct	Change	-13	-0.2	2.7	4.4	-13	nm	0.021	0.042	0.006	0.007	-0.8	nm	nm	nm
	Value	149	8.0	10.9	10.5	47	2.4	0.137	0.094	0.051	0.134	1.2	NQ	NQ	NQ
Sixth Water Creek below Fifth Water Creek	Change	-61	-0.2	2.1	1.8	-5	nm	-0.058	0.047	-0.042	-0.829	0.4	nm	nm	D
	Value	159	8.1	11.2	10.9	47	1.2	0.150	0.089	0.054	0.131	1.2	NQ	NQ	NQ
Diamond Fork Creek below Three Forks	Change	-69	-0.3	2.3	2.0	-6	nm	-0.060	0.064	0.473	0.034	0.5	nm	nm	D
	Value	161	8.0	11.4	11.1	46	1.6	0.163	0.106	0.570	0.131	1.3	NQ	NQ	NQ
Diamond Fork Creek below Red Hollow	Change	-60	-0.3	1.9	1.5	-6	nm	-0.132	0.079	-0.070	0.011	0.8	nm	nm	D
	Value	175	8.0	11.3	10.9	46	1.6	0.196	0.101	0.062	0.127	1.3	NQ	NQ	NQ
Spanish Fork River at Castilla Gage	Change	-120	0.0	1.5	1.3	-3	nm	-0.108	0.037	-0.060	0.176	0.4	nm	nm	D
	Value	215	8.1	11.0	10.8	47	3.0	0.222	0.077	0.077	0.313	1.0	NQ	NQ	NQ
Spanish Fork River at Lake Shore	Change	-128	-0.5	-0.3	-0.4	+3	nm	-0.049	-0.182	-0.027	-0.001	-0.5	nm	nm	D
	Value	331	8.1	10.1	10.0	45	NQ	0.322	0.101	0.103	0.129	0.9	NQ	NQ	NQ
Maximum Levels				(Minimum)											
Sixth Water Creek below Strawberry Tunnel Outlet[5]	Change	-210	-0.2	-0.8	-3.0	-11	nm	-0.334	0.389	-0.073	0.004	-17.3	nm	nm	D
	Value	244	8.3	8.3	6.1	55	3.2	0.399	0.510	0.116	0.193	2.7	NQ	NQ	NQ
Sixth Water Creek below Sixth Water Aqueduct	Change	-272	-0.2	3.0	4.8	-12	nm	-0.295	0.371	-0.057	0.059	-1.7	nm	nm	D
	Value	182	8.3	9.8	8.3	55	2.4	0.264	0.629	0.082	0.239	2.6	NQ	NQ	NQ
Sixth Water Creek below Fifth Water Creek	Change	-260	-0.2	4.7	3.6	-11	nm	-0.465	0.483	-0.122	0.047	-1.2	nm	nm	D
	Value	194	8.3	10.3	9.2	55	1.3	0.268	0.604	0.067	0.236	2.6	NQ	NQ	NQ
Diamond Fork Creek below Three Forks	Change	-260	-0.2	3.4	2.6	-11	nm	-0.465	0.483	-0.122	0.047	-1.2	nm	nm	D
	Value	194	8.3	10.5	9.7	55	2.0	0.268	0.604	0.067	0.236	2.6	NQ	NQ	NQ
Diamond Fork Creek below Red Hollow	Change	-163	-0.2	2.0	1.2	-2	nm	-0.516	0.548	-0.090	0.015	1.1	nm	nm	D
	Value	216	8.3	10.5	9.7	55	2.0	0.519	0.604	0.131	0.236	2.5	NQ	NQ	NQ
Spanish Fork River at Castilla Gage	Change	-210	-0.4	1.6	1.3	-1	nm	-0.964	0.223	-0.140	-0.097	1.0	nm	nm	D
	Value	290	8.2	10.1	9.8	55	4.5	0.593	0.457	0.133	0.176	2.2	NQ	NQ	NQ
Spanish Fork River at Lake Shore	Change	-147	-0.8	1.4	1.4	+3	nm	-1.957	-0.470	-0.381	-0.363	-0.2	nm	nm	D
	Value	385	8.4	9.4	9.4	55	NQ	1.343	0.306	0.212	0.230	1.4	NQ	NQ	NQ

Notes:
Temperature data are not directly comparable with table 3-7 since values presented here are weighted for the amount of flow occuring during each month.
[1]This value reflects temperature of water from below the thermocline (>33 ft depth), since temperature depends on where water is drawn from in the reservoir.
[2]Phosphorus concentrations depend on where water is drawn from in the reservoir. Water is drawn from below the thermocline but a mixed, average concentration condition is also supplied.
[3] Contributions from Strawberry Reservoir use DO concentrations at deep depths as opposed to mixed conditions
[4]Based on May through October values, and less than detection limit replaced with 1/2 detection limit
[5]Selenium values in this reach are for Strawberry Tunnel Outlet and not actual instream values
NQ= not quantified
nm = no measurable change
D = non quantified potential decrease

impacts would be expected. In addition, lower temperatures would make ammonia less of a critical parameter, but the impact is not quantifiable.

Phosphorus loads would vary, depending on the timing of spring runoff and snowmelt and on whether Strawberry Reservoir releases would be made from below a potential thermocline or from mixed water. Releases from mixed water would generally reduce phosphorus in Diamond Fork Creek and Spanish Fork River. Standards would still be exceeded, but concentrations would be considerably less than baseline (a significant impact). Periodic exceedances would still occur along the entire system, but these would be at lower levels than baseline.

Releases from below a potential thermocline would increase average phosphorus concentrations along the entire system, except for Sixth Water Creek from Fifth Water Creek to Three Forks and Spanish Fork River from Spanish Fork Diversion Dam to Utah Lake. This would result in a higher exceedance of the standard, which would be a significant impact. Periodic exceedances would be greater in Sixth Water Creek and Diamond Fork Creek, but lower throughout the Spanish Fork River.

Temperatures would also vary, depending on whether releases from Strawberry Reservoir are made from the relatively cool water below a thermocline or from more uniformly mixed waters. State water quality standards set maximum allowable temperatures to support the water body use (Table 3-4), but it is also important to consider the effects of minimum temperatures. Large releases of cold water during the winter could possibly lead to ice and flooding concerns. Table 3-12 shows annual average and maximum water temperatures resulting from the No Action Alternative. Table 3-13 shows the estimated monthly average and minimum monthly temperature for the releases made from depths greater than 33 feet, which is below a potential thermocline if stratification occurs between May and October. These temperatures are not directly comparable with Table 3-12, which uses an average weighted by amount of flow occurring during each month.

Releases from below a potential thermocline under the No Action Alternative would generally reduce both average and minimum monthly average temperatures within the river system. Temperature mixing model analysis indicates that, compared to baseline, No Action Alternative temperature reductions would have little additional effect on icing potential during cold and dry climate conditions. For both baseline and No Action Alternative conditions, water temperatures above the Spanish Fork Diversion Dam can reach freezing conditions during cold years from November to March. Mixing model analysis shows that baseline water temperature equilibrium with ambient air can occur within 3 to 13 feet of the confluence of Diamond Fork Creek and 2 to 7 feet under the No Action Alternative, although this model does not account for the effect of water volume thermal mass in its analysis. The short mixing distance is largely caused by high turbulence associated with faster water velocity.

Because there is potential for freezing at the Spanish Fork Diversion dam, it can be expected that this potential also exists at the other Spanish Fork River diversions, depending on ambient climate conditions. Regardless of freezing location, the significance of freezing impacts under the No Action Alternative would be greater than with baseline conditions because of the higher flows that could be blocked by ice.

Dissolved oxygen impacts depend on whether Strawberry Reservoir stratification occurs or whether releases are from mixed conditions. Formation of a thermocline would result in lower DO concentrations at depths greater than 33 feet, near the Syar Tunnel inlet. However, re-aeration would partially reduce the effect of low DO releases from Strawberry Reservoir. Table 3-12 shows the effect of No Action Alternative change in flow regime on DO for both mixed conditions and releases from below 33 feet under stratified conditions.

Higher water flows under the No Action Alternative create turbulent conditions that assist in active re-aeration. Thus, average DO meets state standards for all sections of the system and was generally higher for No Action Alternative compared to baseline, except for Sixth Water Creek from Strawberry Tunnel to Sixth Water Aqueduct and Spanish Fork River from Spanish Fork Diversion Dam to Utah Lake. Additionally, there was no periodic

Table 3-13
Estimated Monthly Average and Minimum Temperatures Under the No Action Alternative

Month	Strawberry Reservoir Releases Using Average Below 33-ft Depth Temperature								Strawberry Reservoir Releases Using Minimum Below 33-ft Depth Temperature							
	Sixth Water Creek (°F)				Diamond Fork Creek below Red Hollow (°F)		Spanish Fork River at Castilla Gage (°F)		Sixth Water Creek (°F)				Diamond Fork Creek below Red Hollow (°F)		Spanish Fork River at Castilla Gage (°F)	
	Below Strawberry Tunnel Outlet		Below Sixth Water Aqueduct						Below Strawberry Tunnel Outlet		Below Sixth Water Aqueduct					
	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline	Temp.	Change from Baseline
October	50	-1	50	+4	51	0	50	+1	47	-4	46	-1	47	-4	48	-1
November	51	-15	48	-14	48	-18	46	+5	51	-15	48	-15	48	-18	46	+5
December	36	-1	36	-1	36	-1	37	-4	36	-1	36	-1	36	-1	37	-4
January	36	0	36	0	36	0	36	0	36	0	36	0	36	0	36	0
February	36	0	36	0	36	0	37	-2	36	0	36	0	36	0	37	-2
March	37	0	37	0	37	0	38	+4	36	-1	36	-1	36	-1	38	-3
April	39	+1	39	+1	40	+2	44	-4	39	+1	39	+1	40	+2	43	-5
May	48	+3	49	+1	48	+3	47	0	48	+3	49	+1	48	+3	47	0
June	50	-4	49	-9	49	-5	50	-4	50	-4	49	0	49	-5	50	-4
July	53	-2	53	-14	53	-2	53	-3	46	-9	44	0	44	-11	46	-10
August	54	-1	54	-13	54	-1	54	-1	49	-6	48	0	48	-7	49	-6
September	55	+2	55	-7	55	+2	55	+4	46	-7	45	0	45	-8	46	-5

Notes:
These data cannot be directly compared with Table 3-6. Table 3-6 uses a weighted-average based on amount of flow occurring each month.
Based on average monitored historical data (STORET database), results presented in the Draft *Hydrology and Water Resources Technical Report* (CUWCD 1998c), and *Water Quality Technical Memorandum* (CUWCD 1999f)
Estimates based on releases from below potential thermocline depth (33 feet)

exceedance of standards, and No Action Alternative conditions reduced periodic baseline exceedance of standards in Sixth Water Creek (a significant impact).

The No Action Alternative would not cause measurable changes to pH, BOD, or coliforms. The pH would not be measurably changed because of the similarity of the pH of the various source waters and the buffering in the system that limit pH changes. BOD and coliforms would not be measurably impacted because the additional water from Strawberry Reservoir is similar to other source waters, and the No Action Alternative would not result in additional sources of these key parameters.

Dilution of Strawberry Tunnel seepage by Strawberry Reservoir waters would reduce baseline exceedance of selenium standards (a significant impact) from Strawberry Tunnel to Three Forks under operation of the No Action Alternative.

Table 3-14 shows estimated tons of sediment transported as bedload and suspended sediment under the No Action Alternative, as well as concentrations of total suspended solids in ppm. Bedload adjustments were assumed to be 10 percent of total transported sediments (CUWCD 1998b). In all reaches, except for Diamond Fork Creek, more sediment would be transported compared to baseline conditions, with an associated increase in concentration. High flows necessary for conveying sufficient releases through Sixth Water Creek to Three Forks contribute significantly more sediment than baseline flows. Existing channels have already adjusted to high flows from Strawberry Reservoir historic releases. With proposed changes in operations, both channels would undergo a period of adjustment to the new flows. Qualitative estimates have been made of the impacts for the channels of Diamond Fork and Sixth Water creeks under the No Action Alternative (Table 3-14). Sediment retention analysis shows that most of this sediment (96 percent) would not be retained in Three Forks Reservoir (USBR 1990; Schueler 1987). Sediment transport is reduced in Diamond Fork Creek because water is diverted from the highly erodible creek, resulting in lower total flows through this reach. Return of diverted waters to Spanish Fork River would increase flows and, therefore, transported sediment.

Emergency operations release of 200 cfs from Strawberry Tunnel would temporarily increase turbidity, TSS, and sediment transportation in Sixth Water Creek above Sixth Water Aqueduct.

3.3.6.5.2.2 Groundwater Quality. Groundwater quality under the No Action Alternative would be affected by application of 14,700 acre-feet of Strawberry Valley Project supplemental irrigation water on irrigated portions of South Utah Valley. The supplemental irrigation water, diverted from Spanish Fork River, would be of the same water quality as the water diverted for irrigation of the same areas under baseline conditions and would occur during the irrigation season, probably in July and August. This increase in application of irrigation water would be small compared to the total amount of similar quality water diverted for irrigation from the Spanish Fork River at the Spanish Fork Diversion Dam and applied to South Utah Valley. The changes associated with the increased application of the irrigation water would be immeasurable and unquantifiable.

3.3.6.5.3 Impact Summary. Construction would not cause any significant surface or groundwater quality impacts.

Some decreases in salinity levels would occur under operation of the No Action Alternative. Temperatures would decrease as well as phosphorus levels. Operation of the No Action Alternative would result in increased sediment loads from Sixth Water Aqueduct to Three Forks. The reduction of selenium concentrations in Sixth Water Creek would be a significant impact.

Table 3-14
Sediment Budget and Impacts Resulting from the No Action Alternative

Location		Sediment Transport (tons/year)	Total Suspended Solids (ppm)	Impacts
Sixth Water Creek above Sixth Water Aqueduct	Change[1]	+5,235.6	+153.8	No significant impacts compared to historical transport
	Value[2]	5,240	154	
Sixth Water Creek below Sixth Water Aqueduct	Change[1]	+55,160	+397	Increased sediment loading and continued bank erosion
	Value[2]	90,460	671	
Sixth Water Creek below Fifth Water Creek[3]	Change[1]	+46,730	+124	Same as previous segment
	Value[2]	84,430	421	
Diamond Fork Creek below Three Forks	Change[1]	-22,970	-91	Reduced sediment loading, reduced bank erosion
	Value[2]	13,230	92	Approx. sediment trapped = 530 tons/yr
Diamond Fork Creek at Mouth[4]	Change[1]	-9,040	-5	Decreased bank erosion; gradual narrowing of channel; braided sections would become more stable and develop a single, dominant channel
	Value[2]	19,720	124	
Spanish Fork River at Castilla Gage Estimate	Change[1]	+43,820	+135	Increased bank erosion; gradual widening of channel; increased transport of accumulated sediments
	Value[2]	86,020	276	

[1]Changes are based on the relative reduction from baseline conditions and are generally valid for either monthly or daily flows.
[2]Tons per year of sediment transport based on the application of the prediction equation to monthly flows. This underestimates the sediment transported based on daily flows by about 10 to 15 percent.
[3]No analysis was conducted for this reach. It is assumed that this reach responds in the same manner as Sixth Water Creek from Sixth Water Aqueduct to Fifth Water Creek.
[4]Values are average of Diamond Fork Creek below Red Hollow and Diamond Fork Creek at mouth.

3.4 Wetland Resources

3.4.1 Introduction

This section addresses potential impacts on wetland resources from construction and operation of the Proposed Action and No Action Alternative.

The analysis of wetland impacts focuses on all potential wetland types that could be impacted, including direct, indirect, adverse, beneficial, short-term and long-term impacts on riparian forests, shrub wetlands, emergent marshes, wet meadows and open water. Information and analysis in this section was summarized from the *Wetland Resources Technical Memorandum* for the 1999 Diamond Fork System FS-FEIS (CUWCD 1999e).

3.4.2 Issues Eliminated From Further Analysis

None.

3.4.3 Issues Addressed in the Impact Analysis

The issues addressed in this analysis are potential direct and indirect impacts on wetlands in the impact area of influence, including placement of fill into wetlands, draining of wetlands, or changes in stream elevations.

3.4.4 Description of Impact Area of Influence

The wetland resources impact area of influence includes the corridor along Diamond Fork Creek from the proposed Diamond Fork Siphon to the confluence with Spanish Fork River; Sixth Water Creek from Strawberry Tunnel outlet to Three Forks; Red Hollow from Diamond Springs to the confluence with Diamond Fork Creek; and Spanish Fork River from the confluence with Diamond Fork Creek to Utah Lake (see maps A-1 and A-2).

3.4.5 Affected Environment (Baseline Conditions)

For purposes of this analysis, wetlands were classified according to primary vegetation type and hydrologic characteristics. A limited amount of field work was conducted in 1997 and 1998 to characterize the riparian and wetland communities present in the Diamond Fork drainage for the Proposed Action. Baseline information on wetland community types also was taken from the *Conceptual Restoration Plan and Baseline Assessment Lower Diamond Fork* (Trihey & Associates 1997a) and *Preliminary Restoration Plan Sixth Water Creek – Final Report* (Trihey & Associates 1997b).

3.4.5.1 Description of Community Types

Seven wetland community types occur within the impact area of influence as described below.

3.4.5.1.1 Wet Meadow (Palustrine Emergent Marsh, Persistent). The wet-meadow community type is dominated by redtop (*Agrostis stolonifera*). This community is associated with gravel bars where soils consist of 5 inches of silty sand over cobble deposits that are mottled to the surface. An altered wet-meadow community type on valley fill consists of mostly pasture grasses with loamy soils more than 2 feet thick.

3.4.5.1.2 Palustrine Emergent Marsh. The emergent marsh community is dominated by three species, including: road-leaved cattail (*Typha latifolia*), sedge (*Carex nebrascensis*) and wiregrass (*Juncus arcticus,* formerly *Juncus* *balticus*) (Trihey & Associates 1997a). Cattail colonizes exposed moist soils and can persist for long periods in monospecific stands. Cattail marshes are primarily found on low terraces with relatively deep soils (12 inches loam) or adjacent to beaver impoundments where sediments are accumulated. Cattail marshes occupy depressions behind the levees at Redford Crossing, the existing mitigation wetland water intake and in abandoned overflow channels adjacent to the creek.

3.4.5.1.3 Riparian Forest (Palustrine, Forested, Broad-leaved, Deciduous). The riparian forest community is divided into two sub-classes: low tree-dominated communities and cottonwood-dominated communities. One low, tree-dominated community is composed of boxelder (*Acer negundo*) in the overstory with thinleaf alder (*Alnus incana*), red-osier dogwood (*Cornus sericea*) and mixed willow (*Salix sp.*) species making up the shrub stratum. The other low, tree-dominated community is composed of thinleaf alder with a dense shrub layer of mixed willows and red-twig dogwood.

The most prevalent cottonwood-dominated riparian forest communities are composed of mature narrowleaf cottonwood (*Populus angustifolia*) with a dense, multi-layered understory of redtwig dogwood and coyote willow (*Salix exguia*) and a mixture of grasses and forbs. A second cottonwood-dominated community consists of mature to decadent narrowleaf cottonwood with an understory dominated by skunkbush (*Rhus aromatica*), but with an increasing establishment of upland species. A third cottonwood-dominated community consists of a gravel bar community with 50 percent or more cover by narrowleaf cottonwood ranging in height from 12 to 25 feet. The soil in this community consists of 5 to 12 inches of silty sand over cobble deposits (Trihey & Associates 1997a).

The existing riparian forest community is not in pristine condition. It has been adversely impacted by decades of heavy livestock grazing, high streamflows and heavy recreation use in some areas along the streambanks. These activities have hindered the regeneration and establishment of cottonwood trees and adversely affected herbaceous understory vegetation.

3.4.5.1.4 Riparian Shrub (Palustrine, Scrub-Shrub, Broad-leaved, Deciduous). The riparian shrub community occurs as three subtypes, depending on elevation in the impact area of influence. The subtype at higher elevations is dominated by Coyote willow (*Salix exigua*), with small areas of Booth's willow (*Salix boothii*) and river birch (*Betula occidentalis*). Dominant herbaceous species include stinging nettle (*Urtica dioica*), bluebells (*Mertensia ciliata*), meadowrue (*Thalictrum fendleri*) and fowl bluegrass (*Poa palustris*).

The community at middle elevations is dominated by Coyote willow (*Salix exigua*), with small areas of Yellow willow (*Salix lutea*) and Whiplash willow (*Salix lasiandra*). Other species that appear in the riparian shrub community include sedge (*Carex sp.*), wiregrass (*Juncus arcticus*), cattail (*Typha latifolia*), narrow-leaved cottonwood (*Populus angustifolia*), redtop (*Agrostis stolonifera*), hawthorn (*Craaegus douglasii*), red-osier dogwood (*Cornus sericea*), boxelder (*Acer negundo*) and thinleaf alder (*Alnus incana*).

The subtype at lower elevations often is associated with natural springs, creeks and areas that receive irrigation return flows (i.e., runoff). The vegetation along these riparian corridors is comprised of a mix of introduced and native plant species that have been greatly influenced by human activities such as farming, grazing, water diversions and irrigation techniques. Numerous plant species dominate these areas depending on the reach of the creeks, but they are often woody species such as willows, Russian olive (*Elaeagnus angustifolia*) and tamarisk.

3.4.5.1.5 Creek Bed/Riverine. The creek bed/riverine community type is one of two types of open-water aquatic habitat. This designation was used for stream and river systems to represent the open, typically unvegetated channel.

3.4.5.1.6 Aquatic Bed/Open-Water. The aquatic bed/open water community is another type of open-water aquatic habitat. This designation includes ponds, minor areas behind beaver dams or levees, and sites along old stream channels where muskrat have maintained openings within cattail stands. This community type is characterized by one plant species, broadleaf pondweed (*Potamogeton latifolius*). Other common pondweeds include sago pondweed (jennet-leaf) (*P. pectinatus*) and widgeon grass (ditchgrass) (*Ruppia maritima*).

3.4.5.1.7 Spikerush Mudflat. The spikerush mudflat community type is sparsely vegetated with spikerush and inundated annually by river flows greater than 400 cfs.

3.4.5.2 Distribution of Community Types Within the Impact Area of Influence

3.4.5.2.1 Sixth Water Creek. Sixth Water Creek has a steep gradient, with a drop of 289 feet per mile. The majority of the 10- to 30-foot-wide channel is turbulent, fast-water habitat consisting of plunge pools and cascades in a narrow canyon. The creek bed/riverine, riparian shrub and riparian forest communities have been adversely affected by irrigation water releases from Strawberry Reservoir since 1913. From 1913 to 1995, irrigation water was conveyed from Strawberry Reservoir through Strawberry Tunnel and discharged to the creek. However, since 1996, irrigation water has been released from Sixth Water Aqueduct, and Sixth Water Creek above Sixth Water Aqueduct only has conveyed natural flows and seepage from Strawberry Tunnel.

3.4.5.2.1.1 Sixth Water Creek Above Sixth Water Aqueduct. Sixth Water Creek immediately below Strawberry Tunnel has steep side slopes with sparse vegetation. The unconsolidated soils and exposed bedrock in this reach provide little opportunity for vegetation to establish and grow. Small clumps of willows grow sporadically along the channel. Continuing down to Dip Vat Creek (1.5 miles from Strawberry Tunnel), Sixth Water Creek has a single channel that is confined within a narrow V-shaped canyon. This segment of the creek is steep and characterized by exposed bedrock and boulders with plunge pools. Riparian shrub communities are present along less than 60 percent of the channel length, and the vegetation is restricted to narrow strips on boulder terraces. Isolated cottonwood stands also are present on terraces more than 3 feet above the high summer stream level. The riparian shrub community is dominated by coyote willow and includes stands of river birch with isolated cottonwood stands and older shrub and riparian forest communities.

Below Dip Vat Creek, there is a landslide area where 40 percent of Sixth Water Creek is bordered by unvegetated banks. The main channel is relatively straight, but abandoned side channels exist upstream of the landslide area. Some young and early mature cottonwood stands occur immediately downstream of Dip Vat Creek. Older cottonwood stands are present in an abandoned side channel at the hill-slope base. The creek bottom widens slightly and supports wider riparian shrub and riparian forest communities for about the last 1.6 miles to Sixth Water Aqueduct (Trihey & Associates 1997b).

3.4.5.2.1.2 Sixth Water Creek Below Sixth Water Aqueduct. Below Sixth Water Aqueduct, the creek has a more moderate gradient and the channel averages 30 feet wide. The widest riparian zones occur along Sixth Water Creek between Sixth Water Aqueduct and Three Forks. Some riparian zones range from 50 to 100 feet wide; however, portions of the creek channel are narrow and constricted. Side channels or overflow channels occur in some stretches. This reach contains riparian shrub and riparian forest communities, including willow scrub, some young cottonwoods on adjacent low terraces, and river birch along the side channels and overflow channels. Sagebrush, juniper and bitterbrush occur at the edge of the riparian shrub and riparian forest communities along this reach of Sixth Water Creek.

3.4.5.2.2 Cottonwood Creek. Cottonwood Creek is a perennial stream with a steep, narrow, confined channel and minimal floodplain. Riparian forest is the dominant community along Cottonwood Creek.. Cottonwood trees form the prevalent overstory species in the reach upstream from the mouth at Three Forks, with various willow species in the shrub stratum, and grasses and forbs in the understory.

3.4.5.2.3 Diamond Fork Creek. Diamond Fork Creek is a perennial waterway that has a narrow, confined channel in the reach upstream of Brimhall Canyon and a meandering braided channel in the reach downstream of the canyon. Floodplains are not extensive along Diamond Fork Creek because of the constricted canyon landforms. Some small springs and seeps also are found in Diamond Fork Canyon (USBR 1990).

Since 1913, the creek has conveyed irrigation water in addition to natural flows. Baseline conditions in this analysis take into account grazing and land management practices used along Diamond Fork Creek, and baseline flows are those that have occurred historically. Existing wetland and riparian conditions along the creek are not the same as those historically present before irrigation water was conveyed and grazing and agriculture were introduced in the areas along the creek, especially along the reach downstream of Brimhall Canyon.

Diamond Fork Creek has been divided into four primary reaches to describe the affected environment. The physical characteristics of Diamond Fork Creek below Three Forks have been greatly influenced by irrigation releases from Strawberry Reservoir over the past 85 years, intensive livestock grazing along the lower portion of the creek, and clearing for agriculture. The four primary reaches are described below.

3.4.5.2.3.1 Diamond Fork Creek From Proposed Diamond Fork Siphon to Three Forks. This reach of Diamond Fork Creek extends from the proposed Diamond Fork Siphon downstream 2.27 miles to the confluence of Diamond Fork Creek, Sixth Water Creek and Cottonwood Creek (Three Forks). The reach is characterized by a steep-gradient, natural stream unaffected by irrigation releases. The canyon is narrow and bordered on each side by nearly vertical rock cliffs. Riparian vegetation is dense along the creek and considered riparian forest for this analysis. There are some small scattered areas of emergent marsh along the creek. The floodplain is not well-developed because of the steep gradient, and the narrow canyon walls and Diamond Fork Canyon Road confine floodwaters.

3.4.5.2.3.2 Diamond Fork Creek From Three Forks to Red Hollow. This reach of Diamond Fork Creek extends from Three Forks approximately 2.5 miles to Red Hollow. The reach also is in a narrow canyon area but less so than the next upstream reach. From Three Forks downstream to Red Hollow, the canyon gradually widens, the creek channel gradient decreases, and the channel is more meandering. As a result, there are more well-developed floodplain areas farther downstream in this reach. Riparian forest is the dominant vegetative community along this reach, with small areas of riparian shrub community where there are no cottonwood trees.

3.4.5.2.3.3 Diamond Fork Creek From Red Hollow to Brimhall Canyon. This reach extends 3.2 miles from Red Hollow to Brimhall Canyon in a single entrenched channel with low sinuosity. The narrow channel is confined within high, steep canyon walls in a narrow valley floor, ranging from 200 to 500 feet wide. Downstream, the valley floor ranges from 400 to 500 feet wide and the creek transitions to multiple channels flanked by abandoned meanders. Riparian forest is the dominant community type, characterized by narrowleaf cottonwood/skunkbush in the upper end and narrowleaf cottonwood/red-osier dogwood in the lower end. Livestock currently graze the corridor along this reach.

3.4.5.2.3.4 Diamond Fork Creek From Brimhall Canyon to the Confluence With Spanish Fork River. This final reach extends 4 miles from Brimhall Canyon to the confluence with Spanish Fork River. Here the creek flows through a broad valley ranging up to 1,100 feet wide and characterized by multiple channels, active braiding and evidence of repeated and large lateral movements of the channel. Dominant vegetative communities in this reach are palustrine emergent marsh, wet meadow and riparian shrub. The marsh and wet meadow communities are confined to areas immediately along both sides of the creek channel, on point bars within the braided sections of t channels, and in old oxbow cutoff channels. Species present include coyote willow, cottonwood and red-osier dogwood (on mid-elevation and high terraces), and some tamarisk. Farming in the floodplain has been terminated, and grazing (which is managed by the U.S. Forest Service), also has ended except for a few areas. Overall, the corridor lacks riparian species, age class, and spatial diversity. In particular, there is a lack of intermediate class sizes of woody riparian vegetation combined with bare cutbanks. Throughout most of the stream corridor, riparian understory is absent or severely degraded, and much of the mature cottonwood overstory has been lost as a result of farming up to the streambanks, grazing, and high, prolonged annual flows that have not allowed the overstory to re-establish.

Immediately upstream of the Highway 6 embankment over Diamond Fork Creek, there is a palustrine emergent marsh and aquatic bed/open water community adjacent to the creek channel that covers approximately 6 acres. This marsh was formed by the realignment of Highway 6 following the landslide at Thistle. The Highway 6 embankment constructed over Diamond Fork Creek acts as a berm, with water backing up and ponding behind it.

3.4.5.2.4 Spanish Fork River. Spanish Fork River is a perennial waterway with a single channel confined by steep canyon slopes, Highway 6, and the tracks of the Denver and Rio Grande Western Railroad and the Utah Railroad. The river gradually transitions from a canyon landform to a broad alluvial floodplain that extends to Utah Lake. Spanish Fork River has conveyed irrigation water in addition to natural flows since 1913. Consequently, these irrigation flows have prevented establishment and persistence of riparian vegetation in portions of the canyon reach of Spanish Fork River. The river has been divided into two primary reaches below to describe the affected environment.

3.4.5.2.4.1 Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam. Wetland and riparian habitats along this reach of Spanish Fork River exist in a fairly narrow corridor. The river is channelized, with little or no riparian vegetation. Wet meadow, the largest wetland community, occurs in the river's active floodplain, primarily at two different terrace elevations along the river. These are: 1) on gravel bars and low elevation terraces 0.4 to 1.3 feet above the river surface water elevation during the irrigation season (June through September) and 2) on high terraces 1.3 to 2.1 feet above the river water surface during the same period. The wet meadow community along the gravel bars and low terraces is periodically inundated by 2-year and 10-year flood events, whereas the wet meadow community occurring on high terraces requires flood flows greater than the 10-year flood for inundation.

The wet meadow community transitions into a riparian shrub type at slightly higher elevations along this reach. It is dominated by willow and tamarisk, and is located an average of 2.3 to 3.3 feet above the summer water surface. The 10-year flood primarily inundates the riparian shrub community, but portions of the community located on higher terraces are only inundated during a 20-year flood event.

In addition to these community types, a wet meadow type with saline-adapted plant species is located immediately adjacent to the active Spanish Fork River channel. Small areas of creek bed/riverine type also are located immediately adjacent to the river.

A small amount of spikerush mudflat community type occurs at the normal waterline along point bars within 6 inches to 1 foot of the late summer water surface). Inundated annually by a flow of 400 to 600 cfs, this community type occurs adjacent to the river at Cold Springs and is dominated by emergent vegetation (primarily cattail). The palustrine emergent marsh type also occurs in overflow channels along the river that are inundated by 0.2 and 0.5 foot of water from May through July, and inundated annually by a flow of 360 cfs.

3.4.5.2.4.2 Spanish Fork River From Spanish Fork Diversion Dam to Utah Lake. This reach flows through lowland areas and is very constricted as a result of channelization, down-cutting and the creation of levees for flood protection. As a result, the riparian shrub community is limited primarily to the immediate channel and banks and is very sparse and discontinuous along the river. Broader, low-lying floodplains in the vicinity of I-15 (east and west sides of the highway) support more extensive stands of riparian forest, palustrine emergent marsh, and wet meadow communities. The remainder of the riparian shrub community is a narrow band along Spanish Fork River through extensive agricultural areas to the mouth at Utah Lake.

3.4.6 Impact Analysis

3.4.6.1 Methodology

The methodology used in the impact analysis was conducted in two steps. The first was a detailed review of physical project features and their potential impacts on wetlands after Standard Operating Procedures (SOPs) are implemented (see Section 1.7.8, Chapter 1). The second step involved reviewing the operational changes in streamflows and evaluating the potential impacts on wetlands.

3.4.6.2 Significance Criteria

Potential impacts on wetland resources would be considered significant if any one of the following conditions occurred:

- Any wetland acreage would be permanently lost through excavation or fill
- Changes in the quality or quantity of wetland hydrologic support would result in an overall loss or gain of wetland acreage
- Changes in the quality or quantity of wetland hydrologic support would result in conversion of vegetated wetland community type to a non-vegetated community type or upland habitat

These significance criteria were developed as part of the scoping process for the SFN DEIS and through input provided by concerned agencies. They are based upon regulatory and agency policies specifying "no net loss" of wetland acreage or functions and values. Losses of wetland functions and values are addressed by assessing changes in wetland community types or the hydrologic regime.

Non-vegetated wetland community types included creek bed/riverine and aquatic bed/open water. Although aquatic bed/open water can support vegetation, the presence of vegetation depends on suitable growth factors (e.g., depth of inundation and moderate water-level fluctuation). Therefore, the conversion of a vegetated community type to non-vegetated wetland community type would be considered significant if conditions would not allow aquatic vegetation to become established.

3.4.6.3 Potential Impacts Eliminated From Further Analysis

Operation of the blow-off vaults and discharge pipes would not cause any impacts on wetlands or riparian vegetation. The discharge would be regulated to avoid impacts (see Chapter 1, Section 1.4.2.2).

3.4.6.4 Proposed Action

3.4.6.4.1 Impacts During Construction. The impacts on wetlands from construction of the Proposed Action would not be significant with implementation of SOPs as described in Chapter 1, Section 1.7. The key SOP is found in Section 1.7.8.3, Wetlands and Riparian Areas.

3.4.6.4.1.1 Sixth Water Creek Connection to Tanner Ridge Tunnel. One crossing under Sixth Water Creek would be required to connect the outlet of Sixth Water Aqueduct to the proposed Tanner Ridge Tunnel inlet via a connecting pipeline under Sixth Water Creek. The crossing would be located at the existing outlet of the Sixth Water Aqueduct. The creek channel in this location was disturbed when the aqueduct was constructed.

The connecting pipe would be placed in an open trench crossing Sixth Water Creek; the trench would then be filled and the creek channel restored to existing grade. It is estimated that 0.24 acre of creek bed/riverine habitat would be temporarily disturbed from the pipe crossing and two temporary cofferdams. About 0.02 acre of creek bed/riverine community type adjacent to the existing flow control facility at Sixth Water Aqueduct would be permanently lost from construction of the inlet box. This loss would be a significant impact. There is no wetland/riparian habitat adjacent to this previously disturbed creek channel.

3.4.6.4.1.2 Tanner Ridge Tunnel–Unnamed Drainage Crossings. A new temporary access road would be cut into the hillside terrain above Diamond Fork Canyon Road for access to the Tanner Ridge Tunnel outlet portal, which would require crossing 500 feet of an unnamed drainage that only flows during snowmelt runoff and rainstorms. The drainage varies from 2 and 4 feet wide and supports no adjacent wetland communities. Outside the active drainage, the vegetation consists of upland species of sagebrush, rabbitbrush and scrub oak. Several intermittent seeps also are present along the drainage, but none support permanent flow and would be avoided during construction. Therefore, construction of the Tanner Ridge Tunnel outlet portal access road would cause no loss of wetlands.

The Tanner Ridge Tunnel outlet portal would be excavated across 300 feet of an intermittent drainage-way that contains upland vegetation, grasses and forbs and only flows during snowmelt runoff and rainstorms. Upon completion of the tunnel, the drainage-way would be restored to convey runoff through the outlet portal area. Construction of the outlet portal would produce rock waste material that would be disposed in an upland area on the west side of Tanner Ridge. The excavation and disposal of the rock waste material would not affect any wetlands.

3.4.6.4.1.3 Diamond Fork Siphon–Diamond Fork Creek and Unnamed Drainage Crossings. Construction of Diamond Fork Siphon would require one crossing of Diamond Fork Creek. The siphon would be constructed outside the Diamond Fork Creek channel and riparian area except where it crosses under the creek. The creek channel is approximately 16 feet wide at the crossing and the riparian shrub type extends approximately 10 feet from the east side and a maximum of 150 feet from the west side of the creek. The creek crossing would require excavation and riparian shrub removal within a 100-foot-wide right-of-way section of the creek. The creek would be restored to pre-construction grade and the banks revegetated with riparian species. The total temporary disturbance would be 0.09 acre of creek bed/riverine and 0.60 acre of riparian shrub community types.

Diamond Fork Siphon would cross two unnamed ephemeral drainages, temporarily disturbing 0.12 acre of riparian shrub community type that would be restored under the SOPs. Construction of these crossings would have no significant wetland impacts. About 275 feet of one unnamed ephemeral drainage would be filled and then reconstructed, with a temporary loss of 0.06 acre of riparian shrub type. About 260 feet of a second unnamed ephemeral drainage would be cut near the Red Mountain Tunnel inlet portal and restored to original contour, with a temporary loss of 0.06 acre of riparian shrub type. Both restored drainage-ways would be planted with riparian shrubs.

3.4.6.4.1.4 Diamond Fork Bridge. The existing Diamond Fork Bridge downstream of Diamond Fork Siphon would be replaced with a new bridge after completion of construction. The bridge would be replaced in its current location, which is within a riparian shrub-type community. Installation of the replacement bridge would temporarily remove 0.01 acre of riparian shrub type, with no significant impact on the riparian shrub community. Riparian shrubs would be planted in the area around the replacement bridge, as described under the SOPs.

3.4.6.4.1.5 Red Hollow Pipeline–Access Road and Crossing Under Red Hollow Drainage. Construction of the Red Hollow Pipeline access road would require limited improvements to the first 1.5 miles of the existing unpaved truck road from the confluence with Diamond Fork Creek up Red Hollow. The improvements would require widening a particularly narrow area uphill and adjacent to the Red Hollow drainage; however, no fill would be placed into the Red Hollow drainage.

Construction of the Red Hollow Pipeline would require one temporary road crossing over the Red Hollow drainage and several ephemeral drainage crossings. The perennial channel at the temporary road crossing is 2 feet wide, and no riparian habitat is present. The total amount of temporary impacts on wetlands (creek bed/riverine) at the road and pipeline crossing would be 0.04 acre. Construction of the pipeline also would require crossing several unnamed ephemeral drainages, resulting in 0.53 acre of temporary impacts on creek bed/riverine habitat. The impacted creek bed/riverine habitat would be restored under the SOPs.

3.4.6.4.1.6 Diamond Fork Creek Outlet. Diamond Fork Creek Outlet would be constructed in the riparian forest community type. About 0.01 acre of riparian shrubs along the edge of the creek would be permanently removed for placement of rock rip-rap on the bank between the covered outlet structure and the creek. Some riparian shrubs would re-establish in and around the rock rip-rap. Construction of the covered outlet structure and connecting pipe in the right-of-way would temporarily affect 0.38 acre of shrubs in the riparian forest type. These shrubs would be restored under the SOPs. The covered outlet structure would permanently remove 0.01 acre of riparian shrubs in the riparian forest type. Permanent loss of 0.02 acre of riparian forest community type would be a significant impact on wetland resources. The temporary removal of vegetation would have no significant impacts on the riparian forest community type during construction of Diamond Fork Creek Outlet.

3.4.6.4.1.7 Spanish Fork River Outlet From Diamond Fork Pipeline. The Spanish Fork River Outlet from Diamond Fork Pipeline would be constructed on the northeast-facing slope of the Highway 6 embankment, which is vegetated with upland grass species. The construction right-of-way extends over the creek at the culvert inlet, but there would be no changes to the creekbed. Therefore, construction of the outlet would have no impacts on wetland resources.

3.4.6.4.1.8 Spanish Fork River Diversions. Construction modifications to the Spanish Fork River Diversions are described in Chapter 1, Section 1.3.2.8. Five of the six Spanish Fork River diversions would have rip-rap placed in the channel bottom to reduce erosion of the riverbed. The rip-rap placement would cause no significant impacts on riparian or wetland resources.

The following describes specific potential construction impacts on wetland resources at the five diversions:

Spanish Fork Diversion Dam. The channel would be extended in a disturbed section of the river channel, so there would be no impacts on creek bed/riverine or riparian vegetation.

East Bench Dam. The new channel would be constructed in upland vegetation and would only affect riparian vegetation where it connects to the river. There would be short-term impacts on riparian shrub vegetation where the new channel connects to the river. These impacts would not be significant.

Mill Race Diversion. The existing unused diversion channel contains no riparian vegetation and consists only of open water. Construction of the channel extension and placement of rock rip-rap to prevent erosion of the riverbed would have no significant impacts on creek bed/riverine habitat.

Lake Shore Diversion. Construction of the new channel would cause minor impacts on riparian shrub vegetation, but they would not be significant.

Huff Dam. Construction of the channel extension would cause minor impacts on riparian shrub vegetation. A very narrow zone of riparian vegetation along the channel is bordered by crop land. The impacts on riparian vegetation would not be significant.

3.4.6.4.2 Impacts During Operation. This section presents the impacts of flow changes on wetland resources, (including riparian vegetation) during interim operation of the Proposed Action. The discussion also summarizes changes that would occur to the stream systems based on recent documented studies and best professional judgment. The *Wetland Resources Technical Memorandum* (CUWCD 1999e) provides a more detailed description of estimated changes in watershed characteristics, streamflow, sediment transport capacity, stream temperature, channel morphology, streambank erosion and riparian vegetation.

3.4.6.4.2.1 Sixth Water Creek Above Sixth Water Aqueduct. **Strawberry Valley Project** (SVP) irrigation flows in Sixth Water Creek above Sixth Water Aqueduct ceased in 1996 when Syar Tunnel and Sixth Water Aqueduct became operational. The remaining streamflows (baseline conditions) consist of natural flows and seepage from Strawberry Tunnel. This section presents a qualitative summary of the impacts of providing minimum streamflows in this reach.

Long-term watershed characteristics and vegetative cover would remain the same as under baseline conditions. Streamflows in this reach would increase in every month because of the minimum flows released from Strawberry Tunnel (see Table 3-2 in Chapter 3, Section 3.2.6.4.2.1). Sediment transport capacity would be slightly increased from baseline conditions (see Table 3-11 in Chapter 3, Section 3.3.6.4.2.1). Monthly average stream temperatures would generally decrease or remain unchanged from baseline conditions except for slight increases in April, May and September (see Table 3-10 in Chapter 3, Section 3.3.6.4.2.1). Streambank erosion would slightly increase because of the higher streamflows. The highly erodible soils and landslide areas would be eroded by the higher flows where they meet the stream, but at a slightly higher rate than under baseline streamflows.

Changes in channel morphology would not be uniform throughout this reach under the Proposed Action. The reach from Strawberry Tunnel to the confluence with Dip Vat Creek would not change measurably. The reach from Dip Vat Creek to 0.25 mile upstream of Rays Valley Bridge would change from a multiple-channel to a single-channel stream under the Proposed Action, with noticeable changes in streambed composition and channel width. Material eroded from landslides would be distributed downstream, with finer materials deposited on the banks and in slower-velocity zones within the channel. The reach from 0.25 mile upstream of Rays Valley Bridge to 0.8 mile downstream also would change under the Proposed Action because flows would not be sustained in side channels and the main channel would collect more fine sediments along stream margins and in existing bars. The segment from 0.8 mile downstream of Rays Valley Bridge to Sixth Water Aqueduct would not change under the Proposed Action except that side channels would be dewatered (Trihey and Associates 1997b).

The Proposed Action would result in minor losses of riparian vegetation along shoreline margins, on mid-channel bars and in side channels because of the slightly higher water surface elevation and higher water velocities than under baseline conditions. The more consistent streamflows under the Proposed Action would allow more riparian vegetation to establish at the channel margin because of more constant shear forces during the growing season than under baseline conditions. As a primary successional species, coyote willow would be the dominant riparian shrub in the drainage. Several other willow species also would grow in the riparian area in scattered clumps. These riparian conditions have been observed in Sixth Water Creek above Sixth Water Aqueduct during the baseline conditions since the high flows from Strawberry Tunnel have ceased. The riparian area width could increase over baseline conditions because of higher water surface elevations, but the increase in elevation likely would maintain more of the riparian area already established under the previous irrigation flow regime.

3.4.6.4.2.2 Sixth Water Creek Below Sixth Water Aqueduct. SVP irrigation flows in Sixth Water Creek below Sixth Water Aqueduct have occurred since 1913. This section includes a qualitative summary of the impacts of removing the irrigation flows and providing minimum streamflows in this reach under the Proposed Action.

Long-term watershed characteristics would remain the same as under baseline conditions. Streamflow in this reach would greatly decrease in the summer and slightly increase in the winter (see Table 3-2 in Chapter 3, Section 3.2.6.4.2.1). Sediment transport would be greatly decreased from baseline conditions (see Table 3-11 in Chapter 3, Section 3.3.6.4.2.1). Monthly average stream temperatures would generally decrease from baseline conditions (see Table 3-10 in Chapter 3, Section 3.3.6.4.2.1). Streambank erosion would decrease because the flow regime would be more like a spring runoff stream, with the highest flows near the beginning of the growing season. The lower, slower-moving summer flows would would cause less shear stress on streamside soils and sediments. Some streambanks would continue to be eroded under the Proposed Action because most of the streamside topography is at the angle of repose.

The Proposed Action would cause minor adjustments in channel morphology in this reach. The stream channel would remain a single channel with plunge pools and high-gradient riffles and runs, with more sediment deposited in point bars and along the channel margins. The channel would narrow somewhat under the lower flows because streamside sediments would gradually rebuild from natural sources and decreased sediment transport capability, providing opportunities for colonization by riparian vegetation.

The Proposed Action would cause riparian vegetation to colonize stream margins and other areas of the narrow floodplain previously inundated by the high summer flows. Several species of willow would grow into these areas dominated by coyote willow. There would be no measurable change in width of riparian vegetation along the channel because the change in water surface elevation would be within the root zone of existing riparian vegetation.

3.4.6.4.2.3 Diamond Fork Creek From Three Forks to Diamond Fork Creek Outlet. SVP irrigation flows in this reach have occurred since 1913. This section includes a qualitative summary of the impacts of removing the irrigation flows and providing minimum streamflows in this reach under the Proposed Action.

Long-term watershed characteristics would remain the same as under baseline conditions. Vegetative cover would be slightly decreased from baseline conditions during the revegetation period following pipeline and tunnel construction. Streamflow in this reach would greatly decrease in the summer and slightly increase in the winter (see Table 3-2 in Chapter 3, Section 3.2.6.4.2.1). Sediment transport would be greatly decreased from baseline conditions (see Table 3-11 in Chapter 3, Section 3.3.6.4.2.1). Monthly average stream temperatures would generally decrease from baseline conditions (see Table 3-10 in Chapter 3, Section 3.3.6.4.2.1). Streambank erosion would decrease because the flow regime would be more like a spring runoff stream, with the highest flows near the beginning of the growing season. The lower, slower-moving summer flows would cause less shear stress on streamside soils and sediments. Although streamflows under the Proposed Action would be lower during the summer compared to baseline flow, some streambanks would continue to erode under flood flows, daily freeze-and-thaw cycles, and other erosion mechanisms.

The Proposed Action would cause minor changes in channel morphology in this reach. The stream channel would remain a narrow, entrenched channel (Western Wetland Systems 1996) with many runs, some riffles, bedrock controls and steep cutbanks (Addley and Hardy 1998). But the channel would narrow somewhat under the lower flows because streamside sediments would gradually rebuild from natural sources and decreased sediment transport capacity, especially in the lower segment of this reach. This would provide some opportunities for colonization by riparian vegetation. Coarser sediments could gradually rebuild under the aggradation that would occur in this reach, leading to the possibility of some pool development.

Riparian vegetation would colonize some stream margins and channel bars under the Proposed Action, but the riparian vegetation in this reach, including some cottonwood trees and willows dominated by coyote willow, is not expected to change dramatically. Coyote willow would grow into the streamside margins previously inundated by high summer flows, and several other willow species likely would grow in small clumps near established willows of the same species. There would be no measurable change in riparian vegetation width along the stream channel because it is entrenched and the change in water surface elevation would be within the root zone of existing riparian vegetation. Diamond Fork Creek is a gaining stream in this reach. Most existing cottonwood trees are perched above the boundary of the floodplain and likely receive water from up-slope areas as well as some recharge from high streamflows. There is limited potential for new cottonwood establishment along the stream margins in this reach.

3.4.6.4.2.4 Diamond Fork Creek Below Diamond Fork Creek Outlet. SVP irrigation flows in this reach have caused numerous changes in the stream system since 1913. This section includes a qualitative summary of the impacts of removing the irrigation flows and providing minimum streamflows in this reach under the Proposed Action.

Long-term watershed characteristics and vegetative cover would not be changed from baseline conditions. Streamflow would decrease in the summer and increase in the winter compared to baseline conditions (see Table 3-2 in Chapter 3, Section 3.2.6.4.2.1). Sediment transport would be greatly decreased from baseline conditions (see Table 3-11 in Chapter 3, Section 3.3.6.4.2.1). Average monthly stream temperatures would decrease from baseline conditions (see Table 3-10 in Chapter 3, Section 3.3.6.4.2.1). Streambank erosion would not change much from baseline conditions. Al though streamflows under the Proposed Action would be lower during the summer compared to baseline flows, the streambanks would continue to erode under flood flows, daily freeze-and-thaw cycles, and other erosion mechanisms.

The channel morphology from Diamond Fork Creek Outlet to Brimhall Canyon would remain fairly stable, with minimal repeated lateral migration or excessive bank erosion. The channel would continue to have a moderate gradient and remain partially entrenched. Some narrowing would occur under the lower flows, and overflow channels likely would be dammed with sediments and no longer convey flow except during high spring runoff. The streamside sediments would gradually rebuild in this reach from natural sources and reduced sediment transport capacity, providing some opportunities for colonization by riparian vegetation.

Under the Proposed Action, the reduced flows and sediment transport would substantially alter the channel morphology in Diamond Fork Creek from Brimhall Canyon to Spanish Fork River Outlet. This reach likely would continue to be unstable and dynamic, with major changes in the channel associated with large floods. The stream would continue to be oversupplied with sediment from channel storage, tributary sources and eroding alluvial fans and terraces (Trihey and Associates 1997a). Future major floods would send large amounts of sediment into the primary channel, effectively plugging it and causing floodwaters to seek a new pathway. The newly-formed channel likely would have a straight course down the valley, resulting in a significant change after each flood recedes (Trihey and Associates 1997a).

Riparian vegetation along Diamond Fork Creek from Diamond Fork Creek Outlet to Brimhall Canyon would be largely unaffected by interim operation of the Proposed Action. The existing cottonwood forests would continue to age, with little or no woody species regeneration because of the limited floodplain area under the Proposed Action flows (Trihey and Associates 1997a). Coyote willow would be the dominant riparian shrub to colonize the stream margins, with other willow species growing in small clumps near existing stands. Sediments would be deposited along the stream margins in point bars, adjacent terraces, and in abandoned overflow channels and meander scars, which would be colonized by willows, other riparian shrubs, grasses and forbs. Flows dominated by spring runoff would allow some riparian vegetation to grow in areas that were inundated throughout the growing season under baseline flow conditions.

Riparian vegetation along Diamond Fork Creek from Brimhall Canyon to Spanish Fork River Outlet likely would regenerate in abundance, including cottonwood trees and willow species. However, the continued lateral instability of the channel would result in an active floodplain with new geomorphic surfaces following periods of over-bank flows. This could limit the quantity of woody seedlings and saplings that reach maturity within the floodplain (Trihey and Associates 1997a).

The riparian vegetation species expected to establish naturally (e.g., coyote willow) would be those that can easily colonize and out-compete other species. Some native species, such as cottonwood, could establish naturally but to a lesser extent than the more aggressive non-native species.

3.4.6.4.2.5 Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam. SVP irrigation flows in Spanish Fork River have occurred since 1913. This section includes a qualitative summary of the impacts of discharging Bonneville Unit water in this reach under the Proposed Action.

Long-term watershed characteristics and vegetative cover would not change from baseline conditions. Streamflow in this reach would increase during every month compared to baseline conditions (see Table 3-2 in Chapter 3, Section 3.2.6.4.2.1). Sediment transport would be increase from baseline conditions (see Table 3-11 in Chapter 3, Section 3.3.6.4.2.1). Monthly average stream temperatures would generally decrease during summer and increase during winter compared to baseline conditions (see Table 3-10 in Chapter 3, Section 3.3.6.4.2.1). Streambank erosion would not change much from baseline conditions. They would continue to erode under flood flows, daily freeze-and-thaw cycles, and other erosion mechanisms. Channel morphology would not change much because it is confined between the steep canyon slopes, railroad embankment and Highway 6 alignment.

There would be minimal impacts on wetland and riparian communities in this reach. Some wet meadow and 1.5 acres of spikerush mudflat community type could be converted to another vegetated wetland community type because of increased streamflows throughout the year, but there would be no permanent loss of vegetated wetland. There would be minimal impacts on marsh communities occupying overflow channels adjacent to Spanish Fork River. Increased flows would raise the water surface by up to 0.6 foot in the main channel during the growing season, and some additional water would seep into the overflow channels. The marsh communities would continue to be inundated and could gradually develop more diverse emergent vegetation because of the slightly deeper water. Portions of the low-terrace, wet meadow communities could be inundated for up to one month during the growing season, which could lead to a gradual conversion to another vegetated wetland community type.

Portions of the riparian shrub community would be inundated by up to 0.6 foot of water from the normal spring runoff flows in Spanish Fork River during the growing season. Although the composition of riparian vegetation species could gradually change, there would be no measurable loss from increased flows.

3.4.6.4.2.6 Spanish Fork River From Spanish Fork Diversion Dam to Utah Lake. Long-term watershed characteristics and vegetative cover in this reach would not change from baseline conditions. Streamflow would increase during every month compared to baseline conditions (see Table 3- in Chapter 3, Section 3.2.6.4.2.12). It is likely that, compared to baseline conditions, sediment transport capacity would increases; stream temperatures would be the same or lower; and there would be no change in streambank erosion, channel morphology and riparian and wetland vegetation because of the armored banks and straightened channel.

3.4.6.4.3 Maintenance Operations Impacts. Impacts of maintenance operations on wetland and riparian resources under the Proposed Action would not be significant. The duration of maintenance operations, ranging from 2 days to 3 weeks during spring runoff or following irrigation season, would not be long enough to adversely affect riparian or wetland vegetation in and along the channel. Flow reductions under maintenance operations would occur either before or after the growing season for riparian and wetland vegetation, and they also would be within the range of naturally occurring flows.

3.4.6.4.4 Emergency Operations Impacts. Impacts of emergency operations on wetland and riparian resources would not be significant under the Proposed Action. A one-month period of 200 cfs released from Strawberry Tunnel, assumed to occur in May during the spring runoff period, would result in streamflows about 2.3 times larger than normal spring runoff. The emergency flows would inundate riparian vegetation along the stream channel between Strawberry Tunnel outlet and Sixth Water Aqueduct, and would transport and deposit sediments in overbank areas. These emergency flows would exceed 50-year flood flows in this reach, which could cause some channel changes. However, the riparian vegetation would survive the inundation and any other vegetation scoured by high-velocity flows would quickly grow back through natural colonization following resumption of normal flows. Impacts on wetland and riparian resources in Sixth Water Creek below Sixth Water Aqueduct would be minimal, with minor overbank flooding in areas containing re-established vegetation under the Proposed Action flows. Impacts on wetland and riparian resources would be minimal in Diamond Fork Creek below Three Forks and below Diamond Fork Creek Outlet and in Spanish Fork River because emergency flows would be within the range of total flows in these reaches under normal operation of the Proposed Action (CUWCD 1999d).

3.4.6.4.5 Impact Summary. Impacts on wetland resources under the Proposed Action include permanent disturbance through fill, as well as temporary disturbance during construction and operation activities. Table 3-15 summarizes wetland resource impacts under the Proposed Action.

Table 3-15
Summary of Impacts on Wetland Resources
During Construction and Operation of the Proposed Action

Wetland Community Type	Location	Impact (acres) Temporary	Impact (acres) Permanent	Significance	Comments
Impacts During Construction					
Creek Bed/ Riverine	Sixth Water Connection to Tanner Ridge Tunnel	0.24		Not significant	Restored under SOPs
			0.02	Significant	Concrete box constructed adjacent to existing inlet box structure in modified section of stream
Creek Bed/ Riverine	Diamond Fork Siphon	0.09		Not significant	Restored under SOPs
Riparian Shrub	Diamond Fork Siphon	0.60		Not significant	Restored under SOPs
Riparian Shrub	Unnamed Drainages along Diamond Fork Siphon	0.12		Not significant	Restored on-site under SOPs
Riparian Shrub	Diamond Fork Bridge	0.01		Not significant	Restored under SOPs
Creek Bed/ Riverine	Red Hollow Pipeline and Access Road unnamed drainages	0.57		Not significant	Restored under SOPs
Riparian Forest	Diamond Fork Creek Outlet	0.38		Not significant	Restored under SOPs
			0.02	Significant	Concrete outlet box and rock riprap constructed on bank above stream
Total Wetland Impacts During Construction		**2.01**			**All temporary impacts would be restored under SOPs**
			0.04		**Significant impacts would require mitigation**
Impacts During Operation					
Spikerush mudflat	Spanish Fork River		1.50	Not significant	The 1.50 acres would remain wetland (see significance criteria)
Total Wetland Impacts During Operation			**1.50**		**Potential conversion of wetland type to another wetland type**

3.4.6.5 No Action Alternative

3.4.6.5.1 Impacts During Construction. Construction of Three Forks Dam and Reservoir would require diverting Diamond Fork Creek around the work area and excavating the creek bottom to construct the dam foundation. Construction of the dam would temporarily impact 1 acre of creek bed/riverine community type and 8 acres of riparian shrub community type. The disturbed areas would be restored after construction is completed. Construction of the dam would permanently remove 0.5 acre of creek bed/riverine and riparian forest community type.

Construction of Diamond Fork Road bypass around Three Forks Dam and Reservoir, and disposal of excavated rock, would only affect upland vegetation. It would have no impact on riparian shrub or riparian forest community types.

Construction of Spanish Fork River Outlet from Diamond Fork Pipeline would have the same impacts as described under the Proposed Action (see Chapter 3, Section 3.4.6.4.1.7).

Modifications of the Spanish Fork River Diversions would have the same impact as described under the Proposed Action (see Chapter 3, Section 3.4.6.4.1.8).

3.4.6.5.2 Impacts During Operation. This section describes the potential impacts of flow changes on wetland resources (including riparian vegetation) under the No Action Alternative,. The discussion also summarizes changes that would occur to the stream systems based on recent documented studies and best professional judgment. The *Wetland Resources Technical Memorandum* (CUWCD 1999e) provides a more detailed description of estimated changes in watershed characteristics, streamflow, sediment transport capacity, stream temperature, channel morphology, streambank erosion and riparian vegetation.

3.4.6.5.2.1 Sixth Water Creek Above Sixth Water Aqueduct. The changes in watershed characteristics, streamflow, sediment transport capacity, stream temperature, streambank erosion, channel morphology and riparian vegetation would be the same as described for the Proposed Action (see Chapter 3, Section 3.4.6.4.2.2).

3.4.6.5.2.2 Sixth Water Creek Below Sixth Water Aqueduct. SVP irrigation flows in Sixth Water Creek below Sixth Water Aqueduct have occurred since 1913. This section includes a qualitative summary of the impacts of discharging Bonneville Unit water into this reach under the No Action Alternative.

Long-term watershed characteristics and vegetative cover would remain the same as under baseline conditions. Streamflow would increase over baseline conditions, which include SVP irrigation flows, during every month (see Table 3-3 in Chapter 3, Section 3.2.6.5.2.1). Sediment transport would be greatly increased from baseline conditions (see Table 3-14 in Chapter 3, Section 3.3.6.5.2.1). Monthly average stream temperatures would generally decrease from baseline conditions (see Table 3-13 in Chapter 3, Section 3.3.6.5.2.1). Streambank erosion would increase because of higher sustained flows throughout the winter and higher flows during the growing season compared to baseline conditions. The higher, faster-moving summer and winter flows would increase the shear stress on streamside soils and sediments, which is likely to increase shoreline erosion. Some streambanks that did not erode during the baseline flows would be subject to erosion under the No Action Alternative because of increased water surface elevation in Sixth Water Creek. The banks of the reservoir's working pool also would be subject to increased erosion because of lost vegetative cover.

The No Action Alternative would cause some changes in channel morphology in this reach. The stream channel would remain a single channel with plunge pools, high-gradient riffles and runs, with little or no sediment deposited long the channel. Some widening of the channel would occur under the higher flows, and streamside sediments would continue to be scoured away by high, sustained flows. Streamside sediments would gradually be eroded from point bars, channel margins and natural sources, providing fewer opportunities for colonization by riparian vegetation. The lowest ½-mile of the Sixth Water Creek channel would be inundated by Three Forks Reservoir, changing the channel from a steep, narrow chute to open, impounded water with sediment deposited in the channel bottom.

The No Action Alternative would cause riparian vegetation to be scoured from stream margins and other areas of the narrow floodplain. There would be some increase in channel width and a corresponding decrease in riparian vegetation width along the channel because the narrow canyon restricts the floodplain width. About 3.4 acres of riparian shrub/riparian forest community types would be inundated and permanently removed by Three Forks Reservoir, which would be a significant impact. Daily reservoir fluctuations would prevent any vegetation from growing below the high pool elevation. A narrow band of riparian vegetation would form along the margins of the high pool of this arm of the reservoir. The reservoir would create up to 14 acres of aquatic bed/open water community, with little or no aquatic vegetation because of daily water level fluctuations.

3.4.6.5.2.3 Cottonwood Creek Above Three Forks. Three Forks Reservoir would inundate riparian vegetation and the stream channel system in this reach. Sediment transport capacity would decrease and larger sediments would collect in the reservoir pool. About 2.3 acres of riparian shrub/riparian forest community types would be inundated, which would be a significant impact. Daily reservoir fluctuations would prevent any vegetation from growing below the high pool elevation. A narrow band of riparian vegetation would form along the margins of the high water pool of this arm of the reservoir.

3.4.6.5.2.4 Diamond Fork Creek Above Three Forks. Impacts on this reach from operating the No Action Alternative would be the same as for Cottonwood Creek above Three Forks (see Chapter 3, Section 3.4.6.5.2.3), except that about 3.4 acres of riparian shrub/riparian forest community types would be inundated and permanently removed by the reservoir which would be a significant impact.

3.4.6.5.2.5 Diamond Fork Creek From Three Forks to Red Hollow. SVP irrigation flows in Diamond Fork Creek from Three Forks to Red Hollow have occurred since 1913. This section includes a qualitative summary of the impacts of removing the irrigation flows and providing minimum streamflows on this reach under the No Action Alternative.

Long-term watershed characteristics and vegetative cover would generally remain the same as under baseline conditions. The Diamond Fork Creek Road replacement would be constructed primarily in rock on the steep slopes of Diamond Fork Canyon and likely would not be a source of sediment to the stream. Streamflow in this reach would decrease from baseline conditions in the summer and increase over baseline conditions in the winter (see Table 3-3 in Chapter 3, Section 3.2.6.5.2.1). Sediment transport would be greatly reduced from baseline conditions (see Table 3-14 in Chapter 3, Section 3.3.6.5.2.1). Periodic releases of sediment from Three Forks Dam could occur in this reach, but the quantity or timing of sediment releases is unknown. Monthly average stream temperatures would generally decrease from baseline conditions except during April, May and September (see Table 3-13 in Chapter 3, Section 3.3.6.5.2.1). Streambank erosion would decrease because the flow regime would be more like a spring runoff stream, with the highest flows near the beginning of the growing season.. The lower, slower-moving summer flows would cause less shear stress on streamside soils and sediments.

The No Action Alternative would cause minor changes in channel morphology in this reach. The stream channel would remain a narrow, entrenched channel (Western Wetland Systems 1996) with many runs, some riffles, bedrock controls and steep cutbanks (Addley and Hardy 1998). But the channel would narrow somewhat under the lower flows because streamside sediments would gradually rebuild from natural sources and decreased sediment transport capacity, especially in the lower segment of this reach. This would provide some opportunities for colonization by riparian vegetation. Coarser sediments could gradually rebuild under the aggradation that would occur in this reach, leading to the possibility of some pool development.

Riparian vegetation would colonize some stream margins and channel bars under the No Action Alternative, but the riparian vegetation in this reach, including some cottonwood trees and willows dominated by coyote willow, is not expected to dramatically change. Coyote willow would grow into the streamside margins previously covered by high summer flows, and several other willow species likely would grow in small clumps near existing established willows of the same species. There would be no measurable change in width of riparian vegetation along the channel because it is entrenched and the change in water surface elevation would be within the root zone of existing riparian vegetation. Diamond Fork Creek is a gaining stream in this reach. Most existing cottonwood trees are perched above the boundary of the floodplain and likely receive water from up-slope areas as well as some recharge from high streamflows. There is limited potential for new cottonwood establishment along the stream margins in this reach of Diamond Fork Creek.

3.4.6.5.2.6 Diamond Fork Creek Below Red Hollow. The impacts of the No Action Alternative on wetland resources in this reach would be the same as for the Proposed Action (see Chapter 3, Section 3.4.6.4.2.4).

3.4.6.5.2.7 Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam. The impacts of the No Action Alternative on wetland resources in this reach would be the same as for the Proposed Action (see Chapter 3, Section 3.4.6.4.2.5).

3.4.6.5.2.8 Spanish Fork River From Spanish Fork Diversion Dam to Utah Lake. The impacts of the No Action Alternative on wetland resources in this reach would be the same as for the Proposed Action (see Chapter 3, Section 3.4.6.4.2.6).

3.4.6.5.3 Maintenance Operations Impacts. Impacts of maintenance operations on wetland and riparian resources under the No Action Alternative would not be significant. The duration of maintenance operations, ranging from 2 days to 3 weeks during spring runoff or following irrigation season, would not be long enough to adversely affect riparian or wetland vegetation in and along the channel. Flow reductions under maintenance operations would occur either before or after the growing season for riparian and wetland vegetation, and they also would be within the range of naturally occurring flows.

3.4.6.5.4 Emergency Operations Impacts. Impacts of emergency operations on wetland and riparian resources under the No Action Alternative would not be significant. The one-month period of 200 cfs emergency flows released from Strawberry Tunnel, assumed to occur in May during spring runoff, would result in streamflows about 2.3 times larger than normal spring runoff. These flows (exceeding 50-year flood flows) would inundate riparian vegetation along the stream channel between the Strawberry Tunnel outlet and Sixth Water Aqueduct, transport sediments and deposit them in overbank areas. This could cause some channel changes, but the riparian vegetation would survive and any other vegetation scoured by high-velocity flows would quickly grow back through natural colonization when normal flows resume. There would be no impacts on wetland and riparian resources along Sixth Water Creek below Sixth Water Aqueduct since the emergency flows would be within the range of normal operation under the No Action Alternative.

3.4.6.5.5 Impact Summary. Impacts on wetland resources under the No Action Alternative include permanent disturbance through fill and inundation, as well as temporary disturbance during construction and operation activities. Table 3-16 summarizes wetland and riparian resource impacts under the No Action Alternative.

Table 3-16
Summary of Impacts on Wetland Resources
During Construction and Operation of the No Action Alternative

Wetland Community Type	Location	Impact (acres)		Significance	Comments
		Temporary	Permanent		
Impacts During Construction					
Riparian Shrub	Diamond Fork Creek, Three Forks Dam	8.0		Not significant	Restored under SOPs
Creek Bed/ Riverine	Diamond Fork Creek, Three Forks Dam	1.0		Not significant	Restored under SOPs
			0.5	Significant	Permanent loss of wetland would require mitigation to achieve no net loss
Total Wetland Impacts During Construction		**9.0**			**All temporary impacts would be restored under SOPs**
			0.5		**Significant impacts would require mitigation**
Impacts During Operation					
Riparian Shrub and Riparian Forest	Three Forks Reservoir		9.1	Significant	Permanent loss of wetland would require mitigation to achieve no net loss
Spikerush mudflat	Spanish Fork River		1.5	Not significant	The 1.50 acres would remain wetland (see significance criteria)
Total Wetland Impacts During Operation			**10.6**		**Significant impacts would require mitigation**

3.5 Wildlife Resources

3.5.1 Introduction

This section addresses potential impacts on wildlife species and their habitat that would result from construction and operation of the Proposed Action and No Action Alternative. Information on wetland habitat conditions was taken from Section 3.4, Wetland Resources, and used to address impacts to wetland-related wildlife. Potential impacts to special-status species are discussed in Section 3.7.

3.5.2 Issues Eliminated From Further Analysis

None.

3.5.3 Issues Addressed in the Impact Analysis

The issues and concerns identified below are addressed in the following impact analysis:

- Impacts to big-game populations from construction and operation of the Proposed Action or No Action Alternative in designated critical winter range.
- Impacts to wildlife habitat from construction and operation of the Proposed Action or No Action Alternative.
- Construction or operation-induced effects on wetland habitats used by wildlife.

3.5.4 Description of Impact Area of Influence

The impact area of influence consists of terrestrial and aquatic habitats in the Diamond Fork Drainage and Spanish Fork River corridor that could be directly or indirectly affected by the construction and operation of the Proposed Action or No Action Alternative. The impact area of influence for wildlife varies by species, depending on their individual habitat requirements, distribution, mobility and sensitivity to disturbance. For example, it may extend substantially beyond the construction right-of-way for species with a low tolerance for disturbance (e.g., some nesting raptors), while the reverse is true for species that have limited mobility, small home ranges or high tolerance of disturbance.

3.5.5 Affected Environment (Baseline Conditions)

This section describes representative wildlife species and habitats that could be affected by construction and operation of the Proposed Action and No Action Alternative. The types of wildlife resources located in the impact area of influence that could be affected are similar for both.

3.5.5.1 Wildlife Habitat

Seven major plant communities that provide wildlife habitat were identified in the impact area of influence: oak woodland, sagebrush/grass, pinyon/juniper, wetlands, previously disturbed areas, mountain brush and aspen/conifer.

3.5.5.1.1 Oak Woodland. The oak woodland, or shrub oak community, is a major component of foothill egetation along the Wasatch Mountains in the impact area of influence. This community generally occurs between

5,500 and 6,500 feet in elevation. Scrub oaks (*Quercus gambelii*) are shrubs or small deciduous trees that often exist in "clumps" separated by open spaces dominated by big sagebrush (*Artemisia tridentata*) or a variety of native grass species.

3.5.5.1.2 Sagebrush/Grass. The sagebrush/grass community covers a substantial portion of the mountains, foothills and valleys along the Wasatch Front and is common in the Diamond Fork drainage. The dominant shrub species in this community is big sagebrush. Other important shrub species are rubber rabbitbrush (*Chrysothamnus nauseosus*), low rabbitbrush (*Chrysothamnus viscidiflorus)* and broom snakeweed (*Gutierrezia sarothrae).* Dominance of grasses varies between sites, but the most common species are bluebunch wheatgrass (*Elymus spicatus*), western wheatgrass (*Elymus smithii*), cheatgrass and muttongrass (*Poa fendleriana).* Dominant forbs are yarrow (*Achillea millefolium*), lupines (*Lupinus* spp.) and asters (*Aster* spp).

3.5.5.1.3 Pinyon/Juniper. The pinyon/juniper community in the impact area of influence is restricted to ridges in the Diamond Fork drainage. Pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) dominate this community.

3.5.5.1.4 Wetlands. As described in Section 3.4, Wetland Resources, seven wetland community types are present throughout the impact area of influence. These include wet meadow, palustrine emergent marsh, riparian forest, riparian shrub, creek bed/riverine, aquatic bed/open water and spikerush mudflat.

3.5.5.1.5 Previously Disturbed Lands. A small amount of previously disturbed lands occurs in the impact area of influence. These include non-native habitats, other than cultivation, and are typically adjacent to highways, railroads and other rights-of-way. Most have been reseeded to a grass/forb community for erosion control, to provide food and cover for wildlife, or for aesthetic purposes. Dominant species in these reseeded areas include yellow sweet clover (*Melilotus officinalis*), pepperweed (*Lepidium montanum*), curly gumweed (*Grindelia squarrosa*), sunflower (*Helianthus annuus*) and bluegrass (*Poa pratensis*).

3.5.5.1.6 Mountain Brush. Mountain brush habitat, the most prevalent vegetation type in the Diamond Fork drainage, occurs at almost all elevations. It is primarily a shrub community dominated by oakbrush and snowberry (*Symphoricarpos longiflorus*). Other important species include big sagebrush, alder-leaf mountain mahogany (*Cercocarpus montanus*) and rabbitbrush (*Chrysothamnus* sp.).

3.5.5.1.7 Aspen/Conifer. This habitat type has limited distribution in the Diamond Fork drainage. It occurs primarily at higher elevations around 8,000 feet. It is dominated by single and mixed stands of quaking aspen (*Populus tremuloides*) and fir (*Abies* spp.).

3.5.5.2 General Wildlife

The plant communities identified above provide habitat for a diverse mix of wildlife species. Representative species from the major wildlife groups and their primary habitat associations are discussed below. Threatened, endangered, candidate and special-concern species in the impact area of influence are described in Section 3.7, Special-Status Species.

3.5.5.2.1 Amphibians. Amphibians in the impact area of influence are generally associated with wetland habitats such as marshes, springs, streams, ponds and wet meadow/pasture habitats. Permanent wetlands generally receive higher use by amphibians than temporary wetlands. Characteristic species include Utah tiger salamander (*Ambystoma tigrinum utahensis*), western (northern) chorus frog (*Pseudacris triseriata*), leopard frog (*Rana pipiens*), bullfrog and Woodhouse's toad (*Bufo woodhousei*).

3.5.5.2.2 Reptiles. Foothill shrub and grassland habitats in the impact area of influence provide good habitat for reptiles. Lizards common to these habitats include northern sagebrush lizard (*Sceloporus graciosus*), northern side-blotched lizard (*Uta stansburiana*), Great Basin (western) whiptail (*Cnemidophorus tigris*) and Salt Lake horned lizard (*Phrynosoma douglassi ornatum*). Snakes occur most commonly near water in canyons and near valley wetlands. Species likely to occur in the impact area of influence include wandering garter snake (*Thamnophis elegans vagrans*), Great Basin gopher snake (*Pituophis melanoleucus deserticola*) and western yellow-bellied racer (*Coluber constrictor mormon*).

3.5.5.2.3 Raptors. Wetlands, agricultural lands, grasslands and deciduous woodlands in the Diamond Fork drainage provide important habitat for raptors. Several are known to nest in the impact area of influence, including northern harrier (*Circus cyaneus*) and great horned owl (*Bubo virginianus*). Other raptors known to be present include turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*Buteo lagopus*), osprey (*Pandion haliaetus*) and American kestrel (*Falco sparverius*) (Shields and Moretti 1982, Smith and Greenwood 1983b).

3.5.5.2.4 Upland Game Birds. Ring-necked pheasants use agricultural lands and perennial grasslands as their primary habitat. However, nesting occurs most frequently in alfalfa and sagebrush (Smith and Greenwood 1983a). Habitats frequented by pheasants during winter include railroad rights-of-way; sagebrush or rabbitbrush; densely vegetated agricultural fields and fence rows; haystacks; willows and other deciduous trees. Mourning doves (*Zenaida macroura*) occur most frequently during summer on agricultural lands and, to a lesser extent, in pasture and sagebrush. Yearly migration causes a rapid decline in mourning dove numbers each fall with the onset of colder temperatures and increased precipitation. Chukar (*Alectoris chukar*) are known to occupy sagebrush-cheatgrass areas on steep slopes (Shields and Moretti 1982). Wild turkeys (*Meleagris intermedia*) have been introduced into the Diamond Fork drainage and roost and forage in side canyons, such as Red Hollow, and in meadows along riparian woodlands. Diamond Campground is a main winter roosting area for wild turkeys.

3.5.5.2.5 Passerine (Perching) Birds and Related Species. A variety of passerine birds and related species, including many neotropical migrants, occupy habitats in the impact area of influence. Conversion of native grasslands and brushlands to agriculture has likely had a profound adverse effect on these species compared to historical use patterns. Riparian habitats adjacent to streams, sloughs, lakes and ponds support species such as Bewick's wren (*Thryomanes bewickii*), hermit thrush (*Catharus guttatus*), warbling vireo (*Vireo gilvus*), yellow warbler (*Dendroica petechia*), rufous-sided towhee (*Pipilo erythrophthalmus*), song sparrow (*Melospiza melodia*) and northern oriole (*Icterus galbula*). Birds found in marshes and in other wetland areas include bank swallow (*Riparia riparia*), red-winged blackbird (*Agelaius phoeniceus*) and yellow-headed blackbird (*Xanthocephalus xanthocephalus*). Birds characteristic of foothill shrublands and woodlands include broad-tailed hummingbird (*Selasphorus platycercus*), northern flicker (*Colaptes auratus*), tree swallow (*Tachycineta bicolor*), scrub jay (*Aphelocoma coerulescens*), American robin (*Turdus migratorius*) and white-crowned sparrow (*Zonotrichia leucophrys*). Birds representative of open grassland and agricultural lands include western kingbird (*Tyrannus verticalis*), horned lark (*Eremophila alpestris*), black-billed magpie (*Pica pica*), common raven, European starling, vesper sparrow (*Pooecetes gramineus*), lark sparrow (*Chondestes grammacus*), western meadowlark (*Sturnella neglecta*) and American goldfinch (*Carduelis tristis*).

3.5.5.2.6 Small Mammals. A variety of small mammals are found throughout the impact area of influence, including vagrant shrew (*Sorex vagrans*), various bats (*Myotis* sp.), Botta's pocket gopher (*Thomomys bottae*), rock squirrel (*Spermophilus variegatus*), deer mouse (*Peromyscus maniculatus*) and meadow vole (*Microtus pennsylvanicus*).

3.5.5.2.7 Mammalian Predators. Mammalian predators occupy different wildlife habitats in the impact area of influence where suitable conditions are present (e.g., mountain brush, wetlands or sagebrush/grass communities). Representative species include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), long-tailed weasel (*Mustela* *frenata*), mink (*Mustela vison*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), American black bear (*Ursus americanus*), bobcat (*Felis rufus*) and cougar (*Felis concolor*). In the Diamond Fork drainage, the Red Hollow area has been documented in previous years to be black bear habitat and may be critical to bears currently in the mountain range. Female black bears and their cubs have occupied the area as recently as 1994 (Sakaguchi 1997). The Red Hollow area is important not only for denning, but for late fall feeding and early spring emergence. The area features abundant grasses that come up early in the spring, and usually has a good acorn crop that supports fall feeding.

3.5.5.2.8 Big Game. Three species of mammals classified by the Utah Division of Wildlife Resources as "big game" occur in the impact area of influence: moose (*Alces alces*), elk (*Cervus elaphus*) and mule deer (*Odecoileus hemionus*).

The foothills in the Diamond Fork drainage serve as important winter range for large numbers of mule deer and elk and a small population of moose that summer in the Wasatch Mountains. Of the plant and wildlife habitat communities in the impact area of influence, big-game winter range habitat is largely comprised of oak woodland, mountain brush and sagebrush/grass. Big game normally occupy winter range in the impact area of influence between December 1 and April 15 (Smith and Greenwood 1983a), but their presence is highly dependent on snow cover at higher elevations and may fluctuate considerably from year to year (Utah Division of Wildlife Resources 1994a, Fairchild 1995). Prior to agricultural and urban expansion and completion of I-15, big-game winter range extended from the foothills along the Wasatch Mountains, across the valley floor to Long Ridge and other low-elevation hills to the west. Although I-15 includes crossings to accommodate big game movement, most wintering mule deer and elk, and possibly some of the remaining bighorn sheep, now concentrate in the narrow strip of foothill habitat between the Wasatch Mountains and I-15 (Utah Division of Wildlife Resources 1993). The Utah Division of Wildlife Resources has designated most of these lands as critical, high-priority, substantial value, or limited value winter range habitat based primarily on their distribution, abundance, forage value and availability to wintering animals. Map 3-1 shows the locations of designated critical big-game winter range habitat in the Diamond Fork drainage.

3.5.5.2.9 Wetland-Associated Wildlife. The wetland communities in the impact area of influence provide a range of habitat values for a diverse population of amphibians, reptiles, birds and mammals. Examples include the Utah tiger salamander, western chorus frog, western leopard frog, woodhouse's toad, bullfrog, wandering garter snake, double-crested cormorant, Canada goose, green-winged teal, mallard, common snipe, great blue heron, Sandhill crane, northern harrier, California gull, tree swallow, red-winged blackbird, western meadowlark, vagrant shrew, meadow vole, long-tailed weasel, mink, striped skunk and coyote.

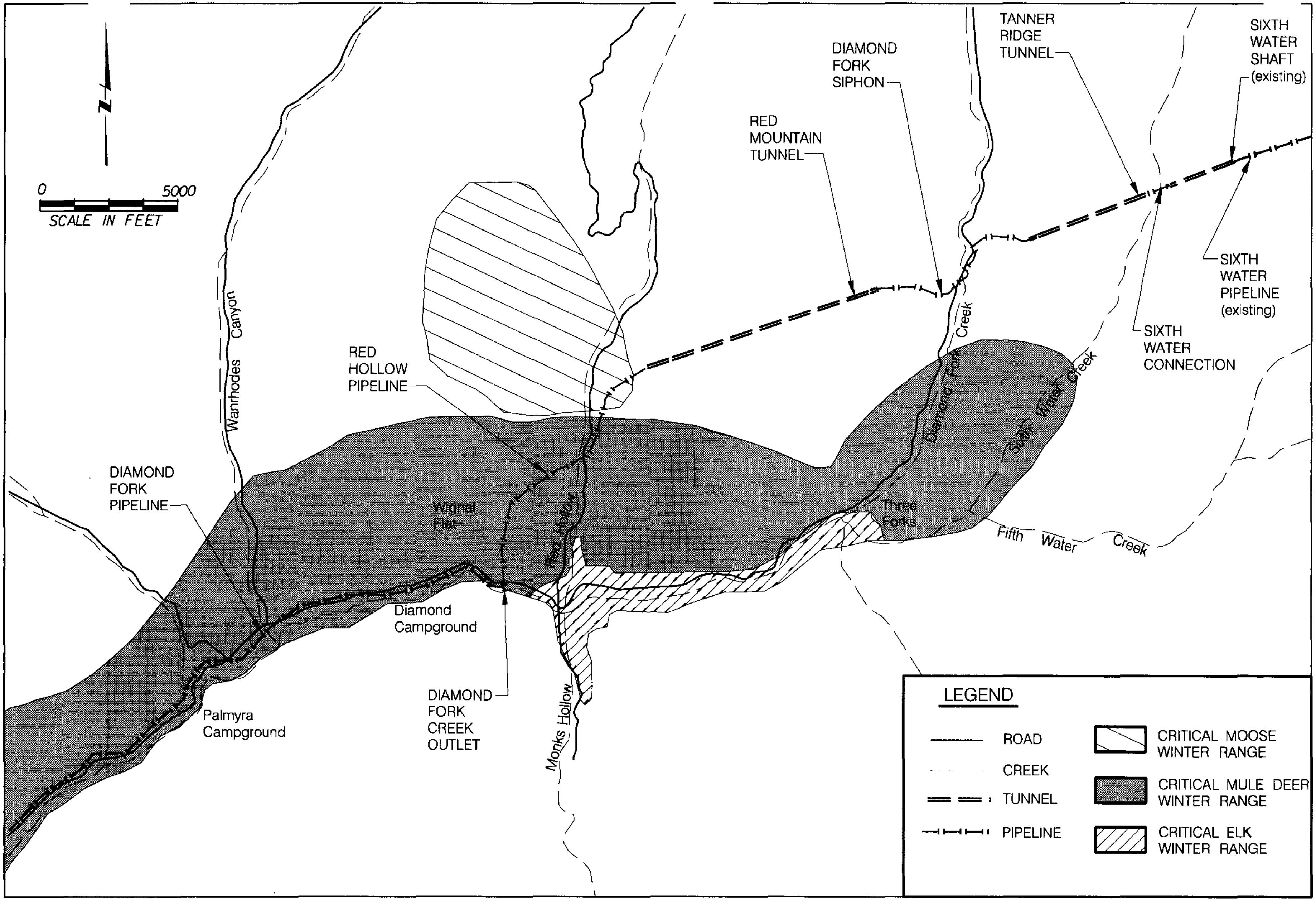
3.5.6 Impact Analysis

3.5.6.1 Methodology

The following categories were used to identify impacts to wildlife that would result from the Proposed Action and No Action Alternative:

- **Construction Impacts.** Construction activities that would directly impact wildlife include removal and disturbance of vegetation, soil and other habitat elements; disturbance to wildlife that could alter their normal behavior; and disturbance that could result in mortality and/or diminished health of animals. Indirect impacts include increased predation from loss of escape cover.

- **Operation Impacts.** Operational activities that would impact wildlife include periodic surveys and maintenance of facilities, weed abatement, increased access for recreation, and changes in land and water management.



Map 3-1

Critical Big Game Habitat

3.5.6.2 Significance Criteria

Potential impacts to wildlife resources from construction and operation of the Proposed Action and No Action Alternative were considered significant if any one of the following conditions should occur:

- Activities that cause substantial disturbance to wildlife. A substantial disturbance would destroy a large area of utilized habitat, disturb or displace a resident population (sub-population), or result in losses of large numbers of individuals of the species. Substantial disturbance is based on the status, population dynamics, behavior, habitat availability and habitat quality for each species or species group (e.g., upland game birds) relative to the type, intensity and duration of a specific impact. For example, species that are locally common (e.g., Brewer's blackbird) or have a high reproductive potential and the ability to rapidly recolonize disturbed sites (e.g., deer mouse) would not be significantly affected by impacts of the Proposed Action or No Action Alternative in the same manner as endangered species.

- Activities cause the loss (temporary or permanent) or unavailability of "critical" big-game winter range habitat (as officially designated by the Utah Division of Wildlife Resources) from December 1 to April 15.

3.5.6.3 Potential Impacts Eliminated From Further Analysis

None.

3.5.6.4 Proposed Action

3.5.6.4.1 Impacts During Construction.

3.5.6.4.1.1 Vegetation/Wildlife Habitats. A total of 138.3 acres of land would be disturbed during construction o. the Proposed Action (Chapter 1, Section 1.7.6, Table 1-33). Of this area, 5.8 acres would be permanently disturbed and the remainder would be revegetated in accordance with the *Standard Operating Procedures* described in Chapter 1, Section 1.7.8. Temporary disturbance of this amount of wildlife habitat would not be considered a significant impact because the disturbance would occur incrementally over a 3-1/2-year period; the majority of habitat would be restored to preconstruction conditions; and the affected habitats are abundant in the impact area of influence. The permanent loss of 5.8 acres of wildlife habitat would not be a substantial acreage loss compared to available habitat in the impact area of influence.

3.5.6.4.1.2 General Wildlife. Clearing, grading and trenching for the Proposed Action would result in direct mortality to certain amphibians and small mammals that are unable to quickly disperse from construction areas. Other animals would escape construction areas and be displaced into surrounding habitats, where available. Disturbed areas that are revegetated following construction would be recolonized through immigration of new animals from adjacent habitats within 1 to 3 years. These impacts on amphibians and small mammals are not considered significant because most of the species that would be affected are locally and regionally common; construction would occur incrementally over a 3-1/2-year period; relatively few individuals of any species would be affected; and the continued existence of species in the impact area of influence would not be substantially disturbed.

Open trenches would create a temporary hazard to amphibians and small mammals and a barrier to their movement. However, several strategies would be used to reduce this impact, including limiting the length of open trench to no more than 600 feet at any time. Trenches would also be covered at the end of each day and inspected for trapped animals prior to backfilling.

Specific construction-related impacts to reptiles, waterbirds, raptors, upland game birds, passerine birds and relat species, mammalian predators, and big game are presented below. It is the policy of the CUWCD to have an environmental coordinator at all construction sites to ensure that construction is carried out in an environmentally sensitive manner.

Reptiles. During construction, it is possible that reptile dens may be encountered along the alignment of the Proposed Action. These dens could be destroyed during construction. To avoid impacts to reptile dens, the CUWCD would comply with provisions of Certificates of Registration issued by the Utah Division of Wildlife Resources, which require that the agency be notified when reptile dens are encountered to allow collection of individuals and eggs in the den (Sakaguchi 1997).

Raptors. Construction could temporarily disturb nesting raptors within 1 mile of Proposed Action facilities. Construction disturbance could result in nest abandonment, loss of eggs and young, and a resulting short-term decline in recruitment of raptor populations. Raptors commonly found in the Diamond Fork drainage, such as red-tailed hawks, prefer to nest in large trees in riparian habitat and forage in grasslands. Such habitats in the Diamond Fork drainage are relatively undisturbed. Temporary and permanent loss of foraging habitat would not be a significant impact since grassland habitats are common in the area.

Upland Game Birds. Construction of the Proposed Action would result in permanent and temporary impacts on foraging habitat for upland game birds, particularly wild turkeys, in the impact area of influence. The loss of foraging habitat (primarily sagebrush/grass, mountain brush and agricultural lands) would not be significant since suitable foraging habitat for these species could be found outside of construction areas. Clearing and grading could result in the loss of nests, eggs and young of the few birds that may nest in construction sites. These impacts would not cause a substantial disturbance to upland game bird populations since few birds would be affected, and habitats in the proposed construction sites are of low value to most upland game birds. In addition, temporarily disturbed habitat would be regraded and reseeded following completion of construction in accordance with the *Standard Operating Procedures* outlined in Chapter 1, Section 1.7.8.

Passerine Birds and Related Species. Construction of the Proposed Action would result in both permanent and temporary loss of breeding and foraging habitat for passerine birds and related species in the impact area of influence. The loss of foraging habitat in wetlands, mountain brush and sagebrush/grass habitats would not be significant since suitable foraging habitat for these species is abundant in the region. Disturbance of nesting birds could result from clearing and grading operations and cause the loss of a limited number of nests, eggs and young. These impacts would not be significant since few birds would be affected; most of the species affected are locally and regionally common; and the continued existence of these species in the impact area of influence would not be substantially disturbed.

Mammalian Predators. Most mammalian predators in the impact area of influence, such as skunks and coyotes, have large home ranges and are highly mobile, thus enabling them to avoid construction activities. However, construction disturbances may cause individuals to relocate to less suitable or already occupied habitats. Impacts on these species would not be significant since few individuals would be affected; most are locally common and widespread; and prey populations would not be substantially disturbed.

Black bear habitat in the Red Hollow area of the Diamond Fork drainage could be impacted by construction associated with the Red Mountain Tunnel outlet. Construction disturbances could disrupt foraging activity and denning behavior and cause displacement into adjacent ranges, which could result in increased competition between individuals.

Big Game. Construction of the Proposed Action would result in impacts to critical winter range habitat (Table 3-17) for mule deer, elk and moose in the Diamond Fork drainage. The majority of the disturbed area would be revegetated and disturbance would occur over a 3-1/2-year period. Tunnel drilling, pipeline excavation and construction traffic would increase noise levels in critical big-game winter range. The expected temporary and permanent loss of critical winter range habitat would be a significant impact.

Table 3-17
Acres of Temporary and Permanent Disturbance to Critical Big Game Winter Range Habitat Resulting From the Proposed Action

Critical Winter Range	Location by Feature	Temporary Disturbance (acres)	Permanent Disturbance (acres)
Mule Deer	Red Hollow Pipeline and connection to Diamond Fork Pipeline, Diamond Fork Creek Outlet	30.0	0.7
Moose	Red Hollow Pipeline and connection to Diamond Fork Pipeline, Permanent Access Road to Red Mountain Tunnel Outlet Portal, Red Mountain Tunnel Spoil Pile	8.6	2.6
Elk	Monks Hollow Staging Area (#3)	7.0	0.0
Elk and Mule Deer	Spanish Fork River Outlet from Diamond Fork Pipeline	7.7	0.5
TOTALS		**53.3**	**3.8**

Big-game species use the upper portion of Red Hollow (near the proposed Red Mountain Tunnel outlet and upper Red Hollow pipeline) as a migration route in early spring and late fall. Construction may impact the route during fall and spring migration by disturbing wildlife moving through the corridor. However, most construction would occur at other times of the year. Snow in the upper Red Hollow area from late fall through winter and early spring creates conditions that are not conducive to construction. During this time of year, it is anticipated that tunnel boring would continue, but that most other construction would be stopped or greatly reduced. Construction from late fall through early spring would therefore be localized at the Red Mountain Tunnel portal and would not be expected to cause substantial disturbance to big game.

3.5.6.4.1.3 Wetland-Associated Wildlife. Construction of the Proposed Action would temporarily disturb 2.01 acres of wetland and permanently disturb 0.04 acres of wetland habitat (see Chapter 3, Section 3.4). These impacts would not be considered significant because most of the species that would be affected are locally and regionally common; relatively few individuals of any species would be affected; and the continued existence of species in the impact area of influence would not be substantially disturbed.

3.5.6.4.2 Impacts During Operation

3.5.6.4.2.1 Vegetation/Wildlife Habitats. Weed abatement would be conducted to inhibit the establishment of vegetation in construction rights-of-way. This would not affect any important wildlife habitats, would not be measurable, and would not be a significant impact.

3.5.6.4.2.2 General Wildlife. Operation of the Proposed Action could impact wildlife by increasing human activity in wildlife habitat areas in the impact area of influence. Maintenance (e.g., weed control, facility site inspections) would occur periodically, but would not cause substantial disturbance to wildlife. In addition, the expected increase in angler days and the resulting increase in traffic could result in an increased disturbance to wildlife and increased vehicle-wildlife collisions. These impacts are not expected to be significant because most of the species that would be affected are locally and regionally common; relatively few individuals of any species would be affected; and the continued existence of species in the impact area of influence would not be substantially disturbed. As noted in Chapter 1, the Red Hollow Road would continue to be gated and locked, preventing motorized public access.

3.5.6.4.2.3 Big Game. Impacts on big game could be caused by operation and maintenance associated with the Proposed Action. These impacts would be of a disturbance nature, especially if winter maintenance activity would be required in the Red Hollow area. Elk and deer in a weakened winter condition could be forced to move and further weaken because of the activity. It is expected that required maintenance of the proposed features would be minimal, therefore substantial disturbance to wildlife would not be expected. Operation personnel would be instructed to minimize disturbance to herds as much as possible if winter maintenance was required.

3.5.6.4.2.4 Wetland-Associated Wildlife. Operation and maintenance of the Proposed Action could impact wetland-associated wildlife by increasing human activity in wildlife habitat areas in the impact area of influence. Maintenance of facilities would occur periodically, but would not cause a substantial disturbance to wetland-associated wildlife.

Operation of the Proposed Action would cause the permanent conversion of 1.5 acres of Spikerush Mudflat along Spanish Fork River above Spanish Fork Diversion Dam to Wet Meadow. Since wetland habitat would be maintained, and the affected acreage is small, no substantial disturbance to wildlife would be expected.

3.5.6.4.3 Impact Summary. The temporary and permanent loss of critical big-game winter range habitat would be a significant impact.

3.5.6.5 No Action Alternative

3.5.6.5.1 Impacts During Construction.

3.5.6.5.1.1 Vegetation/Wildlife Habitat. During construction of the No Action Alternative, 95.4 acres of land would be disturbed (Chapter 1, Section 1.7.6, Table 1-34). Of this area, 30.1 acres would be permanently disturbed and the remainder would be revegetated in accordance with the *Standard Operating Procedures* given in Chapter 1, Section 1.7.8. Temporary disturbance of this amount of wildlife habitat would not be considered a significant impact because the disturbance would occur incrementally over a 3-year period; most of the habitat would be restored to pre-construction conditions; and the affected habitats are abundant in the impact area of influence. The permanent loss of 30.1 acres of wildlife habitat would not be a substantial loss when compared to available habitat in the impact area of influence.

3.5.6.5.1.2 General Wildlife. For trenching operations, impacts would be the same as for the Proposed Action. Construction of Three Forks Dam and Reservoir could also result in direct mortality to certain amphibians and small mammals that are unable to quickly disperse from construction areas. These impacts would not be considered significant because most of the species that would be affected are locally and regionally common; relatively few individuals of any species would be affected; and their continued existence in the impact area of influence would not be substantially disturbed.

Specific construction-related impacts to reptiles, waterbirds, raptors, upland game birds, passerine birds and related species, mammalian predators, and big game are presented below.

Reptiles. Same as the Proposed Action.

Raptors. Same as the Proposed Action.

Upland Game Birds. Same as the Proposed Action.

Passerine Birds and Related Species. Same as the Proposed Action.

Mammalian Predators. Most mammalian predators in the impact area of influence have large home ranges and are highly mobile, thus enabling them to avoid construction. However, construction disturbances may cause individuals to relocate to less suitable or already occupied habitats. However, impacts to these species would not be significant since few individuals would be affected, most are locally common and widespread, and prey populations would not be substantially disturbed.

Big Game. Construction of the No Action Alternative would result in impacts to critical winter range habitat for mule deer and elk in the Diamond Fork drainage. (Table 3-18) Most of the area would be revegetated and disturbance would occur over a 3-year period. Pipeline excavation, reservoir construction and traffic associated with construction would increase noise levels in critical big-game winter range. According to the significance criteria, the expected temporary or permanent loss of critical big-game winter range habitat is considered a significant impact.

Table 3-18

Acres of Temporary and Permanent Disturbance to Critical Big Game Winter Range Habitat Resulting From the No Action Alternative

Critical Winter Range	Location by Feature	Temporary Disturbance (acres)	Permanent Disturbance (acres)
Elk	Three Forks Dam and Reservoir, Diamond Fork Pipeline Extension, Red Hollow Staging Area, Access Road Fill	44.3	8.9
Mule Deer	Three Forks Reservoir, Diamond Fork Pipeline, Permanent Access Road	11.3	20.7
Elk and Mule Deer	Spanish Fork River Outlet from Diamond Fork Pipeline	7.7	0.5
TOTALS		**63.3**	**30.1**

3.5.6.5.1.3 Wetland-Associated Wildlife. Construction of the No Action Alternative would result in the temporary loss of 9 acres of wetland habitat and the permanent loss of 0.5 acres of wetland habitat (see Chapter

Section 3.4). These impacts would not be considered significant because most of the species that would be affected are locally and regionally common; relatively few individuals of any species would be affected; and the continued existence of species in the impact area of influence would not be substantially disturbed.

3.5.6.5.2 Impacts During Operation.

3.5.6.5.2.1 Vegetation/Wildlife Habitats. Same as the Proposed Action.

3.5.6.5.2.2 General Wildlife. Same as the Proposed Action. In addition, some individuals could potentially become trapped in the reservoir and drown. This would not be expected to affect a large number of individuals and would not be considered a significant impact.

3.5.6.5.2.3 Big Game. Same as the Proposed Action. In addition, some individuals could potentially become trapped in the reservoir and drown. This would not be expected to affect a large number of individuals and would not be considered a significant impact.

3.5.6.5.2.4 Wetland-Associated Wildlife. Operation of the No Action Alternative would cause the permanent loss of 9.1 acres of riparian shrub and conversion of 1.5 acres of Spikerush Mudflat along the Spanish Fork River (from Diamond Fork Creek confluence to Spanish Fork Diversion Dam) to Wet Meadow. However, the construction of Three Forks Reservoir would provide 14 acres of new open-water wetland habitat type that could be used by waterbirds.

3.5.6.5.3 Impact Summary. The permanent loss of critical big-game winter range and wetlands would be a significant impact.

3.6 Aquatic Resources

3.6.1 Introduction

This section addresses potential impacts of construction and operation of the Proposed Action and No Action Alternative on the following aquatic resources categories:

- Sport fish and their habitat
- Non-sport fish and their habitat
- Other aquatic resources

The information and analysis provided in this section have been summarized from the Draft *Aquatic Resources Technical Report* (CUWCD 1998a) for the Spanish Fork-Nephi Irrigation System Draft Environmental Impact Statement and from an *Aquatic Resources Technical Memorandum* (CUWCD 1999c). Section 3.7, Special-Status Species, describes the potential impacts on special-status fish (species having federal or State status as threatened, endangered, or species of special concern) within the impact area of influence.

3.6.2 Issues Eliminated From Further Analysis

None.

3.6.3 Issues Addressed in the Impact Analysis

The issues addressed in this analysis are potential impacts on fish and invertebrates found in streams in the impact area of influence.

3.6.4 Description of Impact Area of Influence

The impact area of influence consists of waterways located in southern Utah County that could be affected by construction and operation of the Proposed Action and No Action Alternative. The fishery resources in the impact area of influence, including historical fisheries, are confined to the following perennial streams (see Table 3-19 for more detailed reach descriptions):

- Sixth Water Creek from the Strawberry Tunnel outlet downstream to Diamond Fork Creek (Three Forks)

- Diamond Fork Creek from Three Forks to its confluence with Spanish Fork River

- Spanish Fork River from the confluence of Diamond Fork Creek downstream to Spanish Fork Diversion Dam

- Spanish Fork River from Spanish Fork Diversion Dam downstream to Utah Lake

Table 3-19
Description of Stream Reaches on Sixth Water Creek, Diamond Fork Creek and Spanish Fork River

Major Stream Designations	Component Reaches	Reach Description	Reach Length (miles)
Sixth Water Creek	Reach 1 Sixth Water Creek	Strawberry Tunnel outlet downstream to the Sixth Water Aqueduct	5.87
	Reaches 2 and 3 Sixth Water Creek	Sixth Water Aqueduct downstream to Three Forks	3.60
Diamond Fork Creek	Reach 1 Upstream of Three Forks*	Diamond Fork Creek from the proposed Diamond Fork Siphon Crossing downstream to Three Forks	2.27
	Reach 2 Three Forks to Diamond Fork Creek Outlet (Red Hollow)	Diamond Fork Creek from Three Forks downstream to Diamond Fork Creek Outlet (Red Hollow)	2.54
	Reach 3 Segment 1	Diamond Fork Creek from Diamond Fork Creek Outlet (Red Hollow) to just above Diamond Campground	1.3
	Segment 2	Diamond Fork Creek from just above Diamond Campground downstream to Brimhall Canyon	2.2
	Reach 4 Segment 3	Diamond Fork Creek from Brimhall Canyon to the Spanish Fork River	3.7
Spanish Fork River (Above Spanish Fork Diversion Dam)	Reach 1 Weighted average of microhabitat reaches for entire segment	Spanish Fork River from the mouth of Diamond Fork Creek downstream to Spanish Fork Diversion Dam	4.2
Spanish Fork River (Below Spanish Fork Diversion Dam)	Reach 1 Above East Bench Diversion	Spanish Fork River from Spanish Fork Diversion Dam downstream to East Bench Diversion	1.6
	Reach 2 Below East Bench Diversion	Spanish Fork River from East Bench Diversion to Mill Race Diversion	2.8
	Reach 3 Mill Race Diversion to Lake Shore Diversion Reach 4 Lake Shore Diversion to Huff Dam Reach 5 Huff Dam to Utah Lake	Spanish Fork River from Mill Race Diversion to Utah Lake	15.6

*Three Forks is the confluence of Diamond Fork Creek, Sixth Water Creek, and Cottonwood Creek (a small and sometimes intermittent stream).

3.6.5 Affected Environment (Baseline Conditions)

This section describes the fish and invertebrates that could be affected by construction and operation of the Proposed Action and No Action Alternative. The affected environment for aquatic resources includes algae, aquatic plants and other lower trophic-level aquatic biota, as well as native and sport fish, water quality and instream flow. The description of the affected environment focuses on sport fish (brown, cutthroat and rainbow trout, and channel catfish and black bullhead) because they indicate the overall health of an aquatic system and have recreational and economic value. Where no established sport fisheries exist, the aquatic resources description focuses on native fish. (cutthroat, leatherside chub, Utah chub, speckled dace, redside shiner, mountain sucker and mottled sculpin)

Since habitat requirements such as temperatures and current velocities are often similar for both non-native and native trout, focusing on sport fish habitat does not necessarily exclude natives. Enhancing or degrading non-native trout habitat would usually create a roughly similar benefit or adverse effect on the habitat for native fish. However, it is recognized that non-native trout compete with the native cutthroat and both the non-native trout and cutthroat prey on native minnows such as the leatherside chub.

Baseline habitat conditions are the those that existed from 1994 through 1998 when the field studies and literature review were performed. Baseline conditions were determined through a combination of direct field observations and sampling, review of published literature and agency file data on resources in the area, and discussions with knowledgeable state and federal agency personnel. Baseline flow conditions for Sixth Water Creek upstream of Sixth Water Aqueduct consist of natural streamflows and Strawberry Tunnel seepage after start-up of Syar Tunnel and Sixth Water Aqueduct in 1996. Baseline flow conditions for the rest of the stream segments in the impact area of influence are based on the historical flow record of 44 years (CUWCD 1999d).

Table 3-20 summarizes the aquatic habitats that would be affected by the Proposed Action and No Action Alternative. Table 3-21 lists fish species that would be potentially affected by the Proposed Action and No Action Alternative.

Table 3-20
Aquatic Environment Affected by the Proposed Action and No Action Alternative

Waterway	Proposed Action	No Action Alternative
Sixth Water Creek	C; IO	C; O
Cottonwood Creek	NA	C; O
Diamond Fork Creek above Three Forks	C	C; O
Diamond Fork Creek from Three Forks to Diamond Fork Creek Outlet (Red Hollow)	C; IO	O
Diamond Fork Creek from Diamond Fork Creek Outlet (Red Hollow) to Spanish Fork River	C; IO	O
Spanish Fork River from Diamond Fork Creek to Spanish Fork Diversion Dam	C; IO	O
Spanish Fork River from Spanish Fork Diversion Dam to Utah Lake	C; IO	O; ARF

NOTES:

C = Construction; IO = Interim Operation of the Proposed Action; O = Operation of the No Action Alternative; ARF = Agriculture Return Flows; NA = Not Applicable

Table 3-21 Fish Species Potentially Affected by the Proposed Action and No Action Alternative			
Sport Fish		Non-Sport Fish	
Common Name	Scientific Name	Common Name	Scientific Name
brown trout	*Salmo trutta*	leatherside chub*	*Gila copei*
cutthroat trout*	*Oncorhynchus clarki*	Utah chub*	*Gila atraria*
rainbow trout	*Oncorhynchus mykiss*	speckled dace*	*Rhinichthys osculus*
channel catfish	*Ictalurus punctatus*	longnose dace	*Rhinichthys cataractae*
black bullhead	*Ictalurus melas*	fathead minnow	*Pimephales promelas*
Walleye	*Stizostedion vitreum*	common carp	*Cyprinus carpio*
white bass	*Morone chrysops*	redside shiner*	*Richardsonius balteatus*
		mountain sucker*	*Catostomus platyrhynchus*
		mottled sculpin*	*Cottus bairdi*
		Utah sucker*	*Catostomus ardens*

*Native fish

3.6.5.1 Sixth Water Creek

3.6.5.1.1 Physical/Chemical Characteristics and Instream Habitat. Approximately 9.5 miles of Sixth Water Creek have been heavily influenced by irrigation water releases from Strawberry Reservoir since 1913. From 1913 through 1995, irrigation releases from Strawberry Tunnel entered Sixth Water Creek; since spring of 1996, these releases have occurred lower in the creek via the Syar Tunnel and Sixth Water Aqueduct. Even after irrigation flows through Strawberry Tunnel ceased, it still provides a continuous 5 cfs of seepage that supplements the natural flows of 2 to 18 cfs in the 5.9 miles of Sixth Water Creek above Sixth Water Aqueduct. Before 1996 (when Strawberry Tunnel was still delivering irrigation flows), flows up to 460 cfs scoured the Sixth Water Creek channel above Sixth Water Aqueduct and degraded its fish habitat.

Since 1996, these flows have bypassed this reach and now enter through the Sixth Water Aqueduct 3.6 miles above the creek's mouth. Sixth Water Creek (below the Sixth Water Aqueduct) has continued to be scoured by the same irrigation flows that were previously discharged from Strawberry Tunnel (see Table 3-1 in Chapter 3, Section 3.2.5). These unnaturally high and long irrigation releases have scoured most of the channel, degraded its value as fish habitat, and increased streambank erosion and sediment input.

The Sixth Water Creek channel bed is dominated by bedrock and boulders in the high gradient reach upstream of the Sixth Water Aqueduct and by small boulders and cobble in medium gradients of the lower reach. Substrate suitable for trout spawning is mostly absent from the reach above Sixth Water Aqueduct and limited in the reach below the aqueduct. Pool habitat with sufficient depth and cover to support adult trout and provide winter habitat is limited throughout most of this stream.

Irrigation releases from Strawberry Reservoir determine water temperatures in Sixth Water Creek from late May through September. Baseline temperature characteristics for Sixth Water Creek were extracted from Table 3-7 in Chapter 3, Section 3.3.5.1, using the monthly average temperatures from Strawberry Reservoir releases below 33-foot.

Water temperature in Sixth Water Creek above Sixth Water Aqueduct from June through September average 54°F, with a maximum average of 55°F. Below Sixth Water Aqueduct the temperature averages 64° F, with a maximum monthly average of 67°F. Water quality is generally good throughout the 3.6 miles of Sixth Water Creek below Sixth Water Aqueduct, but instream habitat quality is reduced by turbidity and sedimentation from erosion during rainstorms and high flows. Selenium concentrations in Sixth Water Creek above Sixth Water Aqueduct also exceed the chronic aquatic life standards.

3.6.5.1.2 Fish Species Composition. In the mid-1970s, aquatic resource sampling found the following fish species in Sixth Water Creek below Sixth Water Aqueduct: Bonneville cutthroat trout, brown trout, rainbow trout, mountain sucker, longnose dace, redside shiner and mottled sculpin. In 1990, an accidental release of rotenone-treated water from Strawberry Reservoir killed most of the fish in Sixth Water Creek. Since 1991 the Utah Division of Wildlife Resources has periodically stocked 8,000 fingerling brown trout to restore the trout fishery of this creek (Sakaguchi 1996). Fish sampling conducted in 1994 and 1996 at three locations in Sixth Water Creek found brown trout standing crops of 72 to 76 pounds per acre, but identified no other trout species (Utah Division of Wildlife Resources 1994b and 1996). In August 1997, the Utah Division of Wildlife Resources electroshocked Sixth Water Creek above Rays Valley Bridge and below Dip Vat Creek and found trout standing crops of 125 and 301 pounds per acre, respectively (Wiley and Thompson 1997a). The difference in trout biomass between these two sites may be due to sediment input from a highly erosive area between Dip Vat Creek and Rays Valley Bridge or the decreased streamflows under operation of Syar Tunnel and Sixth Water Aqueduct.

The aquatic invertebrate community in all portions of Sixth Water Creek is comprised largely of mayflies, chironimid midge larvae and oligochaete worms. This community is supported by the organic-rich waters from Strawberry Reservoir (irrigation releases and Strawberry Tunnel seepage) that carry phytoplankton and other organic materials (IABAT 1989).

3.6.5.2 Diamond Fork Creek Above Three Forks

3.6.5.2.1 Physical/Chemical Characteristics and Instream Habitat. The 2.27 miles of Diamond Fork Creek from the proposed Diamond Fork Siphon crossing to Three Forks has natural flows ranging from an average peak flow of 59 cfs in May to a late summer flow of 5 cfs. During drought years, such as the early 1970s, summer flows can be less than 1 cfs. Stream gradient is moderately steep, and the primary substrates are boulders and cobble in a habitat dominated by riffles and rapids. The stream channel is 10 to 15 feet wide and supports a strip of often dense riparian vegetation.

A sulfur spring discharges 1 to 2 cfs of warm, mineralized water to the creek approximately 600 feet upstream of the Diamond Fork Siphon crossing on Diamond Fork Creek. Based on an examination of instream substrates and aquatic invertebrates, it appears that water quality and aquatic habitat in Diamond Fork Creek is degraded by the sulfur spring for approximately 800 feet downstream; the length of the impacted area would vary with seasonal flow variations. The sulfur spring has no apparent adverse effect on fish in most of Diamond Fork Creek in the impact area of influence.

3.6.5.2.2 Fish Species Composition. Fish sampling in the mid-1970s found the first 0.2 mile of Diamond Fork Creek above Three Forks to have 92 pounds of brown, cutthroat and rainbow trout per acre (USBR 1990). Based on current information on streamflow and instream habitat characteristics, a Binns Habitat Quality Index (HQI) predicts a trout standing crop of 108 pounds per acre for the 2.27 miles of Diamond Fork Creek above Three Forks. Although the short section below the sulphur spring has an aquatic invertebrate population heavily dominated by filter-feeding black fly larvae (*Simuliidae*, a family tolerant of organic enrichment), most of the creek has a healthy and diverse population of low-tolerance taxa of stoneflies, mayflies and caddis flies.

Native, non-trout fish species also reside in this reach of Diamond Fork Creek, although current population levels are generally unknown. These include redside shiner, mottled sculpin, leatherside chub, speckled dace, longnose dace and mountain sucker (Ellsworth and Kelleher 1998).

3.6.5.3 Diamond Fork Creek From Three Forks to Red Hollow

3.6.5.3.1 Physical/Chemical Characteristics and Instream Habitat. This 2.54-mile stretch of Diamond Fork Creek receives irrigation flows from Strawberry Reservoir via Sixth Water Creek from late April through September. The average monthly baseline flows for this reach range from 12 to 18 cfs in late fall and winter and average 128 to 295 cfs from May through September. Historical water temperatures (June through September) for this reach average 54°F, with a maximum average of 55°F (CUWCD 1999f). The stream gradient is moderate, and riffles and rapids dominate along with substrates of small to medium boulders and cobble. The stream channel lies in a relatively narrow canyon and is typically 20 to 30 feet wide.

3.6.5.3.2 Fish Species Composition. While this reach has not been sampled since the 1990 release of Strawberry Reservoir's rotenone-treated water, the Utah Division of Wildlife Resources electroshocked Diamond Fork Creek approximately 1.5 miles downstream of this reach at Red Hollow in fall 1997. The trout population there was estimated at 73 pounds per acre — mostly brown trout with fewer cutthroat and rainbow trout (Wiley and Thompson 1997b). Trout biomass in Sixth Water Creek just above Three Forks was estimated at 72 pounds per acre in 1994 (Utah Division of Wildlife Resources 1994b). Therefore, 72 pounds per acre is a reasonable estimate of trout biomass in this reach between Three Forks and the proposed Diamond Fork Creek Outlet.

Native, non-trout fish species also reside in this reach of Diamond Fork Creek, although current population levels are generally unknown. Native species include redside shiner, mottled sculpin, leatherside chub, speckled dace, longnose dace and mountain sucker (Ellsworth and Kelleher 1998).

3.6.5.4 Diamond Fork Creek From Red Hollow to Spanish Fork River

3.6.5.4.1 Physical/Chemical Characteristics and Instream Habitat. This 7.2-mile reach has three distinct geomorphic segments. Segment 1 extends 1.3 miles downstream to just above the Diamond Campground. This entrenched, single channel has low sinuosity and a relatively gentle gradient of 1.3 percent. Segment 2, which continues another 2.2 miles downstream to Brimhall Canyon, has a moderately entrenched single channel with low sinuosity and a gradient of 0.85 percent. Segment 3, from Brimhall Canyon 3.7 miles downstream to Spanish Fork River, has a gradient similar to Segment 2 (0.85 percent), but is dominated by multiple channels with repeated and widespread lateral movement. Massive erosion of streambanks, and instream scouring associated with high irrigation flows up to 460 cfs, have created a wide, unstable, braided stream channel. After the irrigation season, streamflows drop to a base level of 12 to 18 cfs through late fall and winter (see Table 3-1 in Chapter 3, Section 3.2.5).

Because most of the water in Diamond Fork Creek during the irrigation season consists of water from Strawberry Reservoir, irrigation releases have a large effect on water quality below Three Forks. Average water temperature for this reach is 54°F, with a maximum average of 55°F (see Table 3-7 in Chapter 3, Section 3.3.5.1).

Riffle habitat dominates all segments of Diamond Fork Creek below the Diamond Fork Creek Outlet. Riffles comprise 60 percent of Segments 1 and 2 and 77 percent of Segment 3. Run habitat (A hydraulic flowing waterhabitat type that has intermediate flow velocity and depth) is the second most common habitat and comprises 20 percent of each segment. Segment 1 is the only section with a significant number of pools in its main channel. Segment 3 is comprised of 23 percent pool habitat, mostly as cutoff pool habitat in side channels. These pools provide important habitat to the fisheries of lower Diamond Fork Creek. The high percentage of gravel and rubble in Segment 3 provides excellent spawning habitat for trout, but a general lack of pool habitat and cover results in poor to fair trout habitat conditions throughout the Diamond Fork Creek channel due to years of high irrigation flows (IABAT 1990).

3.6.5.4.2 Fish Species Composition. The 1997 sampling of Segments 1 through 3 found the trout population to be 87 percent brown trout, 12 percent cutthroat, and 1 percent rainbow. The rainbow are primarily hatchery-reared fish stocked as 8- to 11-inch "catchables." Estimates of the wild trout (a landlocked salmonid that lives, grows and reproduces in natural habitat without the aid or care of humans) biomass in this stretch vary from 70 to 127 pounds per acre (Wiley and Thompson 1997b). Non-game fish found here during the 1997 sampling include mountain sucker and mottled sculpin. Sampling during 1996 found seven species of fish in 394 backwater and cut-off habitats (Walser et al. 1997). Mottled sculpin was the most abundant and widespread, followed by mountain sucker, leatherside chub, brown trout, fat-head minnow, red-side shiner and cutthroat trout. Native, non-trout, fish species reported in this reach of Diamond Fork Creek include redside shiner, mottled sculpin, leatherside chub, speckled dace, longnose dace and mountain sucker (Ellsworth and Kelleher 1998).

3.6.5.5 Spanish Fork River Above Spanish Fork Diversion Dam

This reach is from the confluence of the Diamond Fork Creek to the Spanish Fork Diversion Dam.

3.6.5.5.1 Physical/Chemical Characteristics and Instream Habitat. The fish habitat in this 4.2-mile reach has been degraded by high flows released from the Strawberry Valley Project (SVP) during the irrigation season and low flows at other times of the year. The Utah Division of Wildlife Resources has classified this reach as a Class 3 fishery, which means it has "high priority" for habitat value, and "fisheries should be enhanced when possible and losses should be minimized" (Nelson et al. undated).

During the irrigation season (typically April 15 to October 15), the Strawberry Water Users Association (SWUA) and the Spanish Fork River companies divert most of the Spanish Fork River flow into the High Line Canal via the Spanish Fork Diversion Dam, located 4.2 river miles below the confluence of Spanish Fork River and Diamond Fork Creek.

Streamflow in this reach consists of water from the Spanish Fork River basin and inflow from its tributary, Diamond Fork Creek. During late fall, winter and spring, most of flow below the mouth of Diamond Fork Creek is natural. From June to early September, most of the flow above Spanish Fork Diversion Dam (ranging from 178 to 405 cfs) is from irrigation releases from Strawberry Reservoir down Diamond Fork Creek (see Table 3-1 in Chapter 3, Section 3.2.5).

Water temperatures in this reach are suitable for maintaining a year-round coldwater fishery (average temperature of 54°F from June through September, see Table 3-7 in Chapter 3, Section 3.3.5.1). However, high turbidity from Diamond Fork Creek irrigation releases and from Halls Fork, Diamond Fork, Soldier Creek and the Thistle Creek slide area during storms have degraded the water quality (Sakaguchi 1993). The Utah Division of Water Quality (1997) has designated this segment of Spanish Fork River as protected waters for secondary contact recreation (i.e., boating, wading or similar uses, coldwater species of game fish, and agricultural use.

Approximately 20 percent of this 4.2-mile stretch of the Spanish Fork River is channelized (i.e., straightened and the banks stabilized with stone riprap), but both the channelized and unchannelized portions are dominated by riffle habitat. Most of trout habitat is in the primary channel along streambanks where rocks and tree roots create shelter for trout. The channel substrates are predominately sand, gravel and small cobble, with occasional patches of small boulderswhich is good trout spawning habitat.

3.6.5.5.2 Fish Species Composition. The non-native fisheries in Spanish Fork River above Spanish Fork Diversion Dam include brown trout, an occasional rainbow trout, and hybrids of rainbow/cutthroat trout. Native fish species reported in the Spanish Fork drainage include redside shiner, mottled sculpin, leatherside chub, Utah chub, speckled dace, longnose dace, Bonneville cutthroat trout, mountain sucker and Utah sucker (Ellsworth and Kelleher 1998). Electroshocking at several sites in 1994 found the trout population to be mostly brown trout, ranging in standing crop biomass from 4.7 to 17.1 pounds per acre, with an average of 8.1 pounds per acre.

Aquatic invertebrates form the majority of the prey base for the fish population of the river. Sampling of the Spanish Fork River above Spanish Fork Diversion Dam was conducted in March and November of 1980 (USBR 1983). The March samples reflected the natural Spanish Fork River aquatic invertebrate community, while the November samples were largely influenced by high upstream discharges. When the irrigation flow releases are occurring (April to October), Spanish Fork River has a greater number of species (*Amphipoda, Copepoda, Ostracoda, Hydroptila* spp., and *Simuliidae*) and greater density because of those species drifting downstream with the water released from Strawberry Reservoir. The dominant invertebrates occurring prior to the irrigation season (in March) include mayflies of the genera *Baetis, Rhithrogena,* and *Ephemerella*; stoneflies of the genera *Prostoia, Pteronarcella,* and *Isoperla*; caddis flies of the genera *Hydropsyche* and *Brachycentrus*; and various chironomids.

3.6.5.6 Spanish Fork River From Spanish Fork Diversion Dam to Utah Lake

3.6.5.6.1 Physical/Chemical Characteristics and Instream Habitat. Flows in this 20 mile reach during the summer consist largely of irrigation water to the various downstream diversions, plus accretion flows from natural seeps and irrigation return flows. The average flows at the Lake Shore gaging station are shown in Table 3-1 in Chapter 3, Section 3.2.5. Most of the summer flow recorded at this gage consists of irrigation return flows.

Flows are complicated by the numerous diversions and irrigation returns. The 4.4 mile stretch between Spanish Fork Diversion Dam and Mill Race Canal Diversion is a bypass for hydropower generation, except during the irrigation season. Immediately below the lowermost diversion on the river (Huff Dam), monthly average flows range from a high of 130 to 200 cfs from March through May to a low flow of 3 cfs in July and August. Below the various diversions along Spanish Fork River, instream flows often consist only of seepage and irrigation return flows.

Water quality in this stretch of Spanish Fork River fluctuates significantly from season to season and deteriorates considerably in the lower reaches during certain times of the year. Because of low flows and irrigation return flows, this part of river experiences high TDS and nutrient levels, with periodic increases in BOD and coliform levels. The annual average water temperature is 50°F, but may be as high as 62°F (see Table 3-6 in Chapter 3, Section 3.3.5.1,). Livestock and urban runoff also contribute a pollutant load to this lower reach (USBR 1984).

Instream habitat is primarily low-gradient, 20 to 40 feet wide, with a silt and sand substrate and thin strip of riparian vegetation along some portions. Low flows and warm water temperatures make this marginal habitat for coldwater fish. A recent assessment of the river from East Bench Diversion Dam to Springville Municipal Golf Course above Mill Race Diversion Dam showed that habitat varied from heavily silted areas with minimal flow and cover to relatively diverse riffle/run reaches with instream structure, moderate riparian vegetation and relatively good flow conditions. Two brown trout adults (estimated at about 20 inches long) were noted in a pool below a large boulder in the area upstream of a discharge from the SWUA Power Canal. Several aquatic macroinvertebrate taxa were also noted (stoneflies, mayflies, caddisflies) (Montgomery Watson 1998).

3.6.5.6.2 Fish Species Composition. Spanish Fork River fisheries below Spanish Fork Diversion Dam are severely constrained by low flows throughout most of the year. The Utah Division of Wildlife Resources has classified the first 2.7 miles of the stream below the dam as Class 6 fishery habitat, the next 8.7 miles (from the springs to the Lake Shore Canal diversion (near 6500 South) are classified as Class 3 fishery habitat and the lowermost reach is classified as Class 6 fish habitat. Portions of this reach support marginal brown and cutthroat trout fisheries (Sakaguchi 1994; Shirley 1994). The 1.6 miles of river immediately below Spanish Fork Diversion Dam are annually dewatered and support no significant numbers of trout. The 2.8-mile reach between East Bench Diversion and the powerhouse also suffers from low winter flows, but spring seepage of 3 cfs allows the reach to support 5 pounds per acre of trout (USBR 1990).

Carp is the most abundant fish species in the lower portions of the river. The Utah Division of Wildlife Resources also found small numbers of channel catfish, black bullhead, walleye, white bass, and cutthroat trout (Sakaguchi 1994).

3.6.6 Impact Analysis

3.6.6.1 Methodology

Potential impacts on aquatic resources were estimated using the Montana Method and Binns HQI, which are comprehensive methods to evaluate the instream flow needs of the entire aquatic system, including invertebrates and riparian vegetation. Analysis output for the Binns HQI is expressed in terms of standing crop of trout, where trout are used as an indicator species for the coldwater aquatic ecosystem. Trout habitat in Diamond Fork Creek below Three Forks and Sixth Water Creek also was assessed using the Incremental Flow Instream Methodology (IFIM). In addition to studying the effect of instream flow changes on aquatic biota, the analysis covered the following water quality concerns: temperature, turbidity, nutrient levels, dissolved oxygen, salinity (as TDS) and trace metals. The temperatures used in the analysis were based on average Strawberry Reservoir releases below 33-foot deep. The impact analysis was categorized according to impacts related to construction and operation.

3.6.6.2 Significance Criteria

The following significance criteria were used to determine if construction or operation of the Proposed Action and No Action Alternative would have a significant impact on aquatic biota or its habitat. An impact is considered significant if one of the following would occur:

- A long-term (more than one year) reduction in sport fish numbers and/or biomass is likely to occur in an affected stream section as a result of change in habitat conditions (quantity and quality of instream flows) as defined by the Montana Method (relationships of percent mean annual flow to aquatic resource maintenance) and the Binns HQI (greater than 5 percent reduction in trout standing crop).

- The Utah Water Quality Standards for protection of aquatic life are violated because discharges from construction sites cause a 10 nephelometric turbidity unit (NTU) increase in the turbidity of the receiving waters (Utah Division of Water Quality 1997).

- The Utah Water Quality Standards for protection of aquatic life are violated because waters classified as 3A (protected for coldwater fish) have temperatures exceeding 68°F (81°F for waters classified 3B [warmwater fisheries]) (Utah Division of Water Quality 1997). If existing temperatures periodically exceed this standard, the assessment of impact significance would be based on the frequency and duration.

- The Utah Water Quality Standards for protection of aquatic life are violated because waters classified as 3A have dissolved oxygen concentrations of less than a 30-day average of 6.5 ppm, a seven-day average greater than 5.0 ppm or less than 9.5 ppm, or a one-day average greater than 4.0 ppm or less than 8.0 ppm (Utah Division of Water Quality 1997). For waters classified as 3B, the dissolved oxygen standards are a 30-day average of 5.5 ppm, a seven -day average of 4.0 to 6.0 ppm, and a one-day average of 3.0 to 5.0 ppm (Utah Division of Water Quality 1997).

- Construction or operation causes waters supporting trout to exceed 2,000 ppm TDS or causes waters supporting fish other than trout to exceed 5,000 ppm TDS (this is a professional judgment standard based on McKee and Wolf (1963). The State of Utah has not adopted water salinity standards for protection of fisheries (Utah Division of Water Quality 1997).

The significance of any impacts to potentially limit aquatic habitats (i.e., sensitive spawning areas) were assessed using professional judgment. Assessments of potential impacts from changes in water quality were based on tolerance levels from professional literature.

3.6.6.3 Potential Impacts Eliminated From Further Analysis

Operation of the blow-off vaults and discharge pipes would not cause any aquatic resource impacts. The discharge would be regulated to avoid impacts (see Chapter 1, Section 1.4.2.2).

3.6.6.4 Proposed Action

3.6.6.4.1 Impacts During Construction. Proposed Action would require the construction of one siphon, two tunnels and a pipeline in the Diamond Fork drainage upstream of Red Hollow. Construction of the Sixth Water Connection on Sixth Water Creek and the Diamond Fork Siphon on Diamond Fork Creek above Three Forks would require excavation of soil and rock near and across the streambed of these two creeks. Construction of the Red Hollow Pipeline would disturb soil that could eventually enter Diamond Fork Creek through ephemeral and intermittent tributary streams. Three construction staging areas also are potential sources of sediment input and chemical contaminants. These include a 2-acre area near the Syar Tunnel outlet; a 2-acre area southwest of the Diamond Fork bridge; and a 7-acre area in the vicinity of Red Hollow. Adhering to the standard operating procedures (SOPs)described in Chapter 1, Section 1.7.8 would minimize construction-related impacts on aquatic resources. The key SOPs are in Section 1.7.8.1 Erosion Control, Section 1.7.8.2 Restoration, and Section 1.7.9.1 Monitoring and Follow-up. There would be no measurable impact on aquatic resources from potential construction modifications at any Spanish Fork River diversions. Construction impacts on aquatic resources would not be significant.

3.6.6.4.2 Impacts During Operation.

3.6.6.4.2.1 Sixth Water Creek Above Sixth Water Aqueduct. Operation of the Proposed Action would maintain the required minimum flows in Sixth Water and Diamond Fork creeks. Table 3-22 shows the flows predicted to occur in an average year, which were used in the Binns analysis. These flows would increase trout standing crop from the baseline condition of 213 pounds per acre to an estimated 356 pounds per acre (see Table 3-23). Part of this enhancement would be derived from the increased proportion of streamflow from Strawberry Reservoir water, which has higher levels of nitrogen and phosphorus than local runoff waters. Results of the IFIM analyses indicate that the range of flows under the Proposed Action during all life cycles of brown and cutthroat trout would increase habitat (Utah Division of Wildlife Resources 1998).

Table 3-22
Average Monthly Flows Used in the Binns HQI Analysis for Sixth Water Creek and Diamond Fork Creek From Three Forks to Diamond Fork Creek Outlet Under the Proposed Action (cfs)

Stream Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Sixth Water Creek (From Strawberry Tunnel to Sixth Water Aqueduct)												
Baseline (Post-1996)	6	6	6	6	6	7	14	21	11	7	6	6
Proposed Action	34	27	26	26	26	27	33	48	37	34	33	34
Sixth Water Creek (From Sixth Water Aqueduct to Three Forks)												
Baseline	34	10	9	8	9	11	35	121	242	288	225	122
Proposed Action	36	30	29	28	29	31	48	75	45	37	36	36
Diamond Fork Creek (From Three Forks to Diamond Fork Creek Outlet)												
Baseline	39	16	14	12	14	18	67	180	260	295	230	128
Proposed Action	42	36	33	32	34	38	80	134	64	45	42	42

Table 3-23
Estimated Fish Production for Sixth Water Creek and Diamond Fork Creek Upstream From Diamond Fork Creek Outlet Under the Proposed Action

Stream Reach	Average Width (ft)[a]	lb/Acre	lb/Reach	Change from Baseline (lb/reach)
Sixth Water Creek (From Strawberry Tunnel to Sixth Water Aqueduct)				
Baseline	22[b]	213	3,333	
Proposed Action	25[b]	356	6,332	+2,999
Sixth Water Creek (From Sixth Water Aqueduct to Three Forks)				
Baseline	15[c]	72	471	
Proposed Action	16[c]	296	2,066	+1,595
Diamond Fork Creek Upstream of Three Forks (From Diamond Fork Creek Siphon to Three Forks)				
Baseline	13[d]	108	357	
Proposed Action	13[d]	108	357	0
Diamond Fork Creek Below Three Forks (From Three Forks to Diamond Fork Creek Outlet)				
Baseline	23[e]	72	510	
Proposed Action	26[e]	192	1,537	+1,027

[a]Average stream widths are estimated for brown trout production, which is favored over cutthroat trout production by the flows shown in Table 3-22, according to the results of IFIM studies prepared by Addley and Hardy (1998) and Utah Division of Wildlife Resources (1998).
[b]Average stream width measured for IFIM study prepared by Utah Division of Wildlife Resources (1998).
[c]Average stream width measured for sediment study prepared by U.S. Geological Survey (1991).
[d]Average stream width measured in field.
[e]Average stream width estimated from IFIM study prepared by Addley and Hardy (1998).

The 25 and 32 cfs minimum streamflows released from Strawberry Tunnel would have lower average stream temperatures compared to baseline conditions. The average June through September temperatures would range from 50°F to 55°F (see Chapter 3, Section 3.3.6.4.2.1, Table 3-10). These temperatures would be within brown trout's optimum growth range of 46°F and 63°F (EPA 1973). Average stream temperatures in this reach would not exceed the maximum temperature standard established for a coldwater fishery in this reach. There would be no significant temperature impacts on aquatic resources in Sixth Water Creek above Sixth Water Aqueduct resulting om the Proposed Action.

Annual spring shutdown of all features except Syar Tunnel for inspection and maintenance (see Chapter 1, Section 1.4.2.2.1) would have minimal impacts on aquatic resources in Sixth Water Creek above Sixth Water Aqueduct. The week-long inspection and maintenance shutdown normally would occur in April during spring runoff. Up to 35 cfs additional flow would be released from Strawberry Tunnel for one week during seven dry years over the 44-year period of hydrologic record to maintain CUPCA-mandated minimum streamflows of 60 cfs in Diamond Fork Creek below Diamond Fork Creek Outlet. This would increase the Strawberry Tunnel discharge to an estimated maximum of 69 cfs in April of some years during the one-week inspection and maintenance shutdown. The estimated 69 cfs release would be within the ranges of maximum winter habitat for brown and cutthroat trout (Utah Division of Wildlife Resources 1998).

The periodic one-day system shutdown to inspect the Syar Tunnel inlet gates (see Chapter 1, Section 1.4.2.2.2) during spring runoff would have no effect on minimum flows in Sixth Water Creek. Minimum flows in Sixth Water Creek would be met through delivery of flows through Strawberry Tunnel, using the new connection to the bypass pipe (see Map A-1, Inset 1 and Chapter 1, Section 1.9.3.2). Therefore, the periodic system shutdown at the Syar Tunnel inlet gates would have no impact on aquatic resources in Sixth Water Creek.

The annual fall inspection of Sixth Water Aqueduct (see Chapter 1, Section 1.4.2.2.3) every October would result in minimal impacts on aquatic resources in Sixth Water Creek above Sixth Water Aqueduct. Up to 27 cfs additional flow would be released from Strawberry Tunnel during the two-day shutdown to maintain minimum flows at Diamond Fork Creek Outlet. This would increase the Strawberry Tunnel discharge to an estimated maximum of 61 cfs in October each year during the inspection and maintenance shutdown. The estimated 61 cfs release would be within the ranges of maximum adult and juvenile habitat for brown and cutthroat trout, and within the range of maximum brown trout spawning habitat (Utah Division of Wildlife Resources 1998).

The periodic clamshell valve maintenance (see Chapter 1, Section 1.4.2.2.4) would reduce minimum streamflows discharged from Strawberry Tunnel for two days following irrigation season once every five to seven years. The flow in Sixth Water Creek above Sixth Water Aqueduct would be temporarily reduced to about 6 cfs, comprised of Strawberry Tunnel seepage and natural flows. This reduction would have short-term impacts on brown trout spawning and the juvenile and adult life stages of brown and cutthroat trout. The quantity of pools and remaining flows in this reach would provide sufficient refuge habitat for juvenile and adult trout life stages with minimal adverse impacts. The two-day shutdown would occur at or near the beginning of the brown trout spawning period and could slightly delay selection of spawning sites and building of redds. The brown trout spawning period occurs in October and November, followed by up to four months of incubation. There would be no significant impacts on brown trout spawning or predicted long-term trout standing crop from the two-day shutdown.

Periodic shutdown of the Diamond Fork System, except for Syar Tunnel (see Chapter 1, Section 1.4.2.2.5), for up to three weeks once every five to seven years during spring runoff would have minimal impacts on aquatic resources. Up to 35 cfs additional flow would be released from Strawberry Tunnel for three weeks during seven dry years over the 44-year period of hydrologic record to maintain CUPCA-mandated minimum flows of 60 cfs in Diamond Fork Creek below Diamond Fork Creek Outlet. This would increase the Strawberry Tunnel discharge to an estimated maximum of 69 cfs in April of some years during the three-week inspection and maintenance shutdown. The estimated 69 cfs release would be within the ranges of maximum winter habitat for brown and cutthroat trout (Utah Division of Wildlife Resources 1998).

Emergency operations would involve the release of up to 200 cfs to Sixth Water Creek from Strawberry Tunnel during May, which is when Bonneville Unit water would be most needed to fill Utah Lake. Such emergency operations would have less than a 1 percent chance of occurrence over the life of the project. The 200 cfs flow through Sixth Water Creek in May would decrease cutthroat trout spawning habitat by 38 percent; decrease brown trout fry habitat by 29 percent and cutthroat juvenile habitat by 4.8 percent, and increase brown trout juvenile habitat by 25 percent (Utah Division of Wildlife Resources 1998). There would be no change in habitat for adult cutthroat or brown trout. The duration and magnitude of these impacts would be minor, potentially reducing cutthroat reproduction and brown trout fry survival in a single-year class. These impacts would be short-term and not significant in terms of the predicted long-term trout standing crop.

3.6.6.4.2.2 Sixth Water Creek Below Sixth Water Aqueduct. The Proposed Action would remove most irrigation flows from this reach and provide minimum flows of 32 and 25 cfs (summer/winter schedule) mandated by CUPCA (see Table 3-22). These minimum flows would reduce bank erosion and turbidity and, based on IFIM results, the new flow regime would increase adult brown and cutthroat trout habitat (Addley and Hardy 1998). Beneficial levels of dissolved nutrients would be provided by the hypolimnetic waters of Strawberry Reservoir. Trout standing crop would increase from 72 pounds per acre to an estimated 296 pounds (see Table 3-23).

Water temperatures would be similar to those described in Section 3.6.6.4.2.1. Average stream temperatures in this reach would not exceed the maximum temperature standard established for a coldwater fishery in this reach. The Proposed Action would cause no significant temperature impacts in Sixth Water Creek below Sixth Water Aqueduct.

The impacts of maintenance operations on aquatic resources would be the same as described for Sixth Water Creek above Sixth Water Aqueduct in Section 3.6.6.4.2.1, except that the periodic clamshell valve maintenance would have no impacts on aquatic resources because the minimum streamflows would be released from the Sixth Water Aqueduct outlet pipe during the two-day shutdown period.

The impacts of emergency operations with release of 200 cfs to Sixth Water Creek from Strawberry Tunnel would be similar to those described in Section 3.6.6.4.2.1.

3.6.6.4.2.3 Diamond Fork Creek From Three Forks to Diamond Fork Creek Outlet. The reach would benefit from providing the 32 cfs and 25 cfs minimum flows exiting Sixth Water Creek (see Table 3-22). The IFIM results show that the Proposed Action flow regime would result in increases of 283 percent increase in adult brown trout habitat (Addley and Hardy 1998), and 83 percent in juvenile brown trout habitat, while fry habitat would decline 44 percent. The Proposed Action flows would not increase brown trout spawning habitat in this reach, but trout standing crop in this reach would increase from the baseline estimate of 72 pounds per acre to 192 pounds under the Proposed Action (see Table 3-23).

Flow in Diamond Fork Creek below Three Forks under the Proposed Action would favor brown trout production over cutthroat. Since brown trout are fall spawners, the flow during the fall would be conducive to reproduction and egg maturation. Flow during the spring, when cutthroat trout spawn, would not result in the same level of predicted benefit compared to brown trout.

Strawberry Reservoir releases would have average temperatures ranging from 52°F to 55°F from June through September (CUWCD 1999f). These temperatures would basically be the same as baseline conditions and would be within optimum range for brown trout growth. Average stream temperatures in this reach would not exceed the maximum temperature standard established for a coldwater fishery in this reach. The Proposed Action would cause no significant temperature impacts in this reach of Diamond Fork Creek.

The impacts of maintenance operations on aquatic resources would be the same as described for Sixth Water Creek above Sixth Water Aqueduct in Section 3.6.6.4.2.1, except that the periodic clamshell valve maintenance would have no impacts on aquatic resources because minimum streamflows would be released from the Sixth Water Aqueduct outlet pipe during the two-day shutdown period.

Emergency operations involving release of up to 200 cfs to Sixth Water Creek from Strawberry Tunnel in May would result in flows of about 300 cfs in this reach of Diamond Fork Creek, including the natural flows tributary to the reach. Such emergency operations would have less than a 1 percent chance of occurrence over the life of the project. The 300 cfs flow through this reach of Diamond Fork Creek in May would decrease cutthroat trout juvenile habitat by 13 percent, adult cutthroat trout habitat by 25 percent and adult brown trout habitat by 45 percent (Addley and Hardy 1998). Habitat for brown trout fry and juveniles and cutthroat spawning would remain unchanged from the Proposed Action under these flow conditions (Addley and Hardy 1998). Habitat impacts would not be significant for the predicted long-term trout standing crop since they would be short-term and minor.

3.6.6.4.2.4 Diamond Fork Creek From Diamond Fork Creek Outlet to Spanish Fork River. The primary impacts of the Proposed Action in this reach are related to the following changes from the baseline conditions: 1) minimum flows of 80 cfs in summer and 60 cfs in winter; 2) lower temperatures; and 3) a change in erosion, sediment load and sedimentation due to the reduced flow regime. The effects of these changes on aquatic resources are discussed in the following paragraphs. Further details on water quality and sedimentation conditions associated with the Proposed Action can be found in Section 3.3.

The Proposed Action flow regime would restore Diamond Fork Creek flows to a more natural pattern of peak runoff in mid-May, with a subsequent gradual reduction in flows down to the summer minimum flow of 80 cfs (see Table 3-24). The IFIM study predicted that adult brown and cutthroat trout habitat from Red Hollow to the Spanish Fork River would be maximized by flows in the range of 60 to 90 cfs and would increase adult trout habitat by 311 percent over the baseline conditions in Segments 1 and 2 and 385 percent over baseline in Segment 3 (Addley and Hardy 1998). Spawning habitat would increase 259 percent over baseline in Segments 1 and 2 and 61 percent over baseline in Segment 3. Estimated trout standing crops would increase from 201 to 253 percent over baseline conditions for the three segments of this reach (see Table 3-25). Nutrient concentrations at optimal levels would continue to be provided by the hypolimnetic waters of Strawberry Reservoir.

Average June through September temperatures in this reach would range from 50°F to 55°F (see Table 3-10 in Section 3.3.6.4.2.1). These temperatures would be within the optimum growth range of 46°F and 63°F (EPA 1973) for brown trout. Proposed Action temperatures would be slightly lower than baseline conditions. Average stream temperatures in this reach would not exceed the maximum temperature standard established for a coldwater fishery in this reach. The Proposed Action would cause no significant temperature impacts in this reach of Diamond Fork Creek.

Maintenance operations would have no impacts on aquatic resources, except that minimum streamflows may not be met at Diamond Fork Creek Outlet during periodic shutdown of the Diamond Fork System when the Syar Tunnel inlet gates would be closed for two days for inspection and maintenance. Streamflows at the Diamond Fork Creek Outlet would be lower for two days than the CUPCA-mandated minimum flow in four years during the 44-year period of record. The periodic system shutdown (once every five to seven years) would be conducted during a year when natural flows, plus the minimum streamflows from Sixth Water Creek, would meet or exceed the minimum flow requirement at Diamond Fork Creek Outlet. Therefore, the potential impact on aquatic resources would be avoided.

Emergency operations involving release of up to 200 cfs to Sixth Water Creek from Strawberry Tunnel in May would result in flows of about 339 cfs in this reach of Diamond Fork Creek, including the natural flows tributary to the reach. Such emergency operations would have less than a 1 percent chance of occurrence over the life of the project. The 339 cfs flow through this reach of Diamond Fork Creek in May would decrease adult brown trout habitat by about 42 percent (Addley and Hardy 1998). All other life-stage habitats for brown and cutthroat trout would remain unchanged from the Proposed Action under these flow conditions (Addley and Hardy 1998). Impacts of these habitat changes on predicted long-term trout standing crop would not be significant since they would be short-term and minor.

Table 3-24
Average Monthly Flows Used in the Binns HQI Analysis for Diamond Fork Creek From Diamond Fork Creek Outlet to Spanish Fork River and Spanish Fork River From Diamond Fork Creek to Spanish Fork River Diversion Dam Under the Proposed Action (cfs)

Stream Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Diamond Fork Creek From Diamond Fork Creek Outlet to Spanish Fork River												
Baseline	39	16	14	12	14	18	67	180	260	295	230	128
Proposed Action	61	60	60	60	60	60	85	140	89	82	81	80
Spanish Fork River (From Confluence of Diamond Fork Creek to Spanish Fork Diversion Dam)												
Baseline	93	70	68	67	82	113	247	465	405	363	283	178
Proposed Action	135	170	181	193	221	259	407	667	583	496	380	249

Table 3-25
Estimated Fish Production for Diamond Fork Creek From Diamond Fork Creek Outlet to Spanish Fork River and Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam
Under the Proposed Action

Stream Reach	Average Width (ft)	lb/Acre	lb/Reach	Change from Baseline (lb/reach)
Diamond Fork Creek From Diamond Fork Creek Outlet to Diamond Campground				
Baseline	24	73	276	
Proposed Action	29	247	1,129	+853
Diamond Fork Creek From Diamond Campground to Brimhall Canyon				
Baseline	35	127	1,185	
Proposed Action	37	382	3,769	+2,584
Diamond Fork Creek From Brimhall Canyon to Spanish Fork River				
Baseline	32	70	950	
Proposed Action	45	247	4,715	+3,765
Spanish Fork River (From Confluence of Diamond Fork Creek to Spanish Fork Diversion Dam)				
Baseline	50	8	204	
Proposed Action	52	42	1,112	+908

3.6.6.4.2.5 Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam. Under the Proposed Action, average monthly flows in for this reach in late fall and winter would range from 42 to 139 cfs higher than the baseline conditions of 67 to 113 cfs (see Table 3-24). Spring-summer average monthly flows would peak in May and then gradually decline through the summer. June through August average monthly flows would be about 96 to 179 cfs higher than flows under baseline conditions. These flow conditions would generally improve trout habitat conditions.

June through September mixed average water temperatures would range from 52°F to 54°F from Strawberry Reservoir releases below the thermocline (see Table 3-10 in Section 3.3.6.4.2.1). These temperatures would be very suitable for the river's brown trout population. The sustained summer flows, optimal water temperatures and a more stable seasonal flow regime would increase the trout standing crop from the existing 8 pounds per acre to an estimated 42 pounds (see Table 3-25).

Maintenance operations would have no impacts on aquatic resources in this reach. Natural flow gains in Spanish Fork River and Diamond Fork Creek during maintenance operations would be within the range of Proposed Action flows.

Emergency operations involving release of up to 200 cfs to Sixth Water Creek from Strawberry Tunnel in May would result in flows of about 586 cfs in Spanish Fork River above Spanish Fork Diversion Dam, including the natural flows tributary to the reach. Such emergency operations would have less than a 1 percent chance of occurrence over the life of the project. The 586 cfs flow through Spanish Fork River above Spanish Fork Diversion Dam in May would be 81 cfs less than the average May flow under the Proposed Action. Therefore, the Proposed Action is likely to cause no changes in all life-stage habitats for brown and cutthroat trout.

3.6.6.4.2.6 Spanish Fork River Below Spanish Fork Diversion Dam. Under baseline conditions, the first 1.6 miles of this stretch to the East Bench Diversion is mostly dry during the winter because flows are diverted into the power canal and returned to the river at the powerhouse just above the Mill Race Canal diversion (see Table 3-26). This lack of year-round flow results in no estimated trout standing crop in this section. The 2.8 miles of river below the East Bench Diversion to the powerhouse presently receives 3 to 5 cfs of spring seepage and supports 5 pounds per acre of trout. The Proposed Action would provide year-round flows in both of these sections (see Table 3-26) and create trout standing crops of 66 pounds per acre in each of the sections above and below the East Bench diversion, (see Table 3-27). There would be some late-summer periods in wet years during the 44-year period of record when flows in Spanish Fork River below East Bench Diversion would be less than 1 cfs. Streamflows in previous months during these wet years could be changed to provide refuge habitat for fish and other aquatic organisms.

Table 3-26
Average Monthly Flows Used in the Binns HQI Analysis for Spanish Fork River Below Spanish Fork Diversion Dam Under the Proposed Action (cfs)

Stream Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Spanish Fork River (From Spanish Fork Diversion Dam to East Bench Diversion)												
Baseline	5	0	0	0	0	0	25	100	54	42	32	17
Proposed Action	43	101	113	126	140	147	180	292	222	165	119	81
Spanish Fork River (From East Bench Diversion to Mill Race Canal)*												
Baseline	0	0	0	0	0	0	17	50	1	0	0	0
Proposed Action	37	101	113	126	140	146	171	243	165	118	85	62
Spanish Fork River (From Mill Race Canal to Utah Lake)												
Baseline	30	67	77	79	97	129	199	138	22	3	3	8
Proposed Action	68	168	190	205	236	276	352	322	189	120	86	70

*These flows do not include the 5 cfs of spring inflows.

Table 3-27
Fish Production for Spanish Fork River Below Spanish Fork Diversion Dam Under the Proposed Action

Stream Reach	Average Width (ft)	lb/Acre	lb/Reach	Change from Baseline (lb/reach)
Spanish Fork River (From Spanish Fork Diversion Dam to East Bench Diversion)				
Baseline	0	0	0	
Proposed Action	43	66	550	+550
Spanish Fork River (From East Bench Diversion to Mill Race Diversion)				
Baseline	10	5	17	
Proposed Action	32	66	717	+700
Spanish Fork River (From Mill Race Diversion to Utah Lake)				
Baseline	10	No estimate	No estimate	
Proposed Action	32	16	968	+968

Two additional agricultural diversions are located in the 15.6 miles of Spanish Fork River below the Mill Race Canal diversion. Flows for this section are reported for the point immediately downstream of the Lake Shore diversion. Baseline flows that drop to 3 cfs in late summer render most of this section marginal for trout. The Proposed Action would increase flows during all months, but August flows would average 86 cfs (see Table 3-26). Flows and temperatures would continue to limit a trout fishery in this reach, but an increase in trout standing crop of 16 pounds per acre is predicted based on the Binns HQI analysis and an assessment of the potential improvements that would result from additional flow (Montgomery Watson 1998). Native non-game fish and non-native fish also would benefit from the Proposed Action flow regime.

Maintenance operations would have no measurable impacts on aquatic resources in this reach of Spanish Fork River except during annual fall inspection of Sixth Water Aqueduct. Discharges from the Spanish Fork River Outlet would stop during the two-day inspection period. Fish would seek refuge habitat and would be minimally affected by this temporary decrease in flows. These impacts would not be significant.

Emergency operations would have no measurable impacts on aquatic resources in this reach of Spanish Fork River. Natural flow gains in May would be within the range of flows under the Proposed Action. The 200 cfs emergency flows would be contracted Bonneville Unit water that would be conveyed directly to Utah Lake through Spanish Fork River. Therefore, streamflows under emergency operations would support aquatic resources in Spanish Fork River from Spanish Fork Diversion Dam to Utah Lake.

3.6.6.4.3 Impact Summary. The Proposed Action would increase trout populations in Sixth Water Creek, Diamond Fork Creek and Spanish Fork River due to a more stabilized flow regime, less erosion and turbidity, and suitable water temperatures. These conditions, combined with the optimal nutrient levels associated with the

Strawberry Reservoir releases, would result in a net increase of 15,949 pounds (218 percent) in wild trout standing crop throughout the impact area of influence (see Table 3-28). The temperature of water released from Strawberry Reservoir during the summer would result in optimal conditions for trout growth throughout each reach. Maintenance operations of the Diamond Fork System would have minimal impacts on trout spawning and rearing success throughout Sixth Water and Diamond Fork creeks, and no impacts on aquatic resources in Spanish Fork River. Emergency operations involving the release of 200 cfs from Strawberry Tunnel for one month would cause short-term decreases in habitat for trout life stages in some affected reaches and short-term increases in habitat for trout life stages in other affected reaches. These short-term changes would not affect the long-term trout standing crop. Interim operation of the Proposed Action would not have significant short-term or long-term impacts on aquatic resources. High flows in Spanish Fork River above Spanish Fork Diversion Dam would degrade trout habitat, but this would be offset by the continuous base flow.

Table 3-28
Summary of Predicted Trout Standing Crop (lb/acre) and Biomass (lbs)[1]
Under The Proposed Action

Page 1 of 2

		Baseline		Proposed Action	
Waterbody	**Reach Description**	**Standing Crop (lbs/acre)**	**Biomass (lbs)**	**Standing Crop (lbs/acre)**	**Biomass (lbs)**
Sixth Water Creek					
Reach 1	Strawberry Tunnel to Sixth Water Aqueduct	213	3,333	356	6,332
Reach 2	Sixth Water Aqueduct to Three Forks	72	471	296	2,066
Diamond Fork Creek					
Reach 1	Upstream of Three Forks	108	357	108	357
Reach 2	Three Forks to Diamond Fork Creek Outlet	72	510	192	1,537
Reach 3					
Segment 1 Segment 2	Diamond Fork Creek Outlet to Diamond Campground Diamond Campground to Brimhall Canyon	73 127	276 1,185	247 382	1,129 3,769
Reach 4 Segment 3	Brimhall Canyon to Spanish Fork River	70	950	247	4,715
Spanish Fork River Above Spanish Fork Diversion Dam					
Reach 1	Spanish Fork River from the confluence of Diamond Fork Creek downstream to the Spanish Fork Diversion Dam	8	204	42	1,112

Table 3-28
Summary of Predicted Trout Standing Crop (lb/acre) and Biomass (lbs)[1]
Under The Proposed Action

Page 2 of 2

		Baseline		Proposed Action	
Waterbody	**Reach Description**	**Standing Crop (lbs/acre)**	**Biomass (lbs)**	**Standing Crop (lbs/acre)**	**Biomass (lbs)**
Spanish Fork River Below Spanish Fork Diversion Dam					
Reach 1	Spanish Fork Diversion Dam to East Bench Dam	0	0	66	550
Reach 2	East Bench Dam to Mill Race Diversion	5	17	66	717
Reach 3 Reach 4 Reach 5	Mill Race Diversion to Lake Shore Diversion Lake Shore Diversion to Huff Dam Huff Dam to Utah Lake	No baseline standing crop data	No estimate made	16	968
Totals			7,303		23,252

[1]Standing crop and biomass predictions rounded to nearest pound.

3.6.6.5 No Action Alternative

3.6.6.5.1 Impacts During Construction. Construction of Three Forks Dam and Reservoir would directly affect 2,400 linear feet of Diamond Fork Creek above Three Forks (0.72 acre of aquatic resource habitat); 2,700 linear feet of lower Sixth Water Creek (0.93 acre of aquatic resource habitat), and 1,600 linear feet of Cottonwood Creek (0.30 acre of aquatic resource habitat). Removal of stream habitat during construction and inundation would cause long-term impacts on aquatic resources, but they would not be significant because they would not substantially reduce long-term trout standing crop. Use of SOPs described in Section 1.7.8 would help prevent adverse impacts on aquatic resources during construction of the dam, reservoir and other features of the No Action Alternative.

3.6.6.5.2 Impacts During Operation.

3.6.6.5.2.1 Sixth Water Creek From Strawberry Tunnel to Sixth Water Aqueduct. Same as the Proposed Action (see Section 3.6.6.4.2.1).

3.6.6.5.2.2 Sixth Water Creek From Sixth Water Aqueduct to Three Forks. Streamflows (see Table 3-29) would increase substantially during all months, especially during the summer irrigation season when this reach would be used to convey SVP irrigation releases. Average monthly flows would be 74 cfs in October; gradually increase from 166 to 209 cfs in November through April; peak at 409 and 465 cfs during June and July, respectively; and decline to 345 cfs in August and 200 cfs in September. Average water temperatures (June through September) would range from 49°F to 55°F, a decrease from baseline conditions. These temperatures would be within the optimum growth range of 46°F to 63°F (EPA 1973) for brown trout. Minimum monthly average temperatures in this reach would be 44°F in July and 45°F in September, no change from baseline conditions. These temperatures could cause a minor decrease in trout standing crop from the predicted value in Table 3-30, but it would not be significant. Trout standing crop would decrease from 72 pounds per acre to a predicted 9 pounds (see Table 3-30) under the No Action Alternative due to higher flows throughout the year. The IFIM studies on lower Sixth Water Creek by Addley and Hardy (1998) indicate that habitat for all brown and cutthroat trout life stages would slightly decrease at these higher flows.

The impacts of all maintenance operations, except periodic clamshell valve maintenance, would improve trout habitat conditions in this reach of Sixth Water Creek during shutdowns because high streamflows would be temporarily reduced to optimal levels for all trout life stages. These short-term shutdowns would not measurably increase trout standing crop and the impacts would not be significant. The periodic clamshell valve maintenance would have no impact on aquatic resources in this reach of Sixth Water Creek because flows would continue to be discharged from Sixth Water Aqueduct during the two-day maintenance period.

The impacts of emergency operations with release of 200 cfs to Sixth Water Creek from Strawberry Tunnel would be similar to those described in Section 3.6.6.4.2.1, except that lower flows in this reach in May would temporarily improve habitat conditions but would not cause measurable changes in trout standing crop.

Table 3-29
Average Monthly Flows Used in the Binns HQI Analysis for Sixth Water Creek and Diamond Fork Creek From Three Forks to Red Hollow Under the No Action Alternative (cfs)

Stream Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Sixth Water Creek (From Strawberry Tunnel to Sixth Water Aqueduct)												
Baseline (Post-1996)	6	6	6	6	6	7	14	21	11	7	6	6
No Action Alternative	34	27	26	26	26	27	33	48	37	34	33	34
Sixth Water Creek (From Sixth Water Aqueduct to Three Forks)												
Baseline	34	10	9	8	9	11	35	121	242	288	225	122
No Action Alternative	74	166	137	148	163	171	209	312	409	465	345	200
Diamond Fork Creek From Three Forks to Red Hollow												
Baseline	39	16	14	12	14	18	67	180	260	295	230	128
No Action Alternative	60	60	60	60	60	60	85	139	87	80	80	80

Table 3-30
Fish Production for Sixth Water Creek and Diamond Fork Creek From Three Forks to Red Hollow Under the No Action Alternative

Stream Reach	Average Width (ft)	lb/Acre	lb/Reach	Change from Baseline (lb/reach)
Sixth Water Creek (From Strawberry Tunnel to Sixth Water Aqueduct)				
Baseline	22	213	3,333	
No Action Alternative	25	356	6,332	+2,999
Sixth Water Creek (From Sixth Water Aqueduct to Three Forks)[1]				
Baseline	15	72	471	
No Action Alternative	21	9	81	-390
Diamond Fork Creek Above Three Forks (From Three Forks 2.27 miles upstream)[2]				
Baseline	13	108	357	
No Action Alternative	13	108	332	-25
Diamond Fork Creek Below Three Forks (From Three Forks to Red Hollow)				
Baseline	23	72	510	
No Action Alternative	25	192	1,478	+968

[1] 0.93 acre lost to inundation
[2] 0.72 acre lost to inundation

3.6.6.5.2.3 Diamond Fork Creek From Three Forks to Red Hollow. Flows in this reach would vary only slightly from the 60 and 80 cfs (CUPCA-mandated) minimum flows and would have an average peak flow of 140 cfs in May (see Table 3-29). The IFIM study shows that adult brown and cutthroat trout habitat in this reach would be optimal at flows of 80 cfs and 50 cfs, respectively (Addley and Hardy 1998). Strawberry Reservoir releases in June through September would result in average monthly temperatures ranging from 50°F to 55°F (CUWCD 1999f), which is within the optimum growth range for brown trout (EPA 1973). With stabilized flows and enhanced winter flows, the trout standing crop (see Table 3-30) would increase from 72 pounds per acre to 192 pounds for this reach.

Maintenance operations would have no impacts on aquatic resources except during the periodic shutdown of the Diamond Fork System. In four years over the 44-year period of hydrologic record, the two-day closure of the Syar Tunnel inlet gates during spring runoff would not discharge enough water from Strawberry Tunnel to maintain minimum streamflows in Diamond Fork Creek below Three Forks. The periodic system shutdown (once every fi to seven years) would be conducted during a year when natural flows, plus the minimum streamflows from Sixth

Water Creek, would meet or exceed the minimum flow requirement in this reach. Therefore, the potential impact on aquatic resources would be avoided.

Emergency operations involving the release of 200 cfs to Sixth Water Creek from Strawberry Tunnel would have no impacts on aquatic resources in this reach of Diamond Fork Creek. Emergency flows would be diverted into Diamond Fork Pipeline at Three Forks Dam, and minimum streamflows would continue to be discharged from Three Forks Dam the same as under normal operations.

3.6.6.5.2.4 Diamond Fork Creek From Red Hollow to Spanish Fork River. The No Action Alternative would result in Diamond Fork Creek flows stabilizing around the required minimum flows. A peak flow of 139 cfs would occur in May, and for the remainder of the year the flows would range from about 60 to 87 cfs, depending on the season (see Table 3-31). Strawberry Reservoir releases in June through September would result in average monthly temperatures ranging from 49°F to 55°F (see Table 3-13 in Section 3.3.6.5.2.1), which would be within optimum range for brown trout (EPA 1973). The IFIM results show adult brown and cutthroat trout habitat in this reach would be optimal at flows of 90 cfs and 60 cfs, respectively(Addley and Hardy 1998). The 7.2 miles of Diamond Fork Creek to the Spanish Fork River would benefit from the No Action Alternative's lower and more stabilized flow regime and yield the same trout standing crop increase as described for the Proposed Action (see Table 3-32).

Maintenance operations would have the same impacts on aquatic resources as described in Section 3.6.6.4.2.4.

Emergency operations involving release of 200 cfs to Sixth Water Creek from Strawberry Tunnel would have the same impacts on aquatic resources as described in Section 3.6.6.5.2.3.

Table 3-31
Average Monthly Flows Used in the Binns HQI Analysis for Diamond Fork Creek From Red Hollow to Spanish Fork River and Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam
Under the No Action Alternative (cfs)

Stream Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Diamond Fork Creek From Red Hollow to Spanish Fork River												
Baseline	39	16	14	12	14	18	67	180	260	295	230	128
No Action Alternative	60	60	60	60	60	60	85	139	87	80	80	80
Spanish Fork River (From Diamond Fork Confluence to Spanish Fork Diversion Dam)												
Baseline	93	70	68	67	82	113	247	465	405	363	283	178
No Action Alternative	133	226	196	206	236	274	420	656	572	541	403	256

Table 3-32
Fish Production for Diamond Fork Creek From Red Hollow to Spanish Fork River and Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam Under the No Action Alternative

Stream Reach	Average Width (ft)	lb/Acre	lb/Reach	Change from Baseline (lb/reach)
Diamond Fork Creek From Red Hollow to Diamond Campground				
Baseline	24	73	276	
No Action Alternative	29	247	1,129	+853
Diamond Fork Creek From Diamond Campground to Brimhall Canyon				
Baseline	35	127	1,185	
No Action Alternatives	37	382	3,769	+2,584
Diamond Fork Creek From Brimhall Canyon to Spanish Fork River				
Baseline	32	70	950	
No Action Alternatives	45	247	4,715	+3,765
Spanish Fork River (From Confluence of Diamond Fork Creek to Spanish Fork Diversion Dam)				
Baseline	50	8	204	
No Action Alternative	69	9	316	+112

3.6.6.5.2.5 Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam. Under the No Action Alternative, this reach would have a late fall and winter base flow ranging from 40 to 155 cfs higher than the baseline conditions of 67 to 93 cfs (see Table 3-31). Spring flows would peak in May and then gradually decline through the summer. June through August flows would be about 120 to 177 cfs higher than flows under baseline conditions. These flow conditions would generally improve trout habitat conditions.

June through September water temperatures would average 50°F to 55°F from mixed Strawberry Reservoir releases (see Table 3-13 in Section 3.3.6.5.2.1), which would be within optimum temperature range for brown trout (EPA 1973). The No Action Alternative would increase the trout standing crop of this reach from the existing 8 pounds per acre to an estimated 9 pounds (see Table 3-32).

Maintenance operations would have the same impacts on aquatic resources as described in Section 3.6.6.4.2.5.

Emergency operations involving release of up to 200 cfs to Sixth Water Creek from Strawberry Tunnel in May would result in flows of about 586 cfs in Spanish Fork River above Spanish Fork Diversion Dam, including the natural flows tributary to the reach. Such emergency operations would have less than a 1 percent chance of occurrence over the life of the project. The 586 cfs flow through Spanish Fork River in May would be 69 cfs less than the average May flow under the No Action Alternative. Therefore, the flow would likely cause no change in life-stage habitats for brown and cutthroat trout.

3.6.6.5.2.6 Spanish Fork River Below Spanish Fork Diversion Dam. The No Action Alternative would result in larger flows to Utah Lake than occur under baseline conditions. This would result in no average annual occurrence of months of dry or nearly dry river conditions (see Table 3-33). Under the No Action Alternative, the trout standing crop would increase compared to baseline conditions (see Table 3-34), the same as predicted for the Proposed Action in Section 3.6.6.4.2.6.

Maintenance and emergency operations would have the same impact as under the Proposed Action (Section 3.6.6.4.2.6).

Table 3-33
Average Monthly Flows Used in Binns HQI Analysis for Spanish Fork River Below Spanish Fork Diversion Dam Under the No Action Alternative (cfs)

Stream Reach	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Spanish Fork River (From Spanish Fork Diversion Dam to East Bench Diversion)												
Baseline	5	0	0	0	0	0	25	100	54	42	32	17
No Action Alternative	34	157	129	140	154	161	193	275	164	127	97	76
Spanish Fork River (From East Bench Diversion to Mill Race Diversion)*												
Baseline	0	0	0	0	0	0	17	50	1	0	0	0
No Action Alternative	28	157	129	140	154	161	184	226	108	81	63	57
Spanish Fork River (Mill Race Diversion to Utah Lake)												
Baseline	30	67	77	79	97	129	199	138	22	3	3	8
No Action Alternative	57	224	206	219	251	290	365	303	121	65	55	62
*These flows do not include the 5 cfs of spring inflows.												

Table 3-34
Fish Production for Spanish Fork River Below Spanish Fork Diversion Dam Under the No Action Alternative

Stream Reach	Average Width (ft)	lb/Acre	lb/Reach	Change from Baseline (lb/reach)
Spanish Fork River (From Spanish Fork Diversion Dam to East Bench Diversion)				
Baseline	0	0	0	
No Action Alternative	43	66	550	+550
Spanish Fork River (From East Bench Diversion to Mill Race Diversion)				
Baseline	10	5	17	
No Action Alternative	32	66	717	+700
Spanish Fork River (From Mill Race Diversion to Utah Lake)				
Baseline	10	No estimate	No estimate	
No Action Alternative	32	16	968	+968

3.6.6.5.3 Impact Summary. The No Action Alternative would increase trout populations in Sixth Water Creek above Sixth Water Aqueduct and in Diamond Fork Creek below Three Forks Dam. Construction of Three Forks Dam and Reservoir would remove 1.95 acres of stream habitat and replace it with up to 14 acres of reservoir pool. This impact would not significantly affect aquatic resources. The No Action Alternative would result in a net increase of 13,084 pounds (179 percent) in wild trout standing crop (see Table 3-35) throughout the impact area of influence. Maintenance operations of the Diamond Fork System would have minimal impacts on trout spawning and rearing success throughout Sixth Water and Diamond Fork Creeks. Emergency operations involving the release of 200 cfs from Strawberry Tunnel for one month would cause a short-term decrease in habitat for cutthroat spawning and other trout life stages in Sixth Water Creek above Sixth Water Aqueduct that would not affect the long-term trout standing crop. Therefore, operation of the No Action Alternative would not have significant short-term or long-term impacts on aquatic resources. High flows in Spanish Fork River above the Spanish Fork Diversion Dam would degrade trout habitat, but this would be offset by the continuous base flow.

Table 3-35
Summary of Predicted Trout Standing Crop (lb/acre) and Biomass (lbs)[a]
Under The No Action Alternative

		Baseline		No Action	
Waterbody	**Reach Description**	**Standing Crop (lbs/acre)**	**Biomass (lbs)**	**Standing Crop (lbs/acre)**	**Biomass (lbs)**
Sixth Water Creek					
Reach 1	Strawberry Tunnel to Sixth Water Aqueduct	213	3,333	356	6,332
Reach 2	Sixth Water Aqueduct to Three Forks	72	691	9	173[b]
Diamond Fork Creek					
Reach 1	Upstream of Three Forks	108	387	108	333[c]
Reach 2	Three Forks to Red Hollow	72	510	192	1,478
Reach 3					
Segment 1	Red Hollow to Diamond Campground	73	276	247	1,129
Segment 2	Diamond Campground to Brimhall Canyon	127	1,185	382	3,769
Reach 4	Brimhall Canyon to Spanish Fork River	70	753	247	4,715
Spanish Fork River Above Spanish Fork Diversion Dam					
Reach 1	Spanish Fork River from the mouth of Diamond Fork Creek downstream to the Spanish Fork Diversion Dam	8	204	9	316
Spanish Fork River Below Spanish Fork Diversion Dam					
Reach 1	Spanish Fork Diversion Dam to East Bench Dam	0	0	66	550
Reach 2	East Bench Dam to Mill Race Diversion	5	17	66	717
Reach 3 Reach 4 Reach 5	Mill Race Diversion to Lake Shore Diversion Lake Shore Diversion to Huff Dam Huff Dam to Utah Lake	No baseline standing crop data	No estimate made	16	968
Totals			7,303		20,387

[a]Standing crop and biomass predictions rounded to nearest pound
[b]0.93 acre lost to inundation from Three Forks Reservoir
[c]0.72 acre lost to inundation from Three Forks Reservoir

3.7 Special-Status Species

3.7.1 Introduction

This section addresses the potential effects of the Proposed Action and No Action Alternative on special-status species, including threatened and endangered plant and animals and species of special concern in the impact area of influence. Also covered are species identified as "sensitive" by the State of Utah (Utah Division of Wildlife Resources 1997a), and the Uinta National Forest (Forest Service 1996b). The information and analysis provided in this section was summarized from the Spanish Fork-Nephi Irrigation System Draft Environmental Impact Statement Draft *Special-Status Species Technical Report* (CUWCD 1998d) and the Completion of the 1999 Diamond Fork System Biological Assessment (CUWCD 1999a).

3.7.2 Issues Eliminated From Further Analysis

None.

3.7.3 Issues Addressed in the Effect Analysis

Potential effects on threatened, endangered and other species of special concern from construction and operation of the Proposed Action and No Action Alternative are addressed in this analysis.

3.7.4 Description of Effect Area of Influence

The effect area of influence for special-status species includes terrestrial and aquatic habitats that could be directly or indirectly affected by construction and operation of the Proposed Action and No Action Alternative. This effect area of influence includes the Diamond Fork drainage area (i.e., Diamond Fork Canyon and its various tributary canyons, including Sixth Water and Red Hollow) and the Spanish Fork River from the confluence of Diamond Fork Creek to Utah Lake.

The specific effect area of influence examined study varies for each of the three main species groups (i.e., plants, fish and wildlife) depending on distribution and habitat requirements. For example, the area examined for fish species was restricted to perennial streams and water bodies, whereas the effect area of influence for plant species included riparian and wetland habitats.

3.7.5 Affected Environment

Table 3-36 lists special-status species likely to occur in the effect area of influence. The only threatened and endangered species that may occur are: June sucker (*Chasmistes liori*s), Ute ladies'-tresses (*Spiranthes diluvialis*), Bald eagle (*Haliaeetus leucocephalus*) and Peregrine falcon (*Falco peregrinus*) (see FWS letter in Appendix B, Section B.6).

The U.S. Forest Service identified the following sensitive species in the Uinta National Forest: Spotted bat (*Euderma maculatum*), North American lynx (*Felis lynx canadensis*), fisher (*Martes pennanti*), Western big-eared bat (*Plecotus townsendii*), Flammulated owl (*Otus flammeolus*), Northern goshawk (*Accipiter gentilis*), Northern three-toed woodpecker (*picoides tridactytus*), spotted frog (*Rena pretiosa*), Colorado cutthroat trout (*Oncorhynchus clarki pleuriticus*), Bonneville cutthroat trout (*oncorhynchus clarki utah*), Barneby woody aster (*Aster kingii var. barnebyana*), Danity moonwort (*Botrychium crenulatum*), Rockcress draba (*Draba densifolia apiculata*), Wasatch jamesia (*Jamesia americana macrocalyx*) and Garrett bladderpod (*Lesquerella garrettii*).

.he following sections describe the affected environment for each of the special-status species located within the effect area of influence and listed in Table 3-36.

Table 3-36
List of Special-Status Species In FS-FEIS Impact Area of Influence
Page 1 of 2

Common Name/ Scientific Name	Status	Primary Habitat	Remarks
Plant Species			
Ute ladies'-tresses *Spiranthes diluvialis*	T	Riparian edges, gravel bars, old oxbows, and moist to wet meadows along springs and streams.	Species present within the impact area of influence along Diamond Fork Creek and Spanish Fork River.
Fish Species			
Leatherside chub *Gila copei*	SC	Variety of habitats including a range of substrate types, flows, cover types, and instream microhabitats.	Found in Diamond Fork Creek, and Spanish Fork River.
June sucker *Chasmistes liorus*	E	Utah Lake and the lower Provo River.	The June sucker Recovery Plan has designated Utah Lake tributaries as potential locations to develop spawning populations.
Bonneville cutthroat trout *Oncorhynchus clarki utah*	SC	High elevation streams with coniferous and deciduous riparian trees to low elevation streams in sage, steppe, and grassland containing herbaceous riparian zones. It also does well in lake habitats.	No pure strains have been found within the impact area of influence. The impact area of influence has been identified in the Conservation Agreement and Strategy as a potential location for establishment of populations.
Birds			
Bald eagle *Haliaeetus leucocephalus*	T	Frequent estuaries, large lakes, reservoirs, major rivers, and some sea coasts. Habitat also must include perching and nesting areas.	Commonly observed from August through March around Utah Lake, Diamond Fork Creek, and scattered wetlands.
Peregrine falcon *Falco peregrinus*	E	Cliffs or man-made surrogates such as buildings and bridges near water.	Spring and fall residents in the impact area of influence by Utah Lake.
Golden eagle *Aquila chrysaetos*	SC[2]	Nests in cliffs and occasionally in large trees.	Common throughout Utah County. Active nesting sites include Diamond Fork Canyon and Red Hollow.
Loggerhead shrike *Lanius ludovicianus*	SC[3]	Sagebrush and pinyon-juniper, open habitat.	Occur in suitable habitat throughout the impact area of influence.
Swainson's hawk *Buteo swainsoni*	SC[4]	Trees near open desert grasslands, shrub-steppes, and agricultural fields.	Suitable habitat occurs within the impact area of influence.
Common yellowthroat *Geothlypis trichas*	SC[4]	Riparian and wetland habitats statewide.	Suitable habitat occurs within the Diamond Fork drainage.
Yellow-breasted chat *Icteria virens*	SC[4]	Dense riparian thickets of lower valleys and canyons statewide.	Suitable habitat occurs within the impact area of influence.
Long-billed curlew *Numenius americanus*	SC[4]	Upland meadows and rangelands of northern and central Utah valleys. Forages in moist meadow wetlands and upland habitats.	Potential suitable habitat exists along Spanish Fork River near Utah Lake.
Grasshopper sparrow *Ammodramus savannarum*	SC[4]	Dry grasslands characterized by short to mid-height clumps of grass with few to no shrubs.	Potential habitat may exist within the impact area of influence, but no known populations exist.

Table 3-36
List of Special-Status Species

Page 2 of 2

Common Name/ Scientific Name	Status	Primary Habitat	Remarks
Reptiles			
Utah mountain king snake *Lampropeltis pyromelana infralabialis*	SC[4]	Chaparral woodland and pine forests in mountainous regions and bushy, rocky canyons, talus slopes, and near streams and springs above 2,800 feet.	Suitable habitat occurs within the impact area of influence.
Utah milk snake *Lampropeltis triangulum taylori*	SC[4]	Semi-arid regions, pine forests, deciduous woodlands, and suburban areas.	Suitable habitat occurs within the impact area of influence.

NOTES:

T = Listed as threatened under the ESA of 1973, as amended.
E = Listed as endangered under the ESA.
C = A candidate for listing under the ESA.
SC = Species of special concern.
SC[2] = Golden eagle is protected under the Eagle Protection Act (16 U.S.C. 668-668d) and the Migratory Bird Treaty Act (16 U.S.C. 701-718h).
SC[3] = Utah population of loggerhead shrike is no longer included on candidate species list.
SC[4] = State of Utah species of special concern.

3.7.5.1 Threatened and Endangered Species

3.7.5.1.1 Ute ladies'-tresses. Listed in 1992, Ute ladies'-tresses (ULT) are a perennial orchid found along riparian edges, gravel bars, old oxbows and moist to wet meadows along perennial freshwater streams and springs at elevations ranging from approximately 4,300 to 7,000 feet (FWS 1992b; Stone 1993). It is an early successional species that is well-adapted to colonizing banks and low floodplains along alluvial streams where scouring and sediment deposition are natural processes. It has also been found in irrigated and sub-irrigated pastures that are mowed or moderately grazed. In general, the orchid occurs in relatively open grass and forb-dominated habitats, and seems intolerant of dense shade. The plants bloom from late July through August (sometimes September), setting seed in the early fall (FWS 1992). A colony is defined as any location where flowering plants have been found in a similarly delineated habitat on that geomorphic surface. Therefore, a colony may be comprised of one or more individuals on a sandbar (large or small) or on a large flood plain delineated by topographical changes in slope or elevation.

3.7.5.1.1.1 Sixth Water Creek. A survey during the flowering season of 1998 from Sixth Water Aqueduct to Three Forks determined that the entire reach has low potential for (ULT) habitat. No ULTs were found.

3.7.5.1.1.2 Diamond Fork Creek. Surveys were conducted in the area of the proposed Diamond Fork Siphon down to Three Forks in February and March of 1997 (Black 1998) and again during the flowering season of 1998. Diamond Fork Creek from Three Forks to the confluence with Spanish Fork River was surveyed during the flowering seasons of 1992, 1993, 1994, 1997 and 1998. These included the areas of Diamond Fork Creek at the Diamond Fork Creek Outlet (about 0.5 miles downstream from Red Hollow) and at the Spanish Fork River Outlet.

Low potential exists for ULT habitat (none were identified) along Diamond Fork Creek upstream from Three Forks and at the proposed Diamond Fork Creek Outlet site. The known range of ULT distribution along Diamond Fork Creek spans from just below Three Forks to the confluence with the Spanish Fork River (approximately 11 river miles). Two small isolated ULT colonies have been identified less than ½ mile downstream from Three Forks. Other than these two isolated colonies, most are found in a 5-mile reach between 4.5 and 9.5 stream miles downstream from Three Forks (Table 3-37).

3.7.5.1.1.3 Red Hollow Creek. A survey conducted during the flowering season of 1997 along Red Hollow Creek 3.5 miles above the confluence with Diamond Fork Creek down to Diamond Fork Creek determined that the entire reach has low potential for ULT habitat. Specifically, there is low potential where the Red Hollow Pipeline is proposed to cross Red Hollow Creek. No ULT were identified in these areas.

3.7.5.1.1.4 Spanish Fork River. Ten colonies have been identified on the Spanish Fork River from the confluence with Diamond Fork Creek to the gaging station at Cold Springs. Three – each less than five individuals – were at or just downstream from the confluence. Five are in the Shurtz Canyon vicinity, with at least one colony sustained with secondary hydrological support via seepage from a storage pond. The lower two colonies, located in or around an old oxbow immediately upstream of the Cold Springs gaging station, are suspected of being supported by secondary hydrologic support.

The number of flowering individuals in Spanish Fork and Diamond Fork canyons varies within a specific colony, and new habitat has been colonized or new colonies identified year to year (see Table 3-38).

Table 3-37
Ute ladies'-tresses (*Spiranthes diluvialis*) Surveys
Along Diamond Fork Creek
(Number of Flowering Plants Found)

Page 1 of 2

Location	Colony ID	1992	1993	1994	1997	1998	Max. # for any 1 year
Three Forks	1	23	192	23	0	242	242
Gaging Station	2	0	2	1	0	135	135
Palmyra Campground	2A	0	0	0	0	6	6
	2B	0	0	0	0	45	45
	3	0	3	5	20	0	20
	3A	0	0	0	0	121	121
	3B	0	0	0	0	47	47
	4	0	132	40	412	266	412
	4A	0	0	0	0	1	1
	5	0	2	0	4	70	70
	6	0	8	8	14	50	50
	6A	0	0	0	15	52	52
	6B	0	0	0	2	0	2
	7	0	2	0	67	3	67
	8	0	3	1	0	0	3
	9	0	120	75	2	234	234
	10A	0	0	0	96	58	96
	11	0	1	0	0	72	72
	12	0	200	0	4	1	200
Brimhall Canyon	12A	0	0	35	389	66	389
	13	0	67	0	1	52	67
	14	0	97	200	957	96	957
	15	0	1	0	24	99	99
Redford Crossing	15A	0	0	0	15	17	17
	15B	0	0	0	27	41	41
	16	0	17	0	3	2	17
	17	4	12	0	114	414	414
	17A	0	0	0	47	21	47
	18	0	1	0	7	0	7
	19	0	1	0	1	3	3
Levee at Intake	19A	0	0	0	2	0	2
	20	28	804	91	1,885	236	1,885
	20B	0	0	0	11	3	11
	20C	0	0	0	207	75	207
	20D	0	0	0	0	1	1
	21	5	486	GI*	360	10,966	10,996
	21A	0	0	0	0	144	144

Table 3-37
Ute ladies'-tresses (*Spiranthes diluvialis*) Surveys
Along Diamond Fork Creek
(Number of Flowering Plants Found)

Page 2 of 2

Location	**Colony ID**	**1992**	**1993**	**1994**	**1997**	**1998**	**Max. # for any 1 year**
Cottonwood-at-Bend	23	0	27	GI*	0	52	52
	23A	0	0	0	0	4	4
	24	1	99	GI*	0	0	99
	24A	0	0	0	1	0	1
East Bank Complex – North	24B	0	0	0	1,409	38	1,409
	24C	0	0	0	44	4	44
	25	0	662	GI*	6,251	2,462	6,251
	25A	0	0	0	20	0	20
	25B	0	0	0	10	0	10
	26	231	2,214	GI*	3	0	2,214
East Bank Meadow Complex	27	0	426	GI*	10	0	426
	28	0	97	GI*	46	0	97
	29	0	2	GI*	0	0	2
	30	0	8	GI*	0	89	89
	31	10	0	0	0	0	10
	32	1	0	0	0	0	1
	33	0	1	0	33	48	48
	33A	0	0	0	0	5	5
USFS Boundary	34	0	91	177	6	0	177
	35	0	71	10	169	388	388
Child's Ranch North	36	0	141	138	382	162	382
	37	0	0	0	6	0	6
	37A	0	0	0	0	1	1
Total Counts	**60**	**303**	**5,990**	**804**	**13,076**	**16,892**	**28,885**

* GI – Grazing Impacts – no data collected.

Table 3-38
Ute ladies'-tresses (*Spiranthes diluvialis*) Surveys
Spanish Fork River From Diamond Fork Creek
To Spanish Fork Diversion Dam
(Number of Flowering Plants Found)

Location	Colony ID	1992	1993	1994	1997	1998	Max # for any 1 year
Confluence	SPK-1	0	0	0	0	1	1
	SPK-2	0	0	0	0	4	4
	SPK-3	0	0	0	0	2	2
Shurtz Canyon Vicinity	SPK-4	3	12	10	27	0	27
	SPK-5	0	0	1	0	0	1
	SPK-6	0	3	0	0	0	3
	SPK-7	0	16	0	0	0	16
	SPK-8	0	77	2	0	0	77
Cold Springs Gaging Station	SPK-9	24	140	22	0	0	140
	SPK-10	0	257	25	0	0	257
Total Counts	**10**	**27**	**505**	**60**	**27**	**7**	**528**

3.7.5.1.2 June Sucker. The June Sucker is not present in the Diamond Fork Creek and Spanish Fork River system. However, the June Sucker is found in Utah Lake and uses the lower Provo River for spawning. The FWS in their Draft Biological Opinion agreed with the CUWCD Biological Assessment conclusion that there would be no direct effect on the June sucker from interim operation of the Diamond Fork System, but there would be an indirect effect on Provo River from operation of Jordanelle Reservoir as a result of exchanges to Utah Lake from interim operation of the Diamond Fork System.

3.7.5.1.3 Bald Eagle. The U.S. Fish and Wildlife Service (FWS) has reclassified the Bald eagle as threatened throughout most of the United States, including Utah (FWS 1994a). Breeding habitat in Utah is limited, and nesting by bald eagles was not documented until 1984. There are no nesting pairs in the effect area of influence.

However, wintering eagles are plentiful in Utah, with 1,263 recorded in 1985 at scattered locations during the National Wildlife Federation's midwinter survey (Henny and Anthony 1987). Counts conducted by the Utah Division of Wildlife Resources also indicate a general increase in wintering eagles (Bunnell 1994). Individuals are seen commonly in small numbers within the effect area of influence from August through March (Smith and Murphy 1973; USBR 1988b). They are frequently observed in the Diamond Fork Creek area and in scattered wetlands throughout central Utah (USBR 1988a). Known roosting sites are located in cottonwood stands along Diamond Fork Creek near Palmyra Campground. The primary food sources for this species are fish, rabbits, waterfowl and carrion (Smith and Greenwood 1983b).

3.7.5.1.4 Peregrine Falcon. Three subspecies of peregrine falcon (*Falco peregrinus*) occur in North America: Arctic peregrine falcon (*Falco peregrinus tundrius*), American peregrine falcon (*F. p. anatum*) and Peale's peregrine falcon (*F. p. pealei*). Currently, all peregrines nesting in the lower 48 states are listed as endangered under the Endangered Species Act (ESA) (FWS 1994b). In 1994, about 200 active nesting territories were recorded in Utah, primarily in the southern part of the state (Bunnell 1994). They also have been re-introduced to northern Utah by the Utah Division of Wildlife Resources using hack towers around Great Salt Lake (Paton 1994). 'eregrine falcons are considered to be spring-through-fall residents in the effect area of influence and are seen occasionally during migration near various wetlands such as Utah Lake (Smith and Greenwood 1983b; USBR

1988b). However, there have been no known active nesting sites in the vicinity of the project since 1968 (Shields and Moretti 1982; Bunnell 1994). Nevertheless, the high cliffs of the Wasatch Front and the proximity of excellent foraging areas around Utah Lake provide conditions suitable for re-establishment of the species in this area (Shields and Moretti 1982).

3.7.5.2 Species of Special Concern

3.7.5.2.1 Fish. The following fish species are of special concern:

Leatherside Chub. Leatherside chub were found historically in the streams and rivers of the eastern Bonneville Basin of Utah, the Sevier River system, and a few streams in Idaho and Wyoming (Sigler and Miller 1963). Available references indicate that the leatherside chub is a generalist occupying a wide variety of habitats, including a range of substrate types, flows, cover types and instream microhabitats (Sigler and Sigler 1987; Keleher 1994; Wilson and Belk 1996). A recent investigation of leatherside chub habitat preferences in the Sevier River found this species at depths of 2.4 to 38 inches, at current velocities of 0.2 to 2.5 feet per second, and in temperatures of 34°F to 78°F (Wilson and Belk 1996).

Within the Diamond Fork Creek/Spanish Fork River watershed, populations of leatherside chub exist in Thistle Creek, Soldier Creek, Diamond Fork Creek and the Spanish Fork River (Shirley 1989 and 1993).

The leatherside chub populations in Sixth Water and Diamond Fork creeks were destroyed in 1990 by an accidental release of rotenone from Strawberry Reservoir (Shirley 1991). In 1991, the Division of Wildlife Resources collected 2,000 leatherside chub from Thistle Creek and stocked these fish at eight locations in the Diamond Fork Creek drainage, including Sixth Water Creek just above Three Forks (Shirley 1991). In November 1993, leatherside chub were reported as being abundant (162 were observed) at the station in Diamond Fork Creek just below Brimhall Canyon (Shirley 1993). None were found in samplings at Sixth Water Creek 0.1 mile above Three Forks in 1994 (Utah Division of Wildlife Resources 1994b) or in 1996 and 1997 in Sixth Water Creek at Rays Valley Bridge and near Dip Vat Creek (Utah Division of Wildlife Resources 1996 and 1997b).

The most extensive survey of the leatherside chub in Diamond Fork Creek was conducted during October and November 1996. Sampling between Highway 6 and Monks Hollow found them to be common and the most abundant minnow in the stream (Walser et al. 1997). However, they were found predominantly in the creek below Brimhall Canyon where braided channels and backwaters are abundant. In the this stretch, most of the leatherside chub occupied the backwaters and cutoff pool habitats, with water depths of less than 12 inches and abundant vegetative cover. They may avoid the main channel due to the presence of abundant brown trout or a previously unknown autumn habitat shift (Walser et al. 1997).

Four to 35 leatherside chub were found at each of four stations surveyed on the Spanish Fork River between Diamond Fork Creek and Spanish Fork Diversion Dam in April and October 1994. Captured leatherside chub in the river were occupying sheltered habitat with low to moderate current velocities, typically consisting of undercut banks with tree roots, backwaters, small eddies along the edges of riprapped banks, and the edges of runs adjacent to stream banks.

Bonneville Cutthroat Trout. The Bonneville cutthroat trout still can be found in relatively isolated habitats throughout its historical range, no pure strains are known to exist in the effect area of influence. Now found in less than 5 percent of its original stream habitat, the Bonneville cutthroat has been listed as a sensitive species by Region 4 of the Forest Service and is recognized as a "Conservation" species (sufficiently managed under a Conservation Agreement) by the State of Utah (FWS 1996). The Conservation Agreement has identified streams in the effect area of influence as potential locations for establishment of populations.

It is likely that Bonneville cutthroat existed historically in the Diamond Fork drainage area. However, Martin et al. (1985 cited by FWS 1996) used electrophoresis techniques on cutthroat trout from Shinglemill, Chase, Fifth Water, Wanrhodes and Little Diamond creeks and determined that the Diamond Fork drainage currently has no pure strains. The abundance and quality of the stream and lake habitat once available to the subspecies has declined as a result of water diversion and degradation of riparian habitats from grazing, road building, mining and timber harvest. Perhaps the greatest effect is from the introduction of other salmonids. Rainbow trout have hybridized with cutthroat throughout the West, and competition and predation from brook and brown trout are suspected to have significantly reduced cutthroat numbers (Kershner 1995). Hybridization with other subspecies of cutthroat trout has also reduced pure strains of Bonneville cutthroat.

3.7.5.2.2 Birds. The following birds are of special concern:

Golden Eagle. Surveys for nesting raptors in the Diamond Fork drainage area have been conducted annually since 1990 (Keller 1997). The surveys consisted of observing historical nest sites and potential cliff habitat for any activity within or adjacent to the site or for the presence of stick nests that would indicate active use. Six pairs of golden eagles are known to nest within Diamond Fork Canyon. Three pairs are located within ½ mile of the construction area for the proposed Diamond Fork Siphon, Red Mountain Tunnel and Red Hollow Pipeline. One of the three pairs has two nests near the proposed Red Mountain Tunnel outlet portal. The second pair has seven to eight nests in the vicinity of Monks Hollow. The third pair has recently been discovered (Keller 1999a) nesting near the proposed Diamond Fork Siphon location. The three other pairs known to nest in Diamond Fork Canyon are approximately equally spaced from the canyon's confluence with Spanish Fork River to the Three Forks Area about 15 miles upstream. One of these nests would be within ½ mile of Three Forks Dam, a No Action Alternative Feature.

The golden eagle is not a listed species or a candidate species for listing under ESA. However, it is protected under the Eagle Protection Act, primarily because of its looks similar to bald eagles, and under the Migratory Bird Treaty Act (Littell 1992). Golden eagles are holarctic in distribution (Clements 1978) and are found in virtually all habitats of the western United States (Palmer 1988). With few exceptions, their breeding range is unchanged from historical times (Harlow and Bloom 1987). Olendorff et al. (1981) estimated a wintering population of nearly 50,000 in the western states, and Braun et al. (1975) estimated a total population of 100,000 for all of North America. During at least one recent year, the golden eagle population in Utah was reported to be increasing, although this may have been temporary, due to local increases in prey (Harlow and Bloom 1987). The species is relatively common throughout Utah and Juab Counties (Shields and Moretti 1982).

Surveys for nesting raptors in the Diamond Fork drainage area have been conducted annually since 1990 (Keller 1997). The surveys consisted of observing historical nest sites and potential cliff habitat for any activity within or adjacent to the site or for the presence of stick nests that would indicate active use.

Loggerhead Shrike. In central Utah, loggerhead shrike are considered year-round residents and are found in suitable habitat throughout the effect area of influence (Shields and Moretti 1982; Smith and Greenwood 1983b). While migrant shrike populations elsewhere in the United States continue to be designated as Category 2 candidate species, the Utah population is no longer a candidate species for listing under ESA (FWS 1994c). The breeding and wintering range of these birds extends from southern Canada to southern Mexico (Clements 1978). They occupy open country such as the sagebrush and pinyon-juniper habitats in Utah. Shields and Moretti (1982) noted shrikes in five habitats near Utah Lake: deciduous woodland, tamarisk, shadescale, greasewood and sagebrush.

Swainson's Hawk. Swainson's hawk (*Buteo swainsonii*), which is known to nest in the effect area of influence, has been identified by the State of Utah as a species of special concern (Utah Division of Wildlife Resources 1997a). This neotropical migratory raptor nests in trees near open desert grasslands, shrub steppes and agricultural fields, primarily but not exclusively, in the northern valleys and west deserts of Utah. While Swainson's hawk populations in Utah have declined from historical levels, they have increased in Utah and across its range from 1966 to 1994. However, pesticide poisonings of tens of thousands of Swainson's hawks have occurred since 1994 in Argentina where at least a portion of Utah's population winters.

Common Yellowthroat. The State of Utah has listed the common yellowthroat (*Geothlypis trichas*) as a species of special concern (Utah Division of Wildlife Resources 1997a). This neotropical migrant nests in riparian and wetland habitats statewide, but the population has declined significantly. A survey prepared for the Uinta National Forest indicates that this species inhabits the herbaceous wetland/willow interface and is therefore most likely to be found near the entrance marshes of Diamond Fork Canyon. The species was absent during the 1996 censuses, but had been reported previously (Forest Service 1996a).

3.7.5.2.3 Reptiles. The following reptiles are of special concern:

Utah Mountain Kingsnake. The State of Utah has listed the Utah mountain kingsnake (*Lampropeltis pyromelana infralabialis*) as a species of special concern (Utah Division of Wildlife Resources 1997a). Likely to be present in the effect area of influence, this colorful tri-colored snake occurs in disjunct, localized populations in many of the central Utah mountain regions. Its habitat includes chaparral woodland and pine forests in mountainous regions and bushy rocky canyons, talus slopes, and near streams and springs above 2,800 feet. Population declines, although difficult to detect in this secretive species, are thought to be due to habitat effects and overcollection.

Utah Milk Snake. The State of Utah has listed the Utah milk snake (*Lampropeltis triangulum taylori*) as a species of special concern (Utah Division of Wildlife Resources 1997a). This species is likely to be found in the effect area of influence, but overcollection and habitat effects may be factors in its apparent decline. It is spottily distributed in the mountain regions of eastern and central Utah. Often nocturnal, this species inhabits semi-arid regions, pine forests, deciduous woodlands, and suburban areas.

3.7.6 Effect Analysis

3.7.6.1 Methodology

3.7.6.1.1 Assumptions (Ute ladies'-tresses). The impact analysis relies on several assumptions developed in coordination with resource experts. Each assumption was applied to the analysis to closely approximate actual conditions, or, if necessary, to estimate effects greater than what would actually occur under the Proposed Action.

The analysis is based on the assumption that access to moisture is the driving force in the location of plants in a riverine system. Several considerations went into this assumption. As a riparian species it requires proximity to flowing water. It is not known from what soil depth the root system can access water, but soil structure and composition greatly affect the degree of capillary rise of soil moisture and holding capacity. Soil moisture may be augmented by several factors:

- Secondary hydrologic sources (springs, seeps, tributary creeks)
- Surface flow
- Subsurface flow
- Dew deposition

However, it is assumed the change in flow in Diamond Fork Creek and Spanish Fork River under the Proposed Action could have potential effects since soil moisture augmentation has not been identified (exception for secondary hydrologic sources at some sites).

Hydrologic analysis suggests that most, if not all, reaches of this system would gain more water from surface or sub-surface sources than they would lose. This means that the slope of the soil water elevation is at a positive angle to the creek water surface, which most likely varies by reach, distance from the channel and time. Although this angle has not been modeled, it is assumed (conservatively) that there is a one-to-one relationship between water surface elevation in the channel and groundwater elevation. Since groundwater responds to average flows in a channel (versus an immediate reaction to daily variation), monthly averages for baseline and proposed flows were used in the analysis.

It is also assumed that any change in flow due to the Proposed Action would take place immediately. While a gradual change in flow may be better for the Ute ladies'-tresses to adapt, migrate and colonize, a one-time change in flow would undoubtedly "open up" new habitat that may be suitable for Ute ladies'-tresses. This analysis does not take into consideration any positive effects on the species that may offset the significance of the negative effects predicted by the Hydrologic Engineering Center-River Analysis System model (HEC-RAS) (see Section 3.7.6.1.2 below).

The number of individuals per colony was estimated through a labor-intensive survey of all potential habitat in the project area. Only flowering individuals were identified and included in the counts, since vegetative individuals could only be identified through an inch-by-inch survey of all habitat. This assumes a relatively constant relationship between flowering individuals and total number of individuals at any one colony or throughout the survey area. Individuals may not flower or even show above-ground vegetative parts every year. Therefore, the maximum number of flowering individuals identified within a colony boundary in any one survey year was used to characterize the potential effect on a particular colony. The analysis then assumed that if a large number of flowering plants were identified in any one year, at least that number remains present at that location even if fewer were identified in previous or subsequent years. This is most likely a conservative assumption, since it also may reflect a change in habitat conditions that may no longer be able to support Ute ladies'-tresses.

It also was assumed that if even one flowering individual was identified at a location, the entire similar surface (point bar, flood plain, etc.) was potential habitat for that colony. Habitat acreage was defined as all the area within a single geomorphic surface similar to the area in which one or more flowering individuals of Ute ladies'-tresses were identified. Therefore, if the one plant was growing in a microhabitat that was unique on this geomorphic surface, the acreage assigned to this colony as potential habitat would have been greatly overestimated.

3.7.6.1.2 Effect Topic Analysis Methods (Ute ladies'-tresses). A number of methods were presented in the 1999 Completion of the Diamond Fork System Biological Assessment. The most comprehensive method used, which is presented here, was the HEC-RAS analysis.

In the fall of 1998, a field team consisting of an ecologist and surveyor flagged select locations of the 60 ULT colonies along Diamond Fork Creek and 10 along Spanish Fork River. The team targeted 32 of the 60 colonies in Diamond Fork Canyon and two of the 10 in Spanish Fork Canyon for a total of 34 colony/cross-section surveys. The surveyor collected topographic data (i.e., a mean elevation of the colony/habitat and micro-topographic changes within a colony/habitat and stream channel) needed to generate several flow-change scenarios using the (HEC-RAS model (Hydrologic Engineering Center 1989).

Results of this modeling were used to predict water surface elevations from predicted flow scenarios and to correlate them with mean colony elevations. Baseline and proposed flows (in cubic feet per second) were used as input flows in the HEC-RAS modeling program, and water surface elevations for these two types of flows were developed at each of the 34 colony cross-sections as outputs.

The model also predicts the percentage of time a particular elevation at a colony would be inundated. Four relative elevations of concern were identified at the cross-sections for each of the 34 colonies: mean surface elevation, 6" below mean surface elevation, 12" below mean surface elevation, and 18" below mean surface elevation. The HEC-RAS then calculated the percentage of time that each of these elevations was exceeded for each cross-section. This analysis was performed for both baseline and proposed flows. Differences in these percentages for baseline flows under the Proposed Action were examined for each cross-section and for the average flows in the growing season (April through October).

First, the potential for effect (high, moderate or low) was assessed for each of the 34 colonies that were located at a hydrologic cross-section. Different subsamples were used because of the difference in flows among the three strea' reaches (Diamond Fork from Three Forks to Diamond Fork Creek Outlet; Diamond Fork Creek from Diamond Fork Creek Outlet to Spanish Fork River; and Spanish Fork River from Diamond Fork Creek to Spanish Fork Diversion Dam).

The HEC-RAS then calculated the percentage of the total number of plants and the percentage of the total number of habitat acres that fell into each effect category. For the stretch between Three Forks to Diamond Fork Creek Outlet, both colonies had cross-sections and the results were not applied to any other colonies. On the Diamond Fork stretch from Diamond Fork Creek Outlet to Spanish Fork River, the percentage from the 30 colonies was then applied to the total number of plants and total number of acres of habitat in this stretch (58 colonies). On the Spanish Fork River the percentage from two colonies was applied to the total number of plants in the 10 colonies. The results were then added to provide a total project effect.

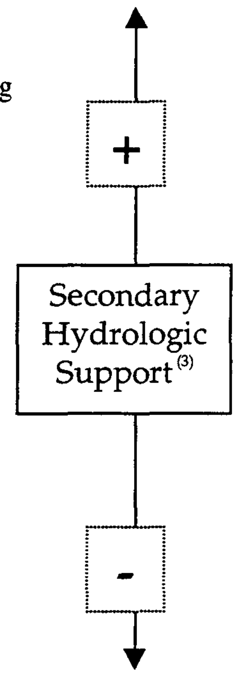
Within the context of the assumptions, the analysis is based on the difference between the elevation of plants and the elevation of the river surface. Short of surveying all plants in the drainage for elevation, the mean elevation of the habitat was estimated from the hydrologic cross-sections. The elevation of habitat at the cross-section was used in the model even if this was not the actual mean colony elevation. Regardless,, the absolute elevation of the occupied habitat is not important compared to the relationship of the habitat to the river channel. The relative relationship between habitat and water surface elevations is maintained by selecting the mean elevation for the entire habitat from the cross-sections. The team did not consider using 15-year-old maps to obtain the habitat elevations. They were developed on 2-foot contours, and in 15 years, movement of water and sediments downstream can create or wash out entire surfaces, shift stream channels, and cut or otherwise modify streambanks.

As mentioned previously, one effect on number of flowering individuals is a more accurate indicator of potential effect on the species than an estimate of potential effect on habitat acreage. The total number of flowering individuals in a colony or in the entire canyon can be easily quantified, but acreage can be subjective. For example, if a small number of flowering individuals are identified at one location during the survey, those individuals may actually be only in a very small portion of a larger geomorphic feature. _The entire feature is most likely identified as habitat when the plants actually are growing in a small patch of area that is the only adequate habitat on the entire geomorphic feature. In this scenario, the acreage identified may be on the order of 0.25 acres, when habitat of sufficient quality to sustain the species is actually on the order of square feet. Hence, the habitat parameter may be greatly over-estimated.

3.7.6.2 Evaluation Criteria

This section describes the criteria used to determine the magnitude of effects from the Proposed Action and No Action Alternative. Under the ESA, the U.S. Fish and Wildlife Service has sole authority to determine effects on threatened and endangered species. The ESA uses the terms “affect” and “may affect” to indicate degree of effect.

3.7.6.2.1 Ute ladies’-tresses. Three categories of "potential for effect" were developed - high, moderate and low – based on the evaluation criteria. Habitat described as having a "high potential for effect" are considered as a “may affect" on the population for purposes of this analysis. Each occupied habitat was placed in one of the three categories for "potential for effect" according to the following criteria (which are defined below):



LOW POTENTIAL

- Low to Moderate drying or wetting [1] in the first two critical depths during growing season
- Secondary Hydrologic Support
- Knowledge of Site Characteristics [2]

MODERATE POTENTIAL

- Moderate to High drying [1] in the first two critical depths during growing season
- Secondary Hydrologic Support
- Knowledge of Site Characteristics [2]

HIGH POTENTIAL

- High drying [1] in three or four critical depths
- No Secondary Hydrologic Support
- Knowledge of Site Characteristics [2]

[1] **Drying/Wetting:**
The proposed project would result in flow changes that will determine the amount of time a particular elevation would be inundated. A drying is a negative change in the percentage of time a particular elevation is inundated; a wetting is a positive change in the percentage of time an elevation is inundated.

[2] **Site Characteristics:**
- Geomorphology - oxbows, bars, flood plains etc.
- Microtopography
- Piezometer readings within a colony
- Manmade structures - berms, dikes, culverts

[3] **Secondary Hydrologic Support (May increase or decrease the categorical placement):**
- Site location in relation to river geometry
- Head source
- Proximity to bank
- Spring or seeps present

These criteria are based on the specific habitat and hydrologic data collected for the occupied habitats along surveyed reaches. Therefore, since only 34 colonies were surveyed (32 in Diamond Fork Canyon, 2 in Spanish Fork Canyon) and their hydrologic relationships modeled, these methods may only be applied to: 1) the 34 specific colonies with surveyed cross-sections, or 2) the analysis results extrapolated to the 70 colonies growing in the applicable sections of Diamond Fork and Spanish Fork canyons.

3.7.6.2.2 Species of Special Concern. Effects on species of special concern were evaluated for significance based on the following criteria:

- Effects to listed threatened and endangered species, or species proposed for listing, that result in any mortality or loss or adverse modification of critical habitat as designated under the ESA or that conflict with the objectives of an official recovery plan for the species.

- Effects on nonlisted species or the habitat of species special concern that result in substantial population reductions. "Substantial" reductions are considered to be those that would destroy a large area of utilized habitat, disturb or displace a resident sub-population, or result in losses of large numbers of individuals o1 the species.

3.7.6.3 *Potential Effects Eliminated From Further Analysis*

The following Forest Service sensitive species were eliminated from further analysis because the species or suitable habitat are not found in the effect area of influence:

- Spotted bat –Rare and may be limited by suitable roosting sites. They are found in relatively remote, undisturbed areas, suggesting that they may be sensitive to human disturbance. None found on the Uinta National Forest (Forest Service 1996b)

- North American lynx –Found across the boreal forests of Canada and Alaska and in isolated spruce, fir and lodgepole pine forests of Washington, Idaho, Montana, Wyoming, Colorado and Utah. (Forest Service 1996b). This type of habitat does not exist in the effect area of influence. There have been no sightings on the Uinta National Forest (Forest Service 1996b).

- Fisher – Recent research does not indicate any record of its existence in Utah (USDA 1994a cited in Forest Service 1996b)

- Western big-eared bat –Found in juniper/pine forests, shrub steppe grasslands, deciduous forests and mixed coniferous forests from sea level to 10,000 feet. None identified on the Uinta National Forest (Forest Service 1996b).

- Flammulated owl –Found in mixed pine forests, from pine mixed with oak and pinyon at lower elevations to pine mixed with spruce and fir at higher elevations. None found in the Uinta National Forest (Forest Service 1996b). Habitat does not exist in the effect area of influence. (Keller 1999b)

- Northern goshawk – Nest areas contain one or more stands of large, old trees with a dense canopy cover (Forest Service 1996b). The effect area of influence does not provide important habitat for the species, and any effects associated with project construction would not be significant. (CUWCD 1998d)

- Northern three-toed woodpecker – Found in forests containing spruce, grand fir, ponderosa pine, tamarack and lodgepole pine. Nests may be found in spruce, tamarack, pine, cedar and aspen trees (Forest Service 1996b). Suitable habitat does not exist in the effect area of influence. (Keller 1999b)

- Spotted Frog – Surveys were conducted in 1994 within Juab and southern Utah county to supplement the previous data collection by Ross et al (1993). No populations were found in the effect area of influence for the Diamond Fork features (CUWCD 1998d).

- Colorado cutthroat trout –Currently limited to a few small headwater streams of the Green River and upper Colorado River in Colorado, Utah and Wyoming (Forest Service 1996b). None are located in the effect area of influence.

- Barneby woody aster –Not found in Diamond Fork drainage or Spanish Fork Canyon (Forest Service 1999c).

- Dainty moonwort – Only one population known in Utah; not found in Diamond Fork drainage or Spanish Fork Canyon (Forest Service 1999c).

- Rockcress draba –Found in alpine tundra, often in rock stripes, talus or meadows; less commonly in spruce-fir communities at 10,300 to 12,500 feet in elevation (Forest Service 1996b). No habitat exists in the effect area of influence.

- Wasatch jamesia – Not known south of Rock Canyon (Forest Service 1999c).

- Garrett bladderpod – Not known in area of effect; primary habitat is high elevation alpine to subalpine elevations (Forest Service 1999c).

3.7.6.4 Proposed Action

3.7.6.4.1 Effects During Construction.

3.7.6.4.1.1 Plants. No Ute ladies'-tresses colonies are located in the area to be disturbed by construction of any of the Proposed Action features or by modifications to the Spanish Fork River diversion dams.

3.7.6.4.1.2 Fish. The only special-status species of fish that could be affected by construction would be the Leatherside chub, which is found in Diamond Fork Creek and Spanish Fork River. Neither the June sucker nor the Bonneville cutthroat trout are currently found in the effect area of influence. Construction activities would not significantly affect water quality (see Section 3.3.6.4.1.1), therefore there would be no effect on Leatherside chub.

3.7.6.4.1.3 Birds. The following bird species may be affected by construction:

Bald Eagle and Golden Eagle. Golden eagle nesting may be disturbed near the site of the proposed Red Mountain Tunnel outlet portal, Red Hollow Pipeline and Diamond Fork Siphon. Construction activities, including blasting, within 1 mile of golden eagle nest sites would increase the potential for nest abandonment, loss of eggs and young, and a short-term decline in recruitment of the local population. Temporary reductions in the local prey base could also occur during construction. Construction effects on golden eagle foraging habitat are not considered significant because the effects would be short-term and higher-value foraging habitat is available throughout the region. The Central Utah Water Conservancy District (CUWCD) would coordinate with the FWS and Utah Division of Wildlife Resources to obtain necessary permits and comply with all conditions.

The Spanish Fork River is not a known roosting or concentration area for bald eagles, and higher value habitat is abundant in the region. Construction of the Spanish Fork River diversions modifications would not affect bald eagles.

Peregrine Falcon. There would be no direct or indirect effects on breeding peregrine falcons since no nesting territories have been active in the region for more than 25 years (Shields and Moretti 1982). Foraging activity of peregrines would also not be affected by construction. Since peregrines are primarily aerial predators, important foraging areas are usually located near wetlands that support large concentrations of birds, especially waterfowl and shorebirds. No important foraging habitat would be disturbed during construction, and no effects on peregrines are anticipated.

Loggerhead Shrike. Shields and Moretti (1982) recorded loggerhead shrike in five habitats near Utah Lake: deciduous woodland, tamarisk, greasewood, shadescale and sagebrush. While migrant populations elsewhere in the United States continue to be designated as a species of special concern (FWS 1995), the Utah population is no longer included listed as a candidate for listing under ESA (FWS 1994c). Western breeding bird surveys indicate significant declines throughout the species' range, but the cause is not clear. No suitable habitat would be affected by construction of the Proposed Action.

Swainson's Hawk. No Swainson's hawk nests have been found in the effect area of influence. If active nests are located near any of the Proposed Action features, construction disturbance would increase the potential for nest abandonment, loss of eggs and young, and a short-term decline in recruitment to the population. However, the potential for short-term declines in productivity would not be a significant effect since the species would recover th following season in the absence of other environmental disturbances. Temporary reductions in the prey base could also occur during construction, but the effect would not be significant since the loss would be short-term, restricted to the construction sites, and would represent a fraction of the prey available in southern Utah and eastern Juab Counties.

Common Yellowthroat. No effects are expected since construction would not affect large wetland habitat preferred for nesting and feeding..

Yellow-Breasted Chat. This species would not be affected because construction would not affect the mature cottonwood forest habitat preferred for nesting and feeding..

Long-Billed Curlew. No effects are expected since construction would not affect large wetland habitat preferred for nesting and feeding.

Grasshopper Sparrow. No effects are expected since construction would not affect the dry grassland habitat preferred by the grasshopper sparrow.

3.7.6.4.1.4 ***Reptiles***. Clearing and grading activities could disturb the dens of reptiles, including the Utah milk snake and mountain king snake. No surveys have been done on denning sites within the rights-of-way required by the Proposed Action. In addition, open trenches and roadways could create a temporary hazard and be a barrier to movements. Implementation of Standard Operation Procedures (i.e., covering open trenches at the end of the day and inspecting for trapped animals before backfilling) would reduce the likelihood of this effect.

3.7.6.4.2 Effects During Operation.

3.7.6.4.2.1 Ute ladies'-tresses. This section presents the results of the effect analysis on the Ute ladies'-tresses population along Diamond Fork Creek and Spanish Fork River. Potential effects were examined on two levels: 1) effects on individuals, and 2) effects on acreage of potential Ute ladies'-tresses habitat. At any one colony location, the number of individuals was defined as the maximum number of flowering individuals identified for any one survey year (see Tables 3-37 and 3-38), which is a conservative estimate. As explained in the assumptions, the acres of habitat were determined by drawing a line around an entire geomorphic surface area where a plant or plants were found. This line may have included habitat that may never be colonized by this species, thereby over-estimating the actual acres of habitat that may be affected.

The effects from operation of the Proposed Action are presented by stream channel as follows:

Sixth Water and Red Hollow creeks. No effect since no colonies were found along Sixth Water or Red Hollow creeks.

Diamond Fork Creek (Three Forks to Diamond Fork Creek Outlet). The flow would increase from October through April and decrease from May through September, relative to baseline flows (see Table 3-39). Flows from November through March would increase by an average of about 20 cfs. The proposed October flow (42 cfs) is similar to the baseline flow (39 cfs). In April, the proposed flow (80 cfs) is slightly higher than baseline (67 cfs). From May through September, proposed flows would be considerably less (up to 85 percent) than baseline.

A total of 377 plants in two colonies (0.38 acres) along this reach of Diamond Fork Creek have a high potential to be affected by the Proposed Action (see Figure 3-1 A and Table 3-40).

Table 3-39
Streamflows Resulting From the Proposed Action

Monthly Flows (cfs)

Feature	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Diamond Fork Creek Below Three Forks (Diamond Fork Creek From Three Forks to Diamond Fork Creek Outlet)												
Change*	3	20	19	20	20	20	13	-46	-196	-250	-188	-86
Average Flow	42	36	33	32	34	38	80	134	64	45	42	42
Diamond Fork Creek Below Diamond Fork Creek Outlet (Diamond Fork Creek From Diamond Fork Creek Outlet to Spanish Fork River)												
Change*	22	44	46	48	46	42	18	-40	-171	-213	-149	-48
Average Flow	61	60	60	60	60	60	85	140	89	82	81	80
Spanish Fork River at Castilla Gage (Spanish Fork River From Diamond Fork Creek to Spanish Fork River Diversion Dam)												
Change*	42	100	113	126	139	146	160	202	178	132	97	71
Average Flow	135	170	181	193	221	259	407	667	583	496	380	249

* Change is equal to Proposed Action Average Flow minus Baseline Average Flow

Table 3-40
Number of Flowering Plants Per Effect Category
Proposed Action

Potential for Effect	Individuals		Acres	
Diamond Fork Creek (Three Forks to Diamond Fork Creek Outlet)				
	Numbers	Percent	Numbers	Percent
High	377	100%	0.38	100%
Moderate	0	0%	0.00	0%
Low	0	0%	0.00	0%
Total	377	100%	0.38	100%

Potential for Effect	Individuals		Acres	
Diamond Fork Creek (Diamond Fork Creek Outlet to Spanish Fork River Outlet)				
	Numbers	Percent	Numbers	Percent
High	1,710	6%	9.31	24.4%
Moderate	9,693	34%	8.93	23.4%
Low	17,105	60%	19.90	52.2%
Total	28,508	100%	38.14	100%

Potential for Effect	Individuals		Acres	
Spanish Fork River (Diamond Fork Creek to Castilla Gaging Station)				
	Numbers	Percent	Numbers	Percent
High	0	0%	N/A	N/A
Moderate	0	0%	N/A	N/A
Low	528	100%	N/A	N/A
Total	528	100%	N/A	N/A

Potential for Effect	Individuals		Acres	
PROJECT TOTAL Diamond Fork Creek Plus Spanish Fork River				
	Numbers	Percent	Numbers	Percent
High	2,087	7%	N/A	N/A
Moderate	9,693	33%	N/A	N/A
Low	17,633	60%	N/A	N/A
Total	29,413	100%	N/A	N/A

NOTE:

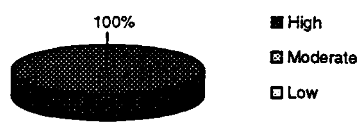
N/A - Not Available

Figure 3-1
HEC-RAS Effect Analysis Results

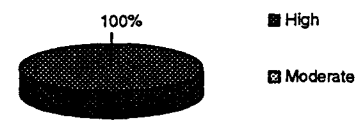
Page 1 of 2

A. Diamond Fork Creek from Three Forks to Diamond Fork Creek Outlet

Potential Effect on Maximum Number of Flowering Individuals



Potential Effect on Acres of Habitat



Maximum Number of Flowering Plants

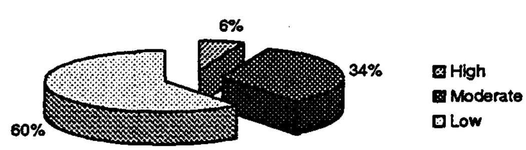
Potential for Effect	Percentage of Total	Total Reach (2 Colonies)
High	100%	377
Moderate	0%	0
Low	0%	0
Total	100%	377

Maximum Number of Acres

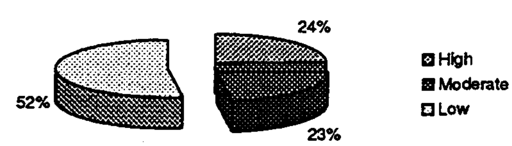
Potential for Effect	Percentage of Total	Total Reach (2 Colonies)
High	100%	0.38
Moderate	0%	0
Low	0%	0
Total	100%	0.38

B. Diamond Fork Creek from Diamond Fork Creek Outlet to Spanish Fork River Outlet

Potential Effect on Maximum Number of Flowering Individuals



Potential Effect on Acres of Habitat



Maximum Number of Flowering Plants

Potential for Effect	Percentage of Total	Sub-Sample (30 Colonies)	Total Reach (58 Colonies)
High	6%	1,500	1,710
Moderate	34%	8,169	9,693
Low	60%	14,717	17,105
Total	100%	24,386	28,508

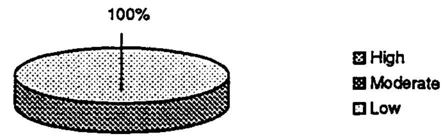
Acres

Potential for Effect	Percentage of Total	Sub-Sample (30 Colonies)	Total Reach (58 Colonies)
High	24.4%	6.81	9.31
Moderate	23.4%	6.54	8.93
Low	52.2%	14.61	19.90
Total	100%	27.96	38.14

Figure 3-1
HEC-RAS Effect Analysis Results

C. Spanish Fork River from Spanish Fork River Outlet to Castilla Gaging Station

Potential Effect on Maximum Number of Flowering Individuals

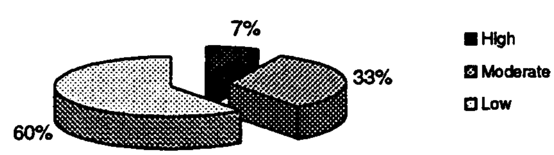


Maximum Number of Flowering Plants

Potential for Effect	Percentage of Total	Sub-Sample (2 Colonies)	Total Reach (10 Colonies)
High	0%	0	0
Moderate	0%	0	0
Low	100%	29	528
Total	100%	29	528

D. Total Analysis Results for All Plants Found in Project Area Diamond Fork Creek from Three Forks to Spanish Fork River Outlet and Spanish Fork River from Spanish Fork River Outlet to Castilla Gaging Station

Potential Effect on Maximum Number of Flowering Individuals in Project Area



Maximum Number of Flowering Plants

Potential for Effect	Percentage of Total	Total Project (70 Colonies)
High	7%	2,087
Moderate	33%	9,693
Low	60%	17,633
Total	100%	29,413

Diamond Fork Creek (Diamond Fork Creek Outlet to Spanish Fork River). As shown in Table 3-39, flows would be stabilized at about 60 cfs from October through March and 80 cfs in August and September. This would result in increased flow in October through March, but a decreased flow in August and September, relative to baseline flows. Compared to baseline, April flows would increase slightly; May flows would be reduced; and flows from June through August (during the growing season) would drop by 213 cfs to 149 cfs) – the greatest reduction from baseline.

Figure 3-1B shows results of the analysis for both flowering individuals and acreage. The percentage of flowering individuals assigned to the high, moderate, and low potential for effect categories was 6 percent, 34 percent and 60 percent, respectively. This translates to 1,500, 8,169, and 14,717 individuals, respectively, for the 30 colonies subsampled. These percentages were applied to the total numbers along this reach (28,508 individuals from 58 colonies); 1,710 plants had a high potential for effect and 9,693 and 17,105 had a moderate and low potential for effect, respectively. Using the evaluation criteria presented earlier, it is anticipated that there would be a high potential, or "may affect," for 6 percent of the total number of flowering individuals in Diamond Fork Canyon between Diamond Fork Creek Outlet and Spanish Fork River as a result of the flow changes under the Proposed Action.

The potential for effect on acres of habitat due to flow change differs from the resulting effect on flowering individuals (Figure 3-1B). Twenty-four percent of total habitat acreage fell in the high potential for effect category. Twenty-three and 52 percent fell into the moderate and low potential categories, respectively. This translates to 6.81, 6.54 and 14.61 acres of surveyed habitat, respectively, for the subsample. When these percentages are applied to total surveyed acreage from the Diamond Fork Creek Outlet to the Spanish Fork River, the totals are 9.31, 8.93, and 19.90 acres, respectively.

Figure 3-2 shows the numbers in a different fashion. Density was examined in order to understand the relationship of numbers of plants to the area defined as potential habitat. Whether looking at number of flowering individuals per acre or numbers of flowering individuals per colony, the relationship remains constant. Colonies with the lowest numbers per plot have a higher potential to be affected. Colonies with the highest numbers per plot have the lowest potential to be affected. When examining the mean of the numbers of flowering individuals per acre (mean density) relative to the potential for effect, the low and moderate potential for effect categories are represented by similar mean densities (1,007 and 1,249 flowering plants per acre, respectively). The lowest mean density colonies (276 flowering plants per acre) fall into the high potential for effect. Therefore, the colonies with the lowest densities may be growing in sub-optimal conditions and the same relative change in water surface elevation may be having a disproportionate effect on these colonies since they are already experiencing sub-optimal hydrologic conditions.

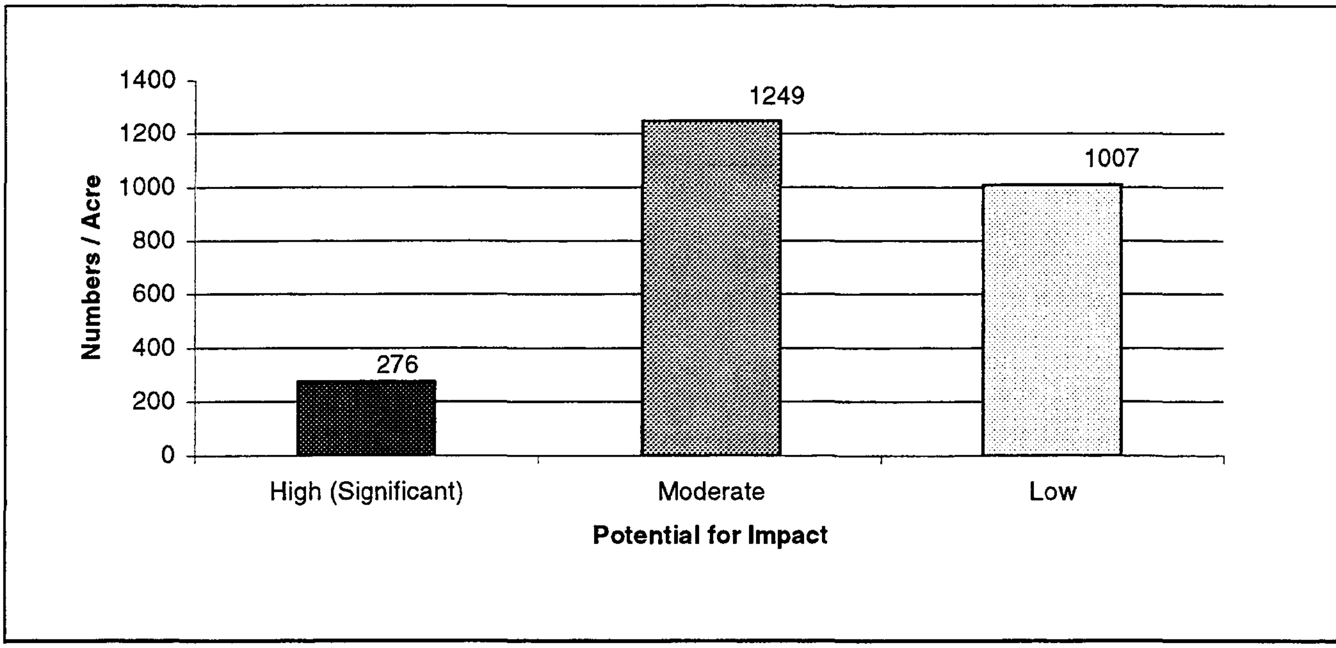


Figure 3-2
Density of Flowering Ute ladies'-tresses per Acre by Impact Category along Diamond Fork Creek Proposed Action

Spanish Fork River From Diamond Fork Creek to Spanish Fork Diversion Dam. As shown in Table 3-39, the flows in Spanish Fork River would be consistently higher than baseline for the entire year. A total of 29 plants in two colonies along this reach of the Spanish Fork River have a low potential to be affected by the Proposed Action (Figure 3-1C). Extrapolating to all the known colonies along this reach, a total of 528 plants in 10 colonies have a low potential for effect.

No acreage estimates are available for the Spanish Fork Canyon because 2-foot contour maps were not available for this portion of the study area.

Total Effects on Ute ladies'-tresses. No Ute ladies'-tresses have been found in the Sixth Water or Red Hollow drainages, therefore no effects on the species are anticipated. However, long-term effects are expected for the three stream reaches in Diamond Fork and Spanish Fork canyons where ULT have been identified. An overall project effect was estimated (Figure 3-1 D, and Table 3-40) by totaling the effects from all three stream reaches (Diamond Fork Creek from Three Forks to Diamond Fork Creek Outlet and from Diamond Fork Creek Outlet to Spanish Fork River; Spanish Fork River from Diamond Fork Creek to Spanish Fork Diversion Dam). For the total project, 7 percent of the plants have a high potential to be affected by the Proposed Action, while 33 percent and 60 percent have a moderate and low potential to be affected, respectively. This translates to 2,087 (high potential), 9,693 (moderate potential) and 17,633 (low potential) plants (29,413 plants total).

Acreage values were only available for Diamond Fork Creek (Three Forks to Spanish Fork River – Table 3-40). This analysis suggests that 25 percent of the total acreage in Diamond Fork Canyon (9.69 acres) would have a high potential for effect, while 23 percent (8.93 acres) and 52 percent (19.90 acres) of the Diamond Fork acreage would have a moderate and low potential for effect, respectively.

However, most of the colonies that have a high potential to be affected by the change in flows are growing in sub-optimal habitat as indicated by the relationship between density of these colonies and the potential for effect on them. In contrast, the proposed flow changes may allow for creation of new ULT habitat along Diamond Fork

Creek. Invariably, if new habitats are created, a portion of them may be suitable for colonization by ULT. Positive effect on the species resulting from an increase in suitable habitat has not been addressed in this analysis, and may offset any potential negative effects of the Proposed Action.

3.7.6.4.2.2 ***June Sucker.*** This section deals with the results of the Section 7 Endangered Species Act consultation with the FWS on the June sucker. The CUWCD's Biological Assessment concluded that interim operation of the Diamond Fork System would not affect the June sucker. The FWS has agreed with this conclusion with regard to direct effects of interim operation of the Diamond Fork System on the June sucker but has determined that there would be an indirect effect on the June sucker because interim operation of the Diamond Fork System would enable the exchange for water in the Provo River as part of the M&I System. The FWS provided the joint-lead agencies with a list of recommendations which if agreed to and implemented would result in a non-jeopardy Biological Opinion on the June sucker. The joint-lead agencies have agreed to the FWS recommendations which are presented in Section 3.20.6.

3.7.6.4.2.3 ***Leatherside Chub.*** Sampling in Sixth Water Creek in 1994, 1996 and 1997 found no leatherside chub. The extensive sampling of Diamond Fork Creek below Monks Hollow in 1996 found very few upstream of Brimhall Canyon. Therefore, this assessment of potential effects on leatherside chub focuses on Diamond Fork Creek below Brimhall Canyon, and the Spanish Fork River.

Diamond Fork Creek. The categories of potential effects on leatherside chub in Diamond Fork Creek are habitat loss, excessive predation by brown trout, and intolerable temperatures. The potential for each of these events to occur under the Proposed Action is evaluated below.

When surveyed in fall 1996, most of the leatherside chub in the 3.5 miles of Diamond Fork Creek below Red Hollow were found in the cutoff pools and backwater habitats rather than in the main channel (Walser et al. 1997). Using basic habitat suitability indices created from the range of water depth and current velocity in which Wilson and Belk (1996) found leatherside chub in the Sevier River, the 1997 Instream Flow Incremental Methodology (IFIM) study generated Weighted Useable Area estimates of leatherside chub habitat for three stations primarily representing the main channel of Diamond Fork Creek between Diamond Fork Creek Outlet and Spanish Fork River. Suitable habitat for leatherside chub in the main channel was maximized by a flow of 35 cfs.

The Proposed Action would change the base flow in this reach to about 60 to 80 cfs, which would increase leatherside chub habitat in the main channel by 24 percent over baseline conditions. Under baseline conditions, the average summer flow for June through September is 228 cfs; under the Proposed Action, it would be 83 cfs. During this 4-month summer period, the Proposed Action would increase the leatherside chub habitat in the main channel to 25 percent over baseline conditions. Therefore, the Proposed Action would create a 24 to 25 percent improvement in main channel habitat available to leatherside chub.

However, most of the leatherside chub are using the vegetated cutoff pool habitats and backwaters, some of which are spring-fed and offer ice-free winter habitat (Belk 1997). Under the Proposed Action, peak flow occurs in May. The average flow in May is about half the average flow in July (295 cfs) under baseline conditions. It is questionable whether the Proposed Action flows would maintain a sufficient quantity of cutoff pool and backwater habitats to support the present numbers of leatherside chub, since the number of braided channels would be reduced by riparian encroachment over a 10- to 20-year period. Because a long-term management goal for the creek is to restore the channel to a size more appropriate to its drainage area and projected streamflows, a certain amount of riparian encroachment and stream bank stabilization would be necessary. The number of actively braiding channels would decrease over time, but an unknown quantity of cutoff pools and spring-fed backwaters would continue to support a possibly reduced population of leatherside chub.

Although the main channels of this reach contained moderate numbers of brown trout, very few trout of a size sufficient to prey on leatherside chub were found in the backwaters and cutoff pools where leatherside chub were abundant. Conversely, very few leatherside chub were found in the main channels where there was little cover to protect them. Walser et al. (1997) suggested that predation by brown trout might explain why so few leatherside chub were found in the main channel.

The amount of leatherside chub habitat available in the main channel at 15 cfs is 6.5 times greater than the quantity of habitat available to adult brown trout. Making this same comparison with the 228 cfs average flow for June through September, an important period for fish growth, leatherside chub habitat is 117 percent of the adult brown trout habitat. Based on this comparison, it appears that brown trout predation may be the reason leatherside chub are rarely found in the main channel, even though there is ample leatherside chub habitat in the main channel (depth and velocity).

The baseline condition trout population (87 percent brown trout) for this segment of Diamond Fork Creek is 90 pounds per acre. The Proposed Action is estimated to increase the trout standing crop to 292 pounds per acre. This increase in brown trout would tend to encourage leatherside chub to remain confined to the shallow, vegetated cutoff pools and backwaters where they are most prevalent under baseline conditions. As noted above, these more isolated habitats will be needed to maintain the existing numbers of leatherside chub in Diamond Fork Creek under the Proposed Action.

The temperatures used in this analysis are based on results documented in Water Quality, Sections 3.3.5.1 and 3.3.6.4.2.1. The temperature analysis was based on Strawberry Reservoir releases using average below-thermocline and minimum below-thermocline temperatures. The baseline temperatures (using average below-thermocline) in Diamond Fork Creek below Red Hollow for May through September range from 45°F to 55°F. Temperatures (using average below-thermocline water) resulting from the Proposed Action for this same period would range from a May low of 46°F to a September high of 55°F. With minimum below-thermocline water, the temperature range for May through September under the Proposed Action would be 46°F in May, with the rest of the summer months averaging 46°F to 50°F.

The change in temperatures from baseline conditions would not adversely affect leatherside chub populations in thi portion of Diamond Fork Creek since this native minnow is found in waters with summer temperatures ranging from 50°F to 74°F Sigler and Sigler (1987). The primary spawning trigger for this species appears to be temperature, with peak spawning occurring when monthly water temperatures average 49°F (Johnson et al. 1995). Although leatherside chub spawning in the Utah Lake drainage typically occurs in May, spawning may occur in other parts of its range from June to August. Minimum-temperature water releases from below the thermocline would result in the leatherside chub spawning in June (average predicted temperature of 50°F). The cooler temperatures under the Proposed Action may result in a slower growth rate for leatherside chub.

Spanish Fork River (confluence of Diamond Fork Creek to Spanish Fork Diversion Dam). Baseline temperatures from May through September are 47°F to 56°F, with the 49°F spawning temperature occurring in June. Under the Proposed Action, temperatures would range from 48° F to 54° F using average below-thermocline water and 48° F to 50° F using minimum below-thermocline water. Under both conditions, the spawning temperature of 49°F would occur in June. Based on the temperature criteria for leatherside chub described above in the discussion of Diamond Fork Creek effects, neither the spring nor summer temperature regimes would have a significant adverse effect on leatherside chub in this part of Spanish Fork River.

As discussed previously for Diamond Fork Creek, the increased trout population as a result of the Proposed Action could increase the percentage of leatherside chub lost to predation. Trout standing crop is estimated to increase from 8 pounds per acre to 42 pounds per acre. Although 42 pounds per acre is still a relatively low density, it is over three times more than the present number of brown trout. This potential for increased predation on leatherside chub is partially mitigated by the fact that the flow conditions that increase habitat for trout (leading to increased trout production) should also improve the habitat for leatherside chub, thereby creating increased numbers of leatherside chub. In a best-case scenario, these increases would be roughly similar, and the percentage of leatherside chub lost to trout predation would be unchanged from the existing conditions. In a worst-case scenario, the numbers of leatherside chub in the Spanish Fork River above Spanish Fork Diversion Dam would decline to an unknown level because increased numbers of brown trout could result in significantly increased predation on leatherside chub.

Spanish Fork River (Spanish Fork Diversion Dam to Mill Race Diversion). The 4.4 miles of river between the Spanish Fork Diversion Dam and the Mill Race Canal diversion receive no flow except during the irrigation season, although 3 to 5 cfs of spring seepage sustains fish in the 2.8 miles of creek below the East Bench Diversion. The Proposed Action would provide year-round flows through this reach, which would benefit leatherside chub (see Table 3-2 in Section 3.2.6.4.2.1). Increased predation on leatherside chub is likely to occur as the trout population increases, but doubling the available year-round habitat should increase the number of leatherside chub in this reach over baseline conditions.

Under baseline conditions, the fisheries in Spanish Fork River (downstream of the Lake Shore Diversion) are limited by July and August flows of 3 cfs. The Proposed Action would increase the July and August flows to 120 and 86 cfs, respectively (see Table 3-2 in Section 3.2.6.4.2.1). Exceeding these proposed instream flows is not possible under the present allocation of water. This flow regime would benefit the existing fisheries of this stretch of river primarily by increasing summer flows, although summer temperatures would still be marginal for trout but beneficial for leatherside chub. The increases in winter flows would not adversely affect the fish population through increased turbidity and a reduction in suitable habitat because of increased current velocities.

3.7.6.4.2.4 Birds. There would be no significant effects on birds from operation of the Proposed Action. Changes in flows could increase the prey base for bald and golden eagles and enhance important winter roost sites and foraging habitat for bald eagles in Diamond Fork Canyon. The increases in winter and spring flows to a minimum of 60 to 80 cfs, combined with reduced late-summer flows, would increase the overall fish biomass in Diamond Fork Creek, providing a food source for bald eagles.

3.7.6.4.2.5 Reptiles. No significant effects on special-status reptiles are expected to occur.

3.7.6.4.3 Effect Summary. Operation could significantly affect 9.69 acres of occupied Ute ladies'-tresses habitat along Diamond Fork Creek, and 2,087 individual plants along Diamond Fork Creek and Spanish Fork River. However, most of the colonies, which have a potential to be significantly affected by the change in flows, are growing in sub-optimal habitat as indicated by the relationship between density of these colonies and the potential for effect on these colonies.

Interim operation of the Diamond Fork System would not directly affect the June sucker, however, the FWS has determined an indirect effect would occur to June sucker in lower Provo River from interim operation of the Diamond Fork System.

Construction of the Red Mountain Tunnel outlet portal, Red Hollow Pipeline and Diamond Fork Siphon could cause golden eagles to abandon their nests, lose eggs and young, and experience a short-term decline in recruitment of a localized population.

Operation would create a 24 to 25 percent improvement over baseline in leatherside chub habitat in Diamond Fork Creek, which would be a significant positive effect. However, lower flows in Diamond Fork Creek could decrease the number of cutoff pool and backwater habitats used by the leatherside chub, leaving the fish vulnerable to predation if the trout population rises as predicted.

3.7.6.5 No Action Alternative

3.7.6.5.1 Effects During Construction.

3.7.6.5.1.1 ***Ute ladies'-tresses.*** No direct disturbances are anticipated since all Ute ladies'-tresses colonies are located downstream of the Three Forks Dam and Reservoir site.

3.7.6.5.1.2 ***Fish.*** Construction of the Diamond Fork Pipeline extension, Three Forks Dam and reservoir and new access road could increase sediment. Standard Operation Procedures for construction procedures (see Chapter 1, Section 1.7.8) would prevent excessive input of sediment and inadvertent discharge of liquids such as petroleum products, harmful solvents, antifreeze, paints and freshly poured concrete. These preventative measures would reduce the risk of construction-related fishery effects to insignificant levels

3.7.6.5.1.3 ***Birds.*** Construction of the Diamond Fork Pipeline extension could affect the pair of golden eagles with seven to eight nests in the vicinity of Monks Hollow and the golden eagle tree nest near the Three Forks Dam site. Construction within 1 mile of golden eagle nest sites would increase the potential for nest abandonment, loss of eggs and young, and a resulting short-term decline in recruitment of the local population. Construction effects on golden eagle foraging habitat are not considered significant since it would be short-term, and higher-value foraging habitat is available throughout the region. The CUWCD would work with the FWS and Utah Division of Wildlife Resources to obtain necessary permits and comply with all conditions.

3.7.6.5.2 Effects During Operation.

3.7.6.5.2.1 ***Ute ladies'-tresses.*** There would be no effect on the ULT along Sixth Water or Red Hollow creeks since no habitat was found.

The effects from the No Action Alternative would be similar to those modeled for the Proposed Action. In Diamond Fork Creek from Three Forks to Red Hollow the difference in flow change over baseline of the No Action Alternative is very similar to the Proposed Action during the growing season.

The effects on the ULT is the same under the No Action Alternative and Proposed Action because of the minor flow changes anticipated. Along Diamond Fork Creek between Red Hollow and Spanish Fork River, the flows estimated under the No Action Alternative vary only slightly from those under the Proposed Action.

The effects on the ULT are the same under the No Action Alternative and Proposed Action because of the minor flow changes anticipated. In Spanish Fork River from Diamond Fork Creek to Spanish Fork Diversion Dam, the flows estimated under the No Action Alternative vary only slightly from those under the Proposed Action.

3.7.6.5.2.2 ***June Sucker.*** The No Action Alternative analysis is the same as under the Proposed Action in Section 3.7.6.4.2.2.

3.7.6.5.2.3 ***Leatherside Chub.*** The focus of the No Action Alternative analysis is the same as under the Proposed Action in Section 3.7.6.4.2.3.

Diamond Fork Creek. Habitat and predation effects of operation would be the same as those described under the Proposed Action.

Baseline temperatures (using average below-thermocline) in Diamond Fork Creek below Monks Hollow for May through September range from 45°F to 55°F. Temperatures (using average below-thermocline water) resulting from the No Action Alternative for this same period in Diamond Fork Creek would range from a May low of 48°F to a September high of 55°F. With minimum below-thermocline water, the Proposed Action temperature range for May through September would be 48°F in May, with the rest of the summer months averaging 44°F to 49°F.

Minimum-temperature water releases from below the thermocline would result in the leatherside chub spawning in June (average predicted temperature of 49°F). The cooler summer temperatures under the No Action Alternative may result in a slower growth rate for leatherside chub.

Spanish Fork River. In Spanish Fork River (from the confluence of Diamond Fork Creek to Spanish Fork Diversion Dam) baseline temperatures for May through September are 47°F to 56°F, with the 49°F spawning temperature occurring in June. Under the No Action Alternative, temperatures would range from 47°F in May to 55°F in September using average below-thermocline water and 47°F to 46°F using minimum below-thermocline water temperatures. Under both conditions, the spawning temperature of 49°F would occur in June. Based on the temperature criteria for leatherside chub neither of the spring and summer temperature regimes would have a significant adverse effect on leatherside chub in Spanish Fork River above Spanish Fork Diversion Dam.

In Spanish Fork River (from the confluence of Diamond Fork Creek to Spanish Fork Diversion Dam), the No Action Alternative is estimated to increase trout standing crop from 8 to 9 pounds per acre. At this level increase, brown trout predation on leatherside chub should not be a problem. The substantially increased current velocity and turbidity would decrease the amount of suitable habitat for leatherside chub. This habitat loss and the corresponding reduction in the leatherside chub population size in this reach would be a significant effect on leatherside chub.

Flows in Spanish Fork River below Spanish Fork Diversion Dam would be increased and provide year-round flow, which would result in a predicted increase in trout population that may increase predation pressure on leatherside chub. This increase could be significant since trout production is predicted to increase from 0 to 5 (baseline) to 16 to 66 pounds per acre under No Action Alternative conditions.

3.7.6.5.3 Effect Summary. The effect on Ute ladies'-tresses would be the same as under the Proposed Action.

Diamond Fork Creek habitat and predation effects on Leatherside chub would be the same as under the Proposed Action. Spawning would not be significantly affected. Loss of habitat in Spanish Fork River above Spanish Fork Diversion Dam may be significant, as would the increase in predation in Spanish Fork River below Spanish Fork Diversion Dam.

3.8 Soils

3.8.1 Introduction

This section addresses potential impacts on soil resources that would result from construction and operation of the Proposed Action and No Action Alternative. Potential impacts on surface water quality from erosion and sedimentation are addressed in Section 3.3, Water Quality, and Section 3.6, Aquatic Resources.

3.8.2 Issues Eliminated From Further Analysis

None.

3.8.3 Issues Addressed in the Impact Analysis

No issues or concerns specific to soil resources were identified during the SFN public and agency scoping process.

3.8.4 Description of Impact Area of Influence

The impact area of influence for soil resources is the area along the Proposed Action and No Action Alternative features and access roads that could experience ground disturbance during construction or operation.

3.8.5 Affected Environment (Baseline Conditions)

Soils that would be affected by the Proposed Action and No Action Alternative are in the Uinta National Forest. Soils within the impact area of influence vary in characteristics and use. Proposed features in the Diamond Fork drainage would be constructed mainly in mountainous terrain where erosion could occur on sloping sidehill areas and in creek bottoms.

The mountainous slopes of the Diamond Fork drainage vary from densely vegetated slopes containing grasses, shrubs and scrub oak to more irregular slopes containing scattered pinyon pines, junipers and rock outcroppings ranging from exposed ledges to massive cliffs. Soils in this area are subject to erosion on exposed slopes and in dry washes when heavy rains or rapid snowmelt occur.

Creek bottoms are typically bordered by steep slopes covered with forest soils interspersed with rock outcroppings. Unconsolidated fine soils are subject to gradual creep toward the creek bottom in several areas. Except where roads have been constructed, creek bottoms are generally dominated by shallow forest soils forming the streambanks and riparian zone, with sloped forest floor beyond. The riparian zone supports willows, shrubs, stands of boxelder, and isolated cottonwoods.

Erosion from construction activities could impact water quality (see Section 3.3) and aquatic habitat (Section 3.6). Disturbed soil at stream crossings would be vulnerable to erosion due to changes in the configuration of streambanks and beds caused by construction activities. Without restoration, higher flows could erode soils and carry them downstream.

Disturbance of soils, without mixing, could also impact soil resources, making it difficult to revegetate. For example, if a large area of alkaline/saline soil that receives less than 9 inches of precipitation a year were to be 'sturbed, revegetation may not succeed within a 3-year period because of climatic conditions and physical constraints of the soil. It is also more difficult to revegetate areas with alkaline soils that receive low rainfall than in areas with deep soils and normal precipitation.

The Sixth Water Creek bed is relatively wide at the proposed location of the Sixth Water Connection. During construction of the existing Sixth Water Aqueduct, the construction contractor established staging and spoil disposal areas in the creek bottom. Upstream from the proposed connection, Sixth Water Creek is bordered by steep colluvial slopes with highly erodible, active landslides that continually provide material for erosion.

Tanner Ridge Tunnel, Diamond Fork Siphon and Red Mountain Tunnel would be constructed on predominantly steep terrain with sloping surfaces and shallow soils. Red Hollow Pipeline and access road would be constructed on similar soils in some areas and on relatively even terrain in other areas. The Diamond Fork Creek Outlet would be constructed on flat terrain near Diamond Fork Creek.

The Spanish Fork River outlet would be constructed on relatively flat terrain in a previously disturbed area along Diamond Fork Road and in a section of the Highway 6 embankment.

Three Forks Dam and Reservoir would disturb the sloping sidehill terrain along Cottonwood, Sixth Water and Diamond Fork Creeks. The Upper Diamond Fork Pipeline would be built along the floor of Diamond Fork Canyon, which is composed of relatively flat terrain.

3.8.6 Impact Analysis

3.8.6.1 Methodology

The impact analysis consisted of a detailed review of project features and their potential impacts on soils after Standard Operating Procedures (described in Section 1.7.8, Chapter 1) are implemented.

3.8.6.2 Significance Criteria

Impacts on soil resources are considered significant if construction, operation or maintenance activities would result in any of the following conditions:

- Increased erosion rates or reduced soil productivity due to compaction or soil mixing to a degree that would prevent successful revegetation.
- Disturbance of soils with physical and chemical limitations that would prevent successful revegetation.
- Poor revegetation results, due to contamination by toxic materials such as fuels, oil and grease or other conditions.

3.8.6.3 Potential Impacts Eliminated From Further Analysis

None.

3.8.6.4 Proposed Action

3.8.6.4.1 Impacts During Construction. By applying the SOPs described in Chapter 1, most soil impacts would be insignificant from construction of the Proposed Action features and modifications of Spanish Fork Diversion dams. The key SOPs are 1.7.8.1 Erosion Control, 1.7.8.2 Restoration, and 1.7.9.1 Monitoring and Follow-Up. The 131.6 acres that would be disturbed would be restored after construction.

Based on the significance criteria, about 6 acres of soil would be significantly impacted. This includes 2 acres above the inlet and outlet tunnel portals of the Tanner Ridge and Red Mountain tunnels that would not be revegetated after construction because it is mostly rocky and inaccessible. Another 4 acres would be disturbed and not revegetated by construction of the Diamond Fork Creek Outlet and flow control structure, Spanish Fork River Outlet, and the Red Hollow access road.

3.8.6.4.2 Impacts During Operation. The increase of minimum flows to about 25 cfs in Sixth Water Creek above Sixth Water Aqueduct would only slightly increase erosion. Any increase in erosion caused by higher flows would be alleviated as Sixth Water Creek equilibrates with the new flow regime. The Proposed Action features would convey water that was formerly carried in Sixth Water Creek below Sixth Water Aqueduct and Diamond Fork Creek. Reduced flows in these two creeks would significantly benefit soils by decreasing erosion. The Spanish Fork River would have higher flows, which would increase streambank erosion and cause an unavoidable but insignificant adverse impact.

3.8.6.4.3 Impact Summary. A significant adverse impact on soils from construction and operation of the Proposed Action would be the lack of revegetation on approximately two acres at the inlet and outlet portals of the Tanner Ridge and Red Mountain Tunnels, and the loss of four acres from the construction of the Diamond Fork Outlet and flow control structure, Spanish Fork River Flow Control Structure, and the Red Hollow access road. A significant beneficial impact of the Proposed Action would be decreased erosion along Sixth Water Creek below Sixth Water Aqueduct and Diamond Fork Creek. Higher flows than occur at present would be carried in the Spanish Fork River. These flows could result in increased stream bank erosion, which would not be considered significant, but an unavoidable adverse impact.

3.8.6.5 No Action Alternative

3.8.6.5.1 Impacts During Construction. Most soil impacts would be insignificant under the No Action Alternative by applying the same SOPs as for the Proposed Action. About 58.8 acres would be disturbed during construction of Three Forks Dam and Reservoir, which would require diverting Diamond Fork Creek around the work area and excavating the creek bed to construct the dam foundation. The diversion system would be constructed to minimize soil erosion into the creek. The pipeline would also be constructed to avoid erosion. Excavation for the dam foundation would be conducted in a dewatered section of the creek bed. In spite of precautions, soil would be washed into the creek at times, particularly when establishing or modifying the temporary diversion during dam construction. However, since erosion is expected to be minimal, the impact on soils would not be significant.

Based on the significance criteria, 30.1 acres of soil would be significantly impacted during construction of the dam, reservoir, new access road and road spoil pile. These areas would not be reclaimed or revegetated.

3.8.6.5.2 Impacts During Operation. The increase of minimum flows to about 25 cfs in Sixth Water Creek above Sixth Water Aqueduct would only slightly increase erosion. Any increase in erosion caused by higher flows would be alleviated as Sixth Water Creek equilibrates with the new flow regime. Operational impacts of the No Action Alternative would consist primarily of increased erosion along Sixth Water Creek due to higher flows. Less erosion would occur to the banks of Diamond Fork Creek because most of the transbasin diversion would be conveyed in the Diamond Fork Pipeline. This would result in higher flows in the Spanish Fork River, which would ıcrease streambank erosion and cause an unavoidable but insignificant adverse impact.

3.8.6.5.3 Impact Summary. A significant adverse impact on soils that would result from construction and operation of the No Action Alternative would be increased bank erosion along Sixth Water Creek from Sixth Wat Aqueduct to Three Forks Reservoir. A significant beneficial impact on soils would be a reduction in bank erosion along Diamond Fork Creek below Red Hollow. This alternative would also cause a significant impact on 30.1 acres of soil that would be removed from production by features of the No Action Alternative. Higher flows than occur at present would be carried in the Spanish Fork River. These flows would result in increased stream bank erosion , which would not be considered significant, but an unavoidable adverse impact.

3.9 Agriculture

3.9.1 Introduction

This section addresses potential impacts on agriculture that would result from construction of the Proposed Action and No Action Alternative. Agricultural impacts are addressed based on an assessment of changes to grazing lands and allotment operations in the impact area of influence.

3.9.2 Issues Eliminated From Further Analysis

None.

3.9.3 Issues Addressed in the Impact Analysis

The primary issue is the impact of construction of the Proposed Action and No Action Alternative on grazing lands and allotment operations in the Diamond Fork Drainage Area.

3.9.4 Description of Impact Area of Influence

The impact area of influence includes 103,043 acres of open-range, dry grazing land in the Diamond Fork Drainage Area. This includes the Diamond Fork Canyon and various tributary canyons in the Uinta National Forest.

3.9.5 Affected Environment (Baseline Conditions)

The 103,043 acres of National Forest lands that would be affected by the Proposed Action or No Action Alternative are used for cattle grazing. The Uinta National Forest allows cattle grazing within the Diamond Fork Drainage under a three-pasture, rest-rotation grazing system under the Diamond Fork C&H Allotment Management Plan (Forest Service 1995). The management plan identifies the need to allow grazing, but maintain vegetative resource conditions that have been established for riparian areas, big game winter range, and aspen and upland habitats.

The plan allows 2,127 cow/calf pairs and 9,004 animal unit months (AUMs) in the area each year. The area includes a number of range improvements such as fences, watering troughs and stock ponds (Forest Service 1995). Of the three pastures only the Diamond Fork and Hollows units would be directly impacted by the Proposed Action or No Action Alternative.

3.9.6 Impact Analysis

3.9.6.1 Methodology

Project impacts on grazing land were determined by calculating acreage lost due to construction in the Uinta National Forest compared to the total acreage in the Diamond Fork Drainage area. The analysis also compared current allotment operations with changes that may be necessary during construction and operation of the Proposed Action or No Action Alternative.

3.9.6.2 Significance Criteria

Impacts on agricultural resources are considered significant if the construction or operation of the Proposed Action or No Action Alternative would:

- Necessitate a change in the grazing system, season of use, type of livestock, or amount of permitted use

- Cause more than a 10 percent increase in the cost of operating or administering the grazing allotment

3.9.6.3 Potential Impacts Eliminated From Further Analysis

None.

3.9.6.4 Proposed Action

3.9.6.4.1 Impacts During Construction. Acreage disturbed during construction of Proposed Action features are primarily range lands managed by the Uinta National Forest under the Diamond Fork C&H Allotment Management Plan. Of the disturbed acreage, 131.6 acres would be revegetated upon completion. The projected loss of about 6 acres that would not be revegetated is less than 1 percent over baseline conditions, which is not a significant impact.

Construction activities would not affect implementation of the Diamond Fork Management Plan except that permittees would need to coordinate livestock movement with construction activities. By applying the SOPs described in Chapter 1, Section 1.7.8, impacts on livestock during construction would be insignificant. The key SOPs are 1.7.8.6 Agricultural Resources and 1.7.9.1 Monitoring and Follow-Up. Impacts on livestock operations would be limited to increased human activity in the pastures to be grazed each year and restricted access during the 3 ½ -year construction period. The impacts are unquantifiable, but any conflicts would be minimized to the extent possible under the SOPs.

3.9.6.4.2 Impacts During Operation. Currently the high flows in Sixth Water and Diamond Fork Creeks provide an effective deterrent to livestock crossing. Reduced flows in Sixth Water and Diamond Fork Creeks would eliminate the natural barrier between the Diamond Fork and Hollows Unit pastures. The allotment is managed under a three pasture rest rotation system. In order to meet the requirements of this system the permittees would have to constantly herd the livestock along about two miles of Diamond Fork Creek near Monks Hollow to prevent them from grazing in the wrong pasture. This would be a substantial cost increase to the permittees, and possibly a significant impact.

3.9.6.4.3 Impact Summary. Construction activities are not expected to cause significant impacts on the grazing resources or allotment operations in the impact area of influence. Operation of the project would cause operational problems which could result in a significant increase in permittee management costs.

3.9.6.5 No Action Alternative

3.9.6.5.1 Impacts During Construction. Acreage disturbed during construction of No Action Alternative features are primarily range lands managed by the Uinta National Forest under the Diamond Fork C&H Allotment Management Plan. Of the acres that would be disturbed, 58.8 acres would be revegetated upon completion. This projected loss of 30.1 acres is less than 1 percent over baseline conditions. Even though the majority of this loss would occur in the Hollows Unit pasture, the loss would not be significant.

By applying the SOPs described in Chapter 1, Section 1.7.8, impacts on existing range improvements would be insignificant. The key SOPs are 1.7.8.6 Agricultural Resources and 1.7.9.1 Monitoring and Follow-Up.

Construction would eliminate access to the Fifth Water and Cottonwood Creek cattle trails, which means cattle would need to be trucked to the other pastures. This would represent a significant operational cost increase to permittees. Such a cost increase could eliminate the viability of grazing the upper half of the Diamond Fork and Hollows pastures, thereby necessitating a temporary reduction in AUM's. Smaller operators may be forced out of business if operating costs are increased significantly. This would be a significant impact. Access restrictions would also affect cattle management during the three-year construction period, but implementing the SOPs would minimize the impact.

3.9.6.5.2 Impacts During Operation. Currently the high flows in Sixth Water and Diamond Fork Creeks provide an effective deterrent to livestock crossing. Reduced flows in Sixth Water and Diamond Fork Creeks would eliminate the natural barrier between the Diamond Fork and Hollows Unit pastures. The allotment is managed under a three pasture rest rotation system. In order to meet the requirements of this system the permittees would have to constantly herd the livestock along about two miles of Diamond Fork Creek near Monks Hollow to prevent them from grazing in the wrong pasture. This would be a substantial cost increase to the permittees, and possibly a significant impact.

Agricultural production under the No Action Alternative would be affected by applying 14,700 acre-feet of Bonneville Unit supplemental irrigation water on irrigated portions of South Utah Valley. Although the specific distribution and use of this water is unknown, the supplemental irrigation water diverted from the Spanish Fork River would occur during the irrigation season, probably in July and August. This increase in application of irrigation water would be small compared to the total amount diverted for irrigation under baseline conditions. The changes associated with the increase would be immeasurable and unquantifiable, and would not likely result in any significant impact on agricultural production compared to baseline conditions.

3.9.6.5.3 Impact Summary. The major construction impact would be the elimination of the Fifth Water and Cottonwood Creek cattle trail access from the Diamond Fork side. The impact on cattle operations of reduced flows in Sixth Water and Diamond Fork Creeks would be the same as for the Proposed Action.

3.10 Recreation Resources and Special Status Areas

This two-part section addresses potential impacts on recreation resources and special status areas (roadless areas) that would result from construction and operation of the Proposed Action and No Action Alternative.

3.10.1 Recreation Resources

3.10.1.1 Introduction

This subsection addresses potential temporary and permanent disruptions to recreational resources that would result from construction, operation and maintenance of the Proposed Action or No Action Alternative.

3.10.1.2 Issues Eliminated From Further Analysis

The impacts to Utah Lake water levels by operation of a future Utah Lake Drainage Basin Water Delivery System of the Bonneville Unit will be addressed in that planning process. Potential impacts to Utah Lake recreational resources as a result of that operation will be addressed in the Utah Lake Drainage Basin Water Delivery System EIS. There are no impacts to Utah Lake water levels by the Diamond Fork System.

3.10.1.3 Issues Addressed in the Impact Analysis

The impact analysis addressed the effects on the following uses:

- Recreational uses in the Diamond Fork Drainage such as camping, picnicking, sightseeing, fishing, hiking, horseback riding, and hunting
- Fishing along the Spanish Fork River from Diamond Fork Creek to Utah Lake

3.10.1.4 Description of Impact Area of Influence

The impact area of influence is shown as the project area on Map S-1, (Section S.3.1, Summary). It includes the area bounded on the East by the Sheep Creek-Rays Valley Road, on the North by the Right Fork of Hobble Creek Road and Halls Fork, on the West by Red Hollow, on the South by Highway 6, and includes the Spanish Fork River corridor from Diamond Fork Creek to Utah Lake.

3.10.1.5 Affected Environment (Baseline Conditions)

Table 3-41 shows recreation uses (and their locations) that could be impacted by construction and operation of the Proposed Action and No Action Alternative.

Table 3-41
Potentially Impacted Recreation Uses and Location

Primary Recreation Uses	Predominant Use Location
Hiking/Horseback riding	Sixth and Fifth Water Creek trails, Monks and Red Hollow areas
Hunting	Entire Diamond Fork Canyon area
Developed camping	Palmyra and Diamond Campgrounds along Diamond Fork Creek
Dispersed picnicking and camping	Along Diamond Fork Creek
Fishing	Sixth Water Creek, Diamond Fork Creek, Spanish Fork River
Sightseeing/driving for pleasure	Entire Diamond Fork Canyon area

The major passenger vehicle access roads which provide recreation access to and through the impact area of influence are: Diamond Fork Road, Right Fork of Hobble Creek Road, Springville Crossing-Rays Valley Road, and Sheep Creek-Rays Valley Road. However, the Right Fork of Hobble Creek Road and Springville Crossing-Rays Valley Road are not passable during wet conditions except by four-wheel drive vehicles.

The amount and type of recreation use currently occurring is unknown. Neither the U.S. Forest Service nor the Utah Division of Wildlife Resources have conducted visitor surveys or counts to determine actual use levels and types of recreation in the Diamond Fork Canyon area and along Spanish Fork River. But the Forest Service estimates the two developed campgrounds – Palmyra and Diamond – receive an estimated 74,000 visitor days (a visitor day consists of 12 hours of use) annually, and the Diamond Fork Canyon had an estimated 720,000 visitor days in 1997 (Forest Service 1998).

During summer the area along Diamond Fork Creek is used heavily for dispersed camping and picnicking. The Diamond Fork drainage is also a favorite place for driving for pleasure and sightseeing. During dry conditions the access roads provide an opportunity for a loop drive. In the fall, many hunters use dispersed camp sites throughout the area. The Forest Service estimates that about 125 dispersed camping sites exist in the impact area of influence (Wanrhodes, Diamond Fork, and Halls Fork area). Hunting use is heavy throughout the Diamond Fork drainage.

Although no creel censuses have been conducted by the Utah Division of Wildlife Resources on Diamond Fork or Sixth Water creeks, fishing is popular in the area. Little fishing use occurs along the Spanish Fork River corridor from Diamond Fork Creek to Utah Lake because the majority of the area is privately owned, access is limited, and flows are erratic.

Table 3-42 shows the estimated baseline angler days per year use for the major stream segments that would be impacted by the Proposed Action or No Action Alternative. The estimated use is based on the current fish production (pounds per acre of stream) in the streams. Section 3.10.1.6.1 provides detail on the methodology used to determine these numbers. Section 3.6 Aquatic Resources in this chapter provides details on current stream conditions and fish production.

Table 3-42
Baseline Angler Day Per Year Use of Key Stream Segments

Stream Segment	Angler Days Per Year
Sixth Water Creek	
Strawberry Tunnel to Sixth Water Aqueduct	3,133
Sixth Water Aqueduct to Fifth Water Creek And Fifth Water Creek to Three Forks	113
Diamond Fork Creek	
Upstream of Three Forks	336
Three Forks to Diamond Fork Creek Outlet	235
Diamond Fork Creek Outlet to Diamond Campground	127
Diamond Campground to Brimhall Canyon	545
Brimhall Canyon to Spanish Fork River Outlet	437
Spanish Fork River*	
Diamond Fork Creek to Spanish Fork Diversion Dam	143
Spanish Fork Diversion Dam to East Bench Dam	0
East Bench Dam to Mill Race Diversion	24
Mill Race Diversion to Utah Lake	0

Notes:

* The use shown for Spanish Fork River is potential use that could be occurring if public access was acquired. At the present time no public access exists along the river and the only use that occurs is by trespass or permission of the landowner.

3.10.1.6 Impact Analysis

3.10.1.6.1 Methodology. The methodology used to determine existing and potential angler use in the impact area of influence was adapted from Wiley, D. and C. Thompson, *Sixth Water Creek Fishery Investigation and Recommendations 1997*, Utah Division of Wildlife Resources, Springville, December 8, 1997 (Wiley and Thompson 1997a). The methodology is based on angler use and trout production on the 5.9 mile stretch of Provo River from Deer Creek Reservoir downstream to Olmstead Diversion.

The Provo River is managed as a high quality trout stream. It was assumed (Wiley and Thompson 1997a) that Diamond Fork Creek also would be managed as a high quality trout stream once the Diamond Fork System was completed. The methodology is based on the pounds of fish produced by a stream. Study of the Provo River determined that about 2.81 angler-days of use occurs per pound of wild trout standing crop. An angler day is 2.6 hours of fishing within a 24 hour period. Due to differences between the Provo River and Sixth Water and Diamond Fork creeks, the methodology was modified and the 2.81 angler-day use factor was adjusted. Details on how the methodology was adjusted and the angler-day use factor used are described in the *Angler Day Methodology Technical Memorandum* (CUWCD 1999b).

Some of the modifications were based on the fact that Sixth Water and Diamond Fork creeks are not accessible or fishable year-round compared to the Provo River. The difference in accessibility to population centers also was considered. The following is an example of how the methodology was adjusted and used.

Months not usable (4) divided by total months (12) times 100 = 33 percent.
Useable percent of the year = 100-33 = 67 percent
Angler day adjustment = 2.81 angler days x .67 = 1.88 x .90 (100 percent – 10 percent reduction for reputation) = 1.69 angler days per pound of fish

The 1.69 angler days per pound of fish was then multiplied by the pounds of fish predicted to be produced by a stream segment to predict the potential angler day use for that segment.

3.10.1.6.2 Significance Criteria. Impacts on recreational resources are considered significant if construction, operation or maintenance activities would result in any of the following conditions:

- A reduction of 5 percent or more in recreational use of existing facilities and/or resources during construction or extending beyond the construction period
- Elimination of any recreation facilities or resources
- Enhancement of any available public recreational facilities and/or resources that would increase recreational use more than 5 percent

3.10.1.6.3 Potential Impacts Eliminated From Further Analysis. None.

3.10.1.6.4 Proposed Action.

3.10.1.6.4.1 Impacts During Construction. The major impact on recreation resources and use would be caused by road closures. A 5.3 mile portion (35 percent of the total road length from State Highway 6 to Springville Crossing) of the Diamond Fork Road would be closed during the 3 ½ year construction period. The Red Hollow Road would be gated at the junction with Diamond Fork Road, prohibiting public use during construction. The road closures would likely start in the fall of 1999 and continue until the first part of July in the year 2003. These road closures would impact driving for pleasure and sightseeing, hiking, horseback riding, dispersed camping, fishing, and hunting.

Access to the main trailhead (Three Forks) for the Sixth Water and Fifth Water trails and the hot springs area would be eliminated by the road closures. The number of users that this would affect is unknown, but the trails and hot springs area would still be accessible from Sheep Creek-Rays Valley Road, including an area near the trailhead that users could park in. The distance from this trailhead access point to the hot springs area is shorter than from the Three Forks trailhead. However the trails are not as well signed and are steeper than the trail from Three Forks. This access point was used during construction of the Diamond Fork Pipeline and did not noticeably reduce the number of users (Swenson 1999).

The road closures would temporarily eliminate the use of about 76 (61 percent) dispersed camping sites. Based on the significance criteria this would be a significant short term (3 ½ year) impact. The number of users (hunters, picnickers, and anglers) that this would impact is unknown. The remainder of the Diamond Fork drainage would remain available for these activities. The closure of these sites could result in increased resource damage in other areas from overuse. However, the closure of these sites would have a beneficial impact of allowing the vegetatior especially riparian vegetation along Diamond Fork Creek to recover.

Hunters and sightseers would not have direct access to the upper part of Diamond Fork Canyon during the road closure. Access would be through a longer route from the Right Fork of Hobble Creek Road, Springville Crossing-Rays Valley Road, and Sheep Creek-Rays Valley Road and a loop drive would still be available. This would be a minor inconvenience, and not a significant impact as it would continue to provide a scenic route to and through the area. The only change from baseline conditions would be the fact that passenger cars would not be able to access the upper part of Diamond Fork Canyon during wet conditions. However, this would not likely affect hunter use since the majority of that use is through the use of four-wheel drive or heavy duty truck vehicles.

Users of the two developed campgrounds (Palmyra and Diamond) would have direct access, but would experience minor inconvenience from construction traffic along Diamond Fork Road during the 3 ½ -year construction period.

The road closures would impact some hunters, especially those who "road hunt". The major impact would be on hunters who use the lower portion of the Red Hollow area. They would have to access the area on foot or horseback. Hunters would also have to access the area around the closed portion of the Diamond Fork Road by foot or horseback. However this area would still be available for hunting. Some areas may be closed to hunting to protect construction workers. Any closures would be coordinated with the Utah Division of Wildlife Resources. However the majority of the Diamond Fork Drainage would remain available for hunting. The number of hunters that would be impacted by these changes is unknown, but this impact is not expected to exceed the five percent significance criteria.

3.10.1.6.4.2 Impacts During Operation. Fishing would be the only recreational use or resource that would be impacted by operation of the Proposed Action. While the methodology described above in this section provides a prediction of potential increase in angler use, actual increases in usage cannot be predicted because specific existing use data is lacking for the area. The predicted increase in angler use is based on predicted changes in stream conditions and trout production, which is explained and documented in the Aquatic Resource Section (Section 3.6.) Although increased trout production is predicted to occur in the Spanish Fork River, no increase in angler use is predicted to occur, as the area is privately owned and no public access exists. The only use that would occur would be by trespass or by permission of the landowners. The amount of this use is un-predictable.

Table 3-43 shows the predicted increase in angler use under the Proposed Action. Angler days per year use would increase by 337 percent over baseline for Sixth Water Creek, and 1,330 percent for Diamond Fork Creek, (an overall increase of 676 percent in angler days per year use for these two creeks). This would likely result in a significant increase in actual fishing and camping use in the impact area of influence. The predicted use shown for the Spanish Fork River is potential use that would only occur if public access was acquired. The only use that would occur would be by trespass or by permission of the land owner.

The gate on Red Hollow Road would be returned to its present location (about 0.75 miles in from the Diamond Fork Road junction). The closed portion of Diamond Fork Road would be reopened to public use and would continue to provide access to the Three Forks trailhead area.

Table 3-43
Predicted Angler Day Per Year Use of Key Stream Segments for the Proposed Action

Stream Segment	Baseline Angler Day Per Year Use	Predicted Angler Day Per Year Use	Impact (Increase In Angler Days Per Year Use Over Baseline)
Sixth Water Creek			
Strawberry Tunnel to Sixth Water Aqueduct	3,133	10,701	+7,568
Sixth Water Aqueduct to Fifth Water Creek and Fifth Water Creek to Three Forks	113	3,492	+3,379
Subtotal	**3,246**	**14,193**	**+10,947**
Diamond Fork Creek			
Upstream of Three Forks	336	603	+267
Three Forks to Diamond Fork Creek Outlet	235	3,228	+2,993
Diamond Fork Creek Outlet to Diamond Campground	127	2,371	+2,244
Diamond Campground to Brimhall Canyon	545	7,915	+7,370
Brimhall Canyon to Spanish Fork River Outlet	437	9,902	+9,465
Subtotal	**1,680**	**24,019**	**+22,339**
Spanish Fork River*			
Diamond Fork Creek to Spanish Fork Diversion Dam	143	1,401	+1,258
Spanish Fork Diversion Dam to East Bench Dam	0	1,392	+1,392
East Bench Dam to Mill Race Diversion	24	1,814	+1,790
Mill Race Diversion to Utah Lake	0	2,449	+2,449
Subtotal	**167**	**7,056**	**+6,889**
Grand Total	**5,093**	**45,268**	**+40,175**

Notes:

* The use shown for Spanish Fork River is potential use that could occur if public access was acquired. At the present time no public access exists along the river and the only use that occurs is by trespass or permission of the landowner.

3.10.1.6.4.3 Impact Summary. The short-term loss of dispersed camping, picnicking and fishing opportunities during construction would be a significant impact. Operation of the Proposed Action would result in a predicted overall increase of 676 percent in angler day per year use for Sixth Water and Diamond Fork Creeks, which could cause a significant increase in fishing and camping use in the impact area of influence.

3.10.1.6.5 No Action Alternative

3.10.1.6.5.1 Impacts During Construction. Construction of Three Forks Dam and Reservoir under the No Action Alternative would eliminate the Three Forks trailhead area which provides access to the Fifth Water, Sixth Water and Cottonwood Creek trails. A portion of these trails would also be eliminated. Construction of the road to bypass Three Forks Reservoir would result in creation of a 6.9-acre rock disposal area along the existing Diamond Fork Creek road, which would eliminate an unknown number of dispersed camping sites. Based on the significance criteria, these impacts are significant because they permanently eliminate recreation resources.

The Three Forks Dam and Reservoir would eliminate stream fishing along 2,400 feet of Diamond Fork Creek above Three Forks, 2,700 feet of Sixth Water Creek, and 1,600 feet of Cottonwood Creek, which would cause a loss of an estimated 153 angler days per year capacity. Based on the significance criteria, this impact is significant because it permanently eliminates a recreation resource.

A 3.4 mile portion (22 percent of the total road length from State Highway 6 to Springville Crossing) of the Diamond Fork Road would be closed, starting in June of 2000, during the 3 year construction period. The road closure would impact driving for pleasure and sightseeing, hiking, dispersed camping, fishing, and hunting. A new road that bypasses the area and reconnects the lower Diamond Fork road with the upper portion would not be completed until July of 2003.

Access to the main trailhead (Three Forks) for the Sixth Water and Fifth Water trails and the hot springs area would be eliminated by the road closures. The number of users that this would affect is unknown, but the trails and hot springs area would still be accessible from Sheep Creek-Rays Valley Road, including an area near the trailhead that users could park in. The distance from this trailhead access point to the hot springs area is shorter than from the Three Forks trailhead. However the trails are not as well signed and are steeper than the trail from Three Forks. This access point was used during construction of the Diamond Fork Pipeline and did not noticeably reduce the number of users (Swenson, 1999).

The road closure would eliminate the use of about 50 (40 percent) dispersed camping sites in the impact area of influence. Based on the significance criteria this would be a significant short term (3 year) impact. The number of users (hunters, picnickers, and anglers) that this would impact is unknown. The remainder of the Diamond Fork drainage would remain available for these activities. The closure of these sites could result in increased resource damage in other areas from overuse. However, the closure of these sites would have a beneficial impact of allowing vegetation, especially riparian vegetation along Diamond Fork Creek to recover.

Users of the two developed campgrounds (Palmyra and Diamond) would still have direct access, but would experience inconvenience from construction traffic along Diamond Fork Road during the 3-year construction period.

The road closure would impact some hunters, especially those who "road hunt". Hunters would have to access the area along the closed portion of the Diamond Fork Road by foot or horseback. However this area would still be available for hunting. Some areas may be closed to hunting to protect construction workers. Any closures would be coordinated with the Utah Division of Wildlife Resources. However the majority of the Diamond Fork Drainage would remain available for hunting. The number of hunters that would be impacted by these changes is unknown, but this impact is not expected to exceed the five percent significance criteria.

Hunters and sightseers would not have direct access to the upper part of Diamond Fork Canyon during the road closure. Access would be through a longer route from the Right Fork of Hobble Creek Road, Springville Crossing-Rays Valley Road, and Sheep Creek-Rays Valley Road and a loop drive would still be available. This would be a minor inconvenience, and not a significant impact as it would continue to provide a scenic route to and through the area. The only change from baseline conditions would be the fact that passenger cars would not be able to access the upper part of Diamond Fork Canyon during wet conditions. However, this would not likely affect hunter use since the majority of that use is through the use of four-wheel drive or heavy duty truck vehicles.

3.10.1.6.5.2 Impacts During Operation. Fishing would be the only recreational use or resource that would be impacted by operation of the Proposed Action. While the methodology described above in this section provides a prediction of potential increase in angler use, actual increases in usage cannot be predicted because specific existing use data is lacking for the area. The predicted increase in angler use is based on predicted changes in stream conditions and trout production, which is explained and documented in the Aquatic Resource Section (Section 3.6.) Although increased trout production is predicted to occur in the Spanish Fork River, no increase in angler use is predicted to occur, as the land is privately owned and no public access exists. The only use that would occur would be by trespass or by permission of the landowners. The amount of this use is un-predictable.

Table 3-44 shows the predicted increase in angler use. Angler days per year use would increase by 231 percent over baseline for Sixth Water Creek, and 1,320 percent for Diamond Fork Creek (an overall increase of 602 percent in angler days per year use for Sixth Water and Diamond Fork Creeks). This would likely result in a significant increase in actual fishing and camping use in the impact area of influence.

The impact of the loss of stream fishery from operation of Three Forks Dam and Reservoir would be offset by the increase in angler day per year use of Sixth Water and Diamond Fork Creeks during operation of the No Action Alternative. The impact from the loss of Three Forks Trailhead would continue.

3.10.1.6.5.3 Impact Summary. Construction activities would cause the loss of the Three Forks trailhead area and access to the Fifth Water, Sixth Water and Cottonwood Creek trails from Diamond Fork Road. This would be a significant impact. Operation of the No Action Alternative would result in an overall increase of 602 percent in the angler days per year use over baseline conditions in Sixth Water and Diamond Fork Creeks. This increase in predicted use would be a significant increase in fishing and camping use in the impact area of influence. The permanent loss of the 6.9 acre area along Diamond Fork Creek for dispersed camping would also be a significant impact.

Table 3-44
Predicted Angler Day Per Year Use of Key Stream Segments for the No Action Alternative

Page 1 of 2

Stream Segment	Baseline Angler Day Per Year Use	Predicted Angler Day Per Year Use	Impact (Increase In Angler Days Per Year Use Over Baseline)
Sixth Water Creek			
Strawberry Tunnel to Sixth Water Aqueduct	3,133	10,701	+7,568
Sixth Water Aqueduct to Fifth Water Creek And Fifth Water Creek to Three Forks	113	35	-78
Subtotal	**3,246**	**10,736**	**+7,490**

Table 3-44
Predicted Angler Day Per Year Use of Key Stream Segments for the No Action Alternative

Page 2 of 2

Stream Segment	Baseline Angler Day Per Year Use	Predicted Angler Day Per Year Use	Impact (Increase In Angler Days Per Year Use Over Baseline)
Diamond Fork Creek			
Upstream of Three Forks	336	561	+225
Three Forks to Red Hollow	235	3,104	+2,869
Red Hollow to Diamond Campground	127	2,371	+2,244
Diamond Campground to Brimhall Canyon	545	7,915	+7,370
Brimhall Canyon to Spanish Fork River Outlet	437	9,902	+9,465
Subtotal	**1,680**	**23,853**	**+22,173**
Spanish Fork River*			
Diamond Fork Creek to Spanish Fork Diversion Dam	143	398	+255
Spanish Fork Diversion Dam to East Bench Dam	0	1,392	+1,392
East Bench Dam to Mill Race Diversion	24	1,814	+1,790
Mill Race Diversion to Utah Lake	0	2,449	+2,449
Subtotal	**167**	**6,053**	**+5,886**
Grand Total	**5,093**	**40,642**	**+35,549**

Notes:

* The use shown for Spanish Fork River is potential use that could occur if public access was acquired. At the present time no public access exists along the river and the only use that occurs is by trespass or permission of the landowner.

3.10.2 Special Status Areas

3.10.2.1 Introduction

Two areas within the impact area of influence have been designated as "roadless areas" (Forest Service 1984). The Forest Service has defined "roadless/undeveloped" as: An area exclusive of improved roads constructed or maintained for travel by means of motorized vehicles intended for highway use. Areas of land can be included in the Wilderness system even though they may not be entirely free of the imprint of man but are fully capable of providing wilderness benefits to the public. Roadless, undeveloped areas could include past timber harvest activities, evidence of old mining, some range improvements, minor recreation sites, water related facilities, etc., if the passage of time or their visibility allowed the area to appear natural (roadless Area Review and Evaluation (RARE II) FEIS, 1979, pg. 6). Forest Service procedures requires the preparation of an analysis of potential impacts of proposed development activities within a roadless area. The analysis must consider impacts that could occur to the following six characteristics of designated roadless areas: natural integrity, apparent naturalness, remoteness, solitude, special features, and manageability/boundaries. Table 3-45 describes the USFS definitions of these characteristics.

Table 3-45
Definitions of USFS Roadless Area Characteristics

Page 1 of 2

Characteristic	Definition
Natural Integrity	Natural integrity is the extent to which long-term ecological processes are intact and operating. Impacts to natural integrity are measured by the presence and magnitude of human-induced change to an area. Such impacts include physical developments (e.g., roads, utility rights-of-way, fences, lookouts, cabins), recreational developments, domestic livestock grazing, mineral developments, wildlife/fisheries management activities, vegetative manipulation, and fire suppression activities.
Apparent Naturalness	The environment looks natural to most people using the area. It is a measure of the importance of visitors' perceptions of human impacts to the area. Even though some of the long-term ecological processes of an area may have been interrupted, the landscape of the area generally appears to be affected by the forces of nature. If the landscape has been modified by human activity, the evidence is not obvious to the casual observer or it is disappearing as the result of natural processes.
Remoteness	A perceived condition of being secluded, inaccessible, and out-of-the-way. The physical factors that can create "remote" settings include topography, vegetative screening, distance from human impacts such as roads and logging operations (sight and sound), and difficulty of travel. A user's sense of remoteness in an area is also influenced by the presence or absence of roads, their condition, and whether they are open to motorized vehicles.
Solitude	A personal, subjective value defined as isolation from the sights, sound, and presence of others and the developments of man. Common indicators of solitude are numbers of individuals or parties one may expect to encounter in an area during a day or the number of parties camped within sight and sound of other visitors. A primitive recreation experience includes the opportunity to experience solitude, a sense of remoteness, closeness to nature, serenity, and spirit of adventure through the application of woodsmen skills in an environment that offers a high degree of challenge and risk.

Table 3-45
Definitions of USFS Roadless Area Characteristics
Page 2 of 2

Characteristic	Definition
Special Features	Those unique geological, biological, ecological, cultural, or scenic features that may be located in roadless areas. Unique fish and wildlife species, unique plants or plant communities, potential Research Natural Areas, outstanding landscape features such as unique rock formations, and significant cultural resource sites are some of the items that should be considered when analyzing this element.
Manageability/ Boundaries	This element relates to the ability of the USFS to manage an area to meet size criteria and the five other roadless area characteristics. Changes in the shape of an area influence how it can be managed.

Source: Forest Service 1999a

The Forest Service recently adopted an interim rule (Administration of the Forest Development Transportation System: Temporary Suspension of Road Construction and Reconstruction in Unroaded Areas) dealing with road construction and reconstruction in roadless areas (Federal Register Vol 64, No. 29 Friday, February 12, 1999, page 7290). This interim rule temporarily suspends decisionmaking regarding road construction and reconstruction in many unroaded areas within the National Forest System. The effect of this interim rule is the suspension of all new road (temporary or permanent) construction and reconstruction projects in most roadless areas in the National Forest System.

3.10.2.2 Issues Eliminated From Further Analysis

None.

3.10.2.3 Issues Addressed in the Impact Analysis

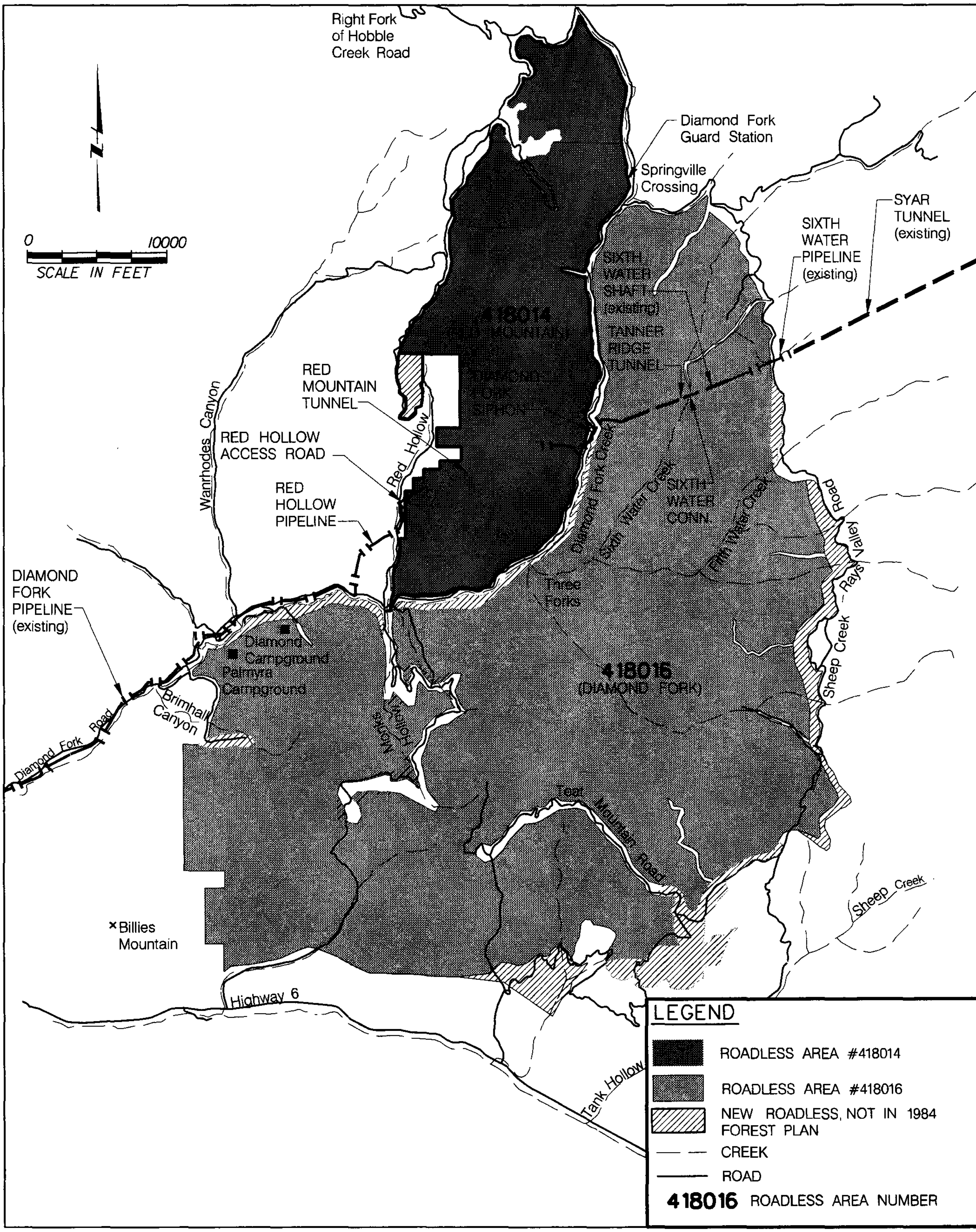
The only issue addressed was: Would the Proposed Action or No Action Alternative impact any of the roadless area characteristics.

3.10.2.4 Description of Impact Area of Influence

The impact area of influence consists of the two designated roadless areas and adjacent land (see Map 3-2).

3.10.2.5 Affected Environment

In 1964 Congress passed the Wilderness Act. In addition to designating 9 million acres of National Forest as wilderness, the Act directed the Secretary of Agriculture to complete a study of "primitive areas" to determine their suitability for wilderness designation. The Forest Service completed this study (known as the Roadless Area Review and Evaluation or RARE) in 1973. In 1977 the Secretary of Agriculture initiated a second nationwide study of



Map 3-2

Roadless Areas

roadless areas (RARE II). In 1983 the National Forest Management Act regulations regarding evaluation of roadless areas in forest planning (36 CFR 219.17) were revised establishing new forest planning procedures for evaluating roadless lands. In response, the Uinta National Forest updated the RARE II inventory (Forest Service 1984) for the Uinta National Forest Land and Resource Management Plan. In 1996, the Forest initiated efforts to update the 1984 roadless area inventory. The Forest has completed a draft inventory (Uinta National Forest, in printing). Roadless areas delineated in this 1999 draft inventory were used in this analysis.

3.10.2.5.1 Red Mountain Roadless Area. The Red Mountain Roadless Area is located (see Map 3-2) north of Monks Hollow on the west side of Diamond Fork Road. The area is 9,675 acres in size and is located entirely within the Uinta National Forest. This is an area of relatively steep terrain. It is characterized primarily by oak brush and maple vegetation cover. The Timber Mountain road penetrates the area for a short distance from the west side.

The boundaries of the Red Mountain Roadless Area are manageable over much of the perimeter. Much of the boundary is highly accessible. A few off-road-vehicle (ORV) tracks extend into the area. The boundaries are difficult to manage. The natural integrity of the area is relatively high, as is the natural appearance. The opportunities for solitude are limited due to the proximity of roads. Opportunities for primitive recreation are confined primarily to camping, hiking and horseback riding. There are few opportunities for challenging experiences, as the cliffs do not provide the types of rock needed for cliff climbing and related activities.

Recreation use consists of dispersed camping, hiking, horseback riding, and trailbike riding. Diverse vegetation throughout the area provides habitat for a variety of game and nongame wildlife. The area provides both winter and summer range for deer and elk. It is heavily hunted during the deer and elk seasons. No significant lakes, ponds or streams are found within the boundaries of the area.

The area is grazed by cattle one out of every three years, and range improvements consist of water developments and fences. Numerous range improvements such as fences and troughs are located within the area.

The area is located in the Overthrust Belt; thus, it has potential oil and gas resources. Two test wells have been drilled on the southern border of the area, and it is probable that more drill sites will be applied for.

3.10.2.5.2 Diamond Fork Roadless Area. The Diamond Fork Roadless Area is a relatively large area containing 35,205 acres. It is located (see Map 3-2) on the east side of the Diamond Fork road and extends from the Billies Mountain area, north to the Diamond Fork Guard Station and east to the Sheep Creek-Rays Valley road. It is located entirely within the Uinta National Forest. The area is characterized by relatively moderate terrain consisting of undulating hills covered by mountain brush and aspen vegetative types.

The area is grazed by cattle and there are several range improvements in the form of fences and water developments. In addition, there has been some range revegetation work in the Tank Hollow, Sheep Creek, and Monks Hollow-Brimhall Canyon areas.

Several roads including the Teat Mountain road penetrate the area for a considerable distance. There are several trails running through the area that are used primarily by horse riders caring for permitted cattle. The Monks Hollow to Long Hollow Trail is a designated all terrain vehicle (ATV) trail.

The Diamond Fork Roadless Area is surrounded by roads. Other roads extend considerable distances into the interior. Parts of the area are traveled extensively by ORVs, resulting in vehicle tracks traversing many areas. The rolling nature of the country makes control of this use very difficult. The natural integrity of the area is low due to its dissection by developed roads which extend to the interior. The natural appearance in parts of this roadless area has been impacted by roads, the Teat Mountain telecommunications site, powerlines, etc. There are some opportunities for solitude and primitive recreation in the deeper canyons; however, in other areas this is limited due to ready road access. Opportunities for challenging experiences are rare.

The area provides a great deal of dispersed recreation, especially during the annual deer and elk hunts. The area is heavily hunted during the general deer hunt and serves as a valuable wildlife habitat area for numerous game and nongame species. Several popular recreation and livestock trails are used during the summer months. Some snowmobile use also occurs.

Diverse vegetation provides habitat for a variety of game and nongame wildlife. Winter and summer range for deer and elk, and two historic golden eagle aeries are found in this area. There are no major natural ponds or lakes; however, the area has several popular fishing streams.

3.10.2.6 Impact Analysis

3.10.2.6.1 Methodology. The number and type of features of the Proposed Action and No Action Alternative that would be constructed in each of the roadless areas were compared to each characteristic to determine the potential change to that characteristic.

3.10.2.6.2 Significance Criteria. Impacts would be significant if construction or operation would result in a major decrease in the size (greater than 10 percent) of the roadless area or elimination of an area as roadless.

3.10.2.6.3 Potential Impacts Eliminated From Further Analysis. None.

3.10.2.6.4 Proposed Action. The Proposed Action would require construction activities and installation of permanent pipeline and other related facilities in the Red Mountain and Diamond Fork roadless areas. Construction-related activities in the roadless areas would include building access roads, tunnel-drilling operations, spoil pile creation, and pipeline installation activities such as trenching, pipe laying and recontouring. Permanent surface facilities that would remain in these roadless areas include access roads, helicopter pads, tunnel portals and vent and access hatch structures.

3.10.2.6.4.1 Impacts During Construction. The following features would be constructed in the Red Mountain Roadless Area:

- Diamond Fork Siphon (0.7 miles)
- Red Mountain Tunnel inlet and outlet portals (1 acre)
- Tunnel spoil disposal area (4.1 acres)
- Red Hollow Pipeline (0.5 miles)
- Permanent access road to the Red Mountain Tunnel outlet portal (0.5 miles)
- Temporary access road to the Red Mountain Tunnel inlet portal (0.73 miles)
- Helicopter pad at the Red Mountain Tunnel inlet portal (0.3 acres)

Table 3-46 describes the impact of construction on the Red Mountain Roadless Area characteristics.

Table 3-46
Impact on Red Mountain Roadless Area Characteristics
Under the Proposed Action

Roadless Area Characteristic	Effect on Characteristic
Natural Integrity	By adding a number of man made features the Proposed Action would have some impact on the natural integrity of the Red Mountain Roadless Area. The area is already penetrated by roads in some areas and the additional permanent road that would be constructed would be located near the southern perimeter. Visible project-related features at the tunnel portals would be limited and only viewed from a short distance away. They would not significantly detract from the existing integrity of the natural features in the area. Construction of the features would temporarily disturb 33.6 acres (0.3 percent of total area). These acres would be revegated and become less noticeable over time. A total of 4.1 acres (less than one tenth of a percent of the total area) would be permanently disturbed. These disturbances would not be a significant impact as they do not exceed the significance criteria.
Apparent Naturalness	The disturbance as described under natural integrity would have a slight impact on the apparent naturalness of the area. The disturbance would be visible from only a limited area and would not be a significant impact.
Remoteness	The addition of the .5 mile of permanent access road and the small helicopter pad would have only a slight long-term impact on the remoteness of the Red Mountain Roadless Area. The access road would be locked and rarely used following construction. The area is already surrounded by roads and existing "remoteness" is limited.
Solitude	The Proposed Action would impact opportunities for solitude within the Red Mountain Roadless Area during the 3 ½ year construction period. Construction-related traffic, noise, and activities would reduce the solitude characteristics in the immediate construction areas. There would be no long-term impact to the solitude characteristics of the area.
Special Features	The Proposed Action would not affect any special features of the Red Mountain Roadless Area.
Manageability and Boundaries	The Proposed Action would not affect the manageability or boundaries of the Red Mountain Roadless Area.

The following features would be constructed in the Diamond Fork Roadless Area:

- Sixth Water Connection (0.02 miles)
- Tanner Ridge Tunnel outlet and inlet portals (1 acre)
- Tunnel spoil disposal area (3.3 acres)
- Helicopter pad at Tanner Ridge Tunnel outlet portal (0.3 acres)

- Diamond Fork Siphon (.42 miles)
- Temporary access road to the Tanner Ridge Tunnel outlet portal (.49 miles)

Table 3-47 describes the impact of construction on the Diamond Fork Roadless Area characteristics.

Table 3-47
Impact on Diamond Fork Roadless Area Characteristics Under the Proposed Action

Roadless Area Characteristic	Effect on Characteristic
Natural Integrity	By adding a few man made features the Proposed Action would have some impact on the natural integrity of the Diamond Fork Roadless Area. Visible project-related features at the tunnel portals would be limited and only viewed from a short distance away. They would not significantly detract from the existing integrity of the natural features in the area. Construction of the features would temporarily disturb 14.5 acres (less than one tenth of a percent of the total area). These acres would be revegated and become less noticeable over time. A total of 1.3 acres (less than one tenth of a percent of the total area) would be permanently disturbed. These disturbances would not be a significant impact as they do not exceed the significance criteria.
Apparent Naturalness	The disturbance as described under natural integrity would have a slight impact on the apparent naturalness of the area. The disturbance would be visible from only a limited area and would not be a significant impact.
Remoteness	The Proposed Action would not have a long-term impact on the remoteness of the Diamond Fork Roadless Area. The temporary access road would be closed and totally reclaimed upon completion of construction.
Solitude	The Proposed Action would impact opportunities for solitude within the Diamond Fork Roadless Area during construction. Construction-related traffic, noise, and activities would reduce the solitude characteristics in the immediate construction areas. This would be a short term impact less than 3 ½ years and there would be no long-term impact to the solitude characteristics of the area.
Special Features	The Proposed Action would not affect any special features of the Diamond Fork Roadless Area.
Manageability and Boundaries	The Proposed Action would not affect the manageability or boundaries of the Diamond Fork Roadless Area.

3.10.2.6.4.2 Impacts During Operation. Except for occasional maintenance work there would be no additional impacts on the roadless areas during project operations.

3.10.2.6.4.3 Impact Summary. The roadless areas would be impacted during the 3 ½ year construction period. Man made facilities would be added to each roadless area. The amount of acreage temporarily or permanently disturbed does not exceed the significance criteria so the impacts would not be significant. The area permanently disturbed, 4.1 acres for Red Mountain and 1.3 acres for Diamond Fork may be removed from the roadless area classification.

3.10.2.6.5 No Action Alternative.

3.10.2.6.5.1 Impacts During Construction. The Red Mountain Roadless Area would not be impacted because no features of the No Action Alternative would be constructed within the area.

The Three Forks Dam and Reservoir would be constructed on the west side of the Diamond Fork Roadless Area within ¼ mile of the Diamond Fork Road. The new alignment of the Diamond Fork Road would also take place within ¼ mile of the existing road. Construction within the Diamond Fork Roadless Area would temporarily disturb 1.5 acres, less than one tenth of one percent of the total area which does not exceed the significance criteria. Construction would permanently disturb 15.5 acres also less than one tenth of one percent of the total area. Only a small portion of the roadless area would be affected by construction activities, noise, etc.

3.10.2.6.5.2 Impacts During Operation. Periodic maintenance would have minor impacts on the solitude of the Diamond Fork Roadless Area.

3.10.2.6.5.3 Impact Summary. The amount of acreage temporarily or permanently disturbed does not exceed the significance criteria so the impacts would not be significant. The area permanently disturbed, 29.6 acres in the Diamond Fork Roadless Area may be removed from the roadless area classification.

3.11 Public Health and Safety, Noise Impacts

3.11.1 Introduction

This section addresses potential impacts on human health and safety that could occur during construction and operation of the Proposed Action or the No Action Alternative. The analysis focuses on four topics: public exposure to toxic materials and pollutants during construction; the risk of pipeline rupture; increased potential for injuries due to public access to project facilities; and public exposure to increased noise levels.

3.11.2 Issues Eliminated From Further Analysis

None.

3.11.3 Issues Addressed in the Impact Analysis

The following issues were identified during the SFN scoping process:

- Potential public exposure to toxics and pollutants due to increased exposure to air pollutants (e.g., mobile source fugitive emissions and fugitive dust); or decline of water quality in violation of state water quality standards for recreation (secondary contact).

- Potential for pipeline rupture due to seismic activity or system failure

- Risk of injuries due to public access to features during or after construction

- Risk of drowning due to emergency flow volumes in rivers and streams in the impact area of influence

- Increased potential for traffic accidents in the impact area of influence due to construction, transportation of project materials or operations

- Delays in emergency vehicle response time during construction

- Noise levels and potential public exposure to levels that exceed allowable public health standards

3.11.4 Description of Impact Area of Influence

The impact area of influence includes the Diamond Fork drainage and Spanish Fork River between the confluence with Diamond Fork Creek and Utah Lake.

3.11.5 Affected Environment (Baseline Conditions)

The affected environment includes areas in the impact area of influence where human health and safety and the public's noise environment could be adversely affected by construction or operation of the Proposed Action or No Action Alternative.

3.11.5.1 Residential Areas

Two homes that are year round residences are located in the Diamond Fork System impact area of influence. They are located in the SW ¼, Section 30, Township 8 South, Range 5 East, and SE ¼ SW ¼, Section 9, Township 9 South, Range 4 East.

3.11.5.2 Transportation Networks

The impact area of influence includes one major highway (Highway 6 in Spanish Fork Canyon) and a number of Forest Service roads such as Diamond Fork, Right Fork of Hobble Creek, Little Diamond, Springville Crossing-Rays Valley, and Sheep Creek-Rays Valley.

The lower section of Diamond Fork Road was improved, widened and paved during construction of the Diamond Fork Pipeline. The upper section is narrow and twisting. The first 7 ½ miles of the Right Fork of Hobble Creek Road is paved but narrow and twisting. The upper section is a mixture of dirt and gravel surface. The Springville Crossing-Rays Valley Road is narrow and twisting with a dirt surface that becomes slick when wet. The Sheep Creek-Rays Valley Road is improved and paved.

3.11.5.3 Water Quality

Existing water quality in the impact area of influence is discussed in detail in Section 3.3, Water Quality. Parameters that could affect public health and safety are currently within acceptable levels in the impact area of influence. These include coliform, nitrate and trace elements such as selenium.

3.11.5.4 Air Quality

Existing air quality in the impact area of influence is discussed in detail in Section 3.16, Air Quality. Parameters that could affect public health and safety include increased air emissions such as nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), particulate matter less than 10 microns in diameter (PM_{10}), and lead. Utah County currently meets all National Ambient Air Quality Standards (NAAQS) with the possible exception of PM_{10} and CO (CO exceedances were limited to the cities of Orem and Provo, outside the impact area of influence). PM_{10} levels can fluctuate greatly depending on local influences. Levels exceeding the NAAQS may cause breathing difficulties in susceptible persons (including infants, the elderly, and people with existing respiratory problems).

3.11.5.5 Noise Sources and Sensitive Receptors

The "A-weighted" decibel scale (dbA) is used in this FS-FEIS to compare existing sound levels to projected levels that would result from construction and operation of the Proposed Action or No Action Alternative. This scale, which is used in noise ordinances, reflects the limited sensitivity range of the human ear. Sound that is considered annoying or offensive is referred to as noise.

The remote Diamond Fork drainage has few noise sources and sensitive receptors. However, people seeking solitude are often irritated by an increase in loudness and duration of sound. Noise sources in Spanish Fork Canyon are limited to traffic along Highway 6 and periodically from passing trains. Noise levels experienced in the canyon are greatly influenced by topography. The same noise tends to be more intense in the steep canyon than it would be near the mouth of the canyon, which has wider topography. Noise levels in the canyon are also expected to vary b-season, since heavy snowfall muffles ambient noise. Sensitive receptors are recreational users of Diamond Fork Canyon.

3.11.6 Impact Analysis

3.11.6.1 Methodology

Projected noise levels and changes in stream flows during construction and operation were examined and compared against baseline conditions.

3.11.6.2 Significance Criteria

Impacts on public safety and health are considered significant if construction, operation or maintenance activities would result in any of the following conditions:

- The public is exposed to toxic materials and pollutants in any of the following ways: violations of federal or state ambient air quality standards, state water quality standards for recreation contact (see Section 3.3, Water Quality), or guidelines for trace elements in vegetation and wildlife that could threaten public safety if consumed.

- A pipe rupture or any other system component failure that floods recreational users.

- If members of the public were exposed to increased risks of accidents or response times or access for emergency response vehicles were disrupted for more than 15 minutes over normal traffic patterns

- If local, state or federal noise level standards were violated.

3.11.6.3 Potential Impacts Eliminated From Further Analysis

None.

3.11.6.4 Proposed Action

3.11.6.4.1 Impacts During Construction. By applying the SOPs described in Chapter 1, most health and safety impacts from construction of the Proposed Action features and modifications of the Spanish Fork Diversion dams would be insignificant. The key SOPs are 1.7.8.7 Water Quality, 1.7.8.10 Health and Safety, 1.7.8.12 Air Quality, and 1.7.8.13 Noise.

The largest concentration of public land users during construction would occur at the two developed campgrounds along Diamond Fork Road. The major construction area closest to these campgrounds would be more than a mile away so noise levels would not exceed the significance criteria. The major noise source for campground users would be construction truck traffic along Diamond Fork Road. This would average 85 dBA per truck, which exceeds the average of 70 dBA for a very noisy residential area (Canter 1977), but would not be a sustained noise.

Two residences may be affected by noise from construction traffic along Diamond Fork Road, but the level is unquantifiable.

Modifications of the Spanish Fork River diversion structures would cause a short-term increase in noise levels. However, these structures are located mostly in farming areas and would not cause significant impact.

Campground users would be exposed to construction traffic and increased potential for accidents on the lower section of Diamond Fork Road, which would be a significant impact. No impacts on public health and safety would occur on the upper section of Diamond Fork Road because it would be closed during the 3 ½ year construction period.

Construction areas would be closed to the public during the 3 ½ year construction period, thereby eliminating potential hazards. However, emergency vehicle response time would increase by more than 15 minutes, which is a significant impact. Diamond Fork Road would be closed to the public from Red Ledges to just past its intersection with the proposed Diamond Fork Siphon, but emergency vehicles would have priority access through the construction zone using radio communication and traffic flaggers. Emergency vehicles also could use Springville Crossing – Rays Valley Road, Sheep Creek-Rays Valley Road and Right Fork of Hobble Creek Road, but response time could be slower because of the longer distance. Emergency helicopter crews also could be used but response time could be slower than road access under baseline conditions.

Traffic would increase on other access roads when the upper part of the Diamond Fork Road is closed. This could lead to increased risk of traffic accidents to the public, but the number or type of accidents that may occur is unpredictable. Any accident resulting in injuries would be considered a significant impact.

3.11.6.4.2 Impacts During Operation. Major health and safety concerns related to operation of Proposed Action features would be from a pipeline rupture or emergency shutdown.

The only realistic cause of pipeline rupture would be a major earthquake; otherwise the potential for rupture of a properly designed and constructed pipeline is extremely low. The Wasatch Fault, in the general area of the mouth o Spanish Fork Canyon, has a maximum credible earthquake of magnitude 7.5 on the Richter scale. Fault segments studied along the Wasatch Front are estimated to have a return period of 500 to 2,600 years (USBR 1990).

Pipeline rupture could cause injuries or drowning, but the exact effects are difficult to quantify. If a rupture were to occur, floodwaters would follow the normal course of Diamond Fork Creek or Sixth Water Creek. The narrow topography within the area would restrict the lateral spread of floodwater until near Red Hollow, where it would spread out in the wider canyon floor where recreation users may be affected.

Emergency releases could be made from Strawberry Tunnel, at the Sixth Water Aqueduct, or from the Diamond Fork Creek Outlet. The highest risk to public safety would be a release from the Diamond Fork Creek Outlet, which is about 1 mile upstream from the Diamond and Palmyra campgrounds.

If Sixth Water Aqueduct had to be suddenly shut down, 200 cfs could be released from the Strawberry Tunnel in gradual stages to avoid a rapid water level rise in Sixth Water Creek. The same would hold true for a release from the Sixth Water Aqueduct. Gradual releases would prevent a major risk to the few people who fish in these stretches of Sixth Water Creek.

If a major failure of the system occurred downstream from the Diamond Fork Creek Outlet, 660 cfs could be released from the Diamond Fork Creek Outlet until the Syar Tunnel gates shut down automatically as designed. The flow would decrease during the release and last no longer than one hour. The increase in flow would not flood the campgrounds, but could be a hazard to anglers and campground users if they were caught in the creek at the time of the release. The possibility of such a release is extremely remote, but any related injuries or drownings would constitute a significant impact.

3.11.6.4.3 Impact Summary. Construction of the Proposed Action would increase traffic and traffic hazards compared to existing conditions, which could result in more accidents. Access of emergency vehicles could be slowed, which would be a significant impact. Normal operation of the Proposed Action would not likely increase concerns for public safety or hazards compared to existing conditions. Emergency releases, while unlikely, could pose a hazard to some recreational users, which would be a significant impact.

3.11.6.5 No Action Alternative

3.11.6.5.1 Impacts During Construction. Public safety and health impacts would be the same as under the Proposed Action.

3.11.6.5.2 Impacts During Operation. The major health and safety concerns related to project operations would be from a pipeline rupture or dam failure.

The potential for pipeline rupture from an earthquake would be the same as for the Proposed Action. The potential for dam rupture or failure would be extremely low. Seismic studies would be conducted to determine the best design, and the dam would be constructed to withstand any expected seismic event in the area. Therefore, Three Forks Dam would not pose a credible threat to public safety.

Although it would not be developed or managed for recreation use, the reservoir would attract some use and present a hazard that does not currently exist. Vehicle access to the reservoir would be limited, but hikers and equestrians could access much of the reservoir shoreline. The inherent public safety risks associated with an open body of water would exist. Because of the potential for loss of life, this risk is considered a significant impact on public health and safety.

3.11.6.5.3 Impact Summary. The construction impacts would be the same as for the Proposed Action. The major operation impact on public health and safety would be the risk created by Three Forks Reservoir.

3.12 Socioeconomics

3.12.1 Introduction

This section addresses potential impacts on social and economic systems that would occur during construction and operation of the Proposed Action and No Action Alternative. Socioeconomic conditions and potential impacts are based on an assessment of the following topics:

- Employment
- Income
- Population
- Public services and related fiscal impacts
- Housing

3.12.2 Issues Eliminated From Further Analysis

None.

3.12.3 Issues Addressed in the Impact Analysis

The following issues were identified during the SFN scoping process.

- Potential short- and long-term effects on employment
- Potential impacts of increased recreational use on local income
- Increases or decreases in population, or a shift in population among counties
- Increases in the demand for temporary housing, such as hotels and other short-term residences, or increases or decreases in the demand for long-term housing in the local area
- Changes to the tax base in communities in the area
- Declines in the quality or level of public services

3.12.4 Description of Impact Area of Influence

The impact area of influence includes Salt Lake, Utah and Juab counties, from which the entire construction crew would likely commute during construction.

3.12.5 Affected Environment (Baseline Conditions)

The economies of Salt Lake, Utah and Juab counties differ in that Juab County is agrarian, Salt Lake County has developed into a major financial and trade center, and Utah County contains a combination of each, with urban centers in Provo and Orem and agricultural development in the southern part of the county.

The following sections provide a summary of the socioeconomic environment of the impact area of influence and provide baseline projections of economic and social activity over the 3 ½-year construction period. These projections are based on the best estimates of state and local planning agencies.

3.12.5.1 Employment

Table 3-48 shows an estimate of baseline total employment and personal income in the impact area of influence for the year 2000. It shows that 40,535 of the 804,638 total jobs in the peak baseline year would be construction-related.

3.12.5.2 Personal Income

Table 3-48 also shows an estimate of aggregate personal income for the regional area, including the construction sector during the peak year. The estimate is based on historical income and projections of employment in 2000 and adjusted for inflation.

Table 3-48
2000 Area Baseline Employment and Personal Income

Employment Sector	Jobs[a]	Aggregate Personal Income[b]	Average Annual Wage
Construction	40,535	Not Available	$ 28,095
Other	764,103	Not Available	$ 26,062
Total	804,638	$ 25,476,500,000	$ 26,203

[a]Utah Department of Workforce Services 1999.
[b]Utah Department of Workforces Services 1999. Accurate data per employment sector not available.

3.12.5.3 Population

Table 3-49 shows an estimate of future population levels through 2045 for the area.

Table 3-49
Regional Baseline Population

	1995	2005	2015	2025	2035	2045
Total Population	1,121,150	1,360,596	1,702,464	1,721,872	1,741,156	1,760,657

Source: Wimmer 1995.
Note that the population forecasts in this source end at 2035. The long-term annual rate of growth (1.15 percent) is assumed to remain constant for the period from 2035 to 2045.

3.12.5.4 Social Environment

Typically, the social environment is defined by specific groups or classes of people in the impact area of influence. Social groups are generally defined by their lifestyle (e.g., patterns of work and leisure, customs and traditions, and relationships with family, friends and others) and their attitudes, beliefs and values (e.g., preferences, expectations, sense of freedom, self-sufficiency, and certainty about the future). Social groups in the area are categorized into five groups: residents (both long- and short-term), farmers, and ranchers, property owners, conservationists and urban workers.

3.12.5.4.1 Residents. Long-time residents are those individuals and their families and employees who have lived in the area at least 10 to 15 years. Newcomers are defined as those individuals and their families, mostly young, who have moved into the area because of lifestyle or affordability and who may commute to cities outside the local area for employment.

3.12.5.4.2 Irrigators and Ranchers. Irrigators and ranchers are typically long-time residents whose income is generally derived from agriculture. They have close ties to the local community and may be active in politics, especially any political activity affecting their livelihoods.

3.12.5.4.3 Property Owners. Property owners are usually owner-occupants (typically concerned about any potential projects that could change the value of their property) or investors from outside who have purchased land for speculative purposes or with the intent of developing it in the future.

3.12.5.4.4 Conservationists. Conservationists represent a widespread, diverse group united by a strong commitment to the preservation and protection of the environment. This group can be highly vocal and willing to devote a great deal of time and effort to causes in which they believe.

3.12.5.4.5 Urban Workers. This group represents primarily career-focused workers who tend to live and work in the downtown urban core. Typically this group brings work experience from other urban areas, may reside in the urban core for a couple of years, then move either to another urban area or become a resident of the area.

3.12.5.5 Public Services

3.12.5.5.1 Education. The seven school districts in Utah, Salt Lake and Juab counties include 278 schools. The average pupil-teacher ratio was 26:1 in 1994. Jordan School District in Sandy and Granite School District in Salt Lake City are the two largest districts in Salt Lake County with enrollments of 74,393 and 73,180 students, respectively (Utah State Office of Education 1997).

3.12.5.5.2 Health Care. The Mountainland District, which includes Utah County, has five hospitals with 645 average patient beds per year. The largest of these hospitals is Utah Valley Regional Medical Center with 395 beds. Average occupancy in 1990 for the hospitals in the Mountainland District was 56.6 percent. As of 1990, there were 364 nonfederal physicians in the Mountainland District, with 328 in Utah County.

The Central District, which includes Juab County, has six hospitals with 160 average patient beds per year. The total number of beds ranges from 20 to 40 for each hospital. Average occupancy in 1990 for the hospitals in the Central District was 19.1 percent. As of 1990, there were 32 non-federal physicians in the Central District, with 5 in Juab County.

3.12.5.5.3 Tax Base. Fiscal year 1997 federal income tax collections in the local area were estimated at $2.7 billion. Property taxes of $508.4 million were charged in the local area in 1997 (Utah State Tax Commission).

3.12.5.5.4 Housing. Table 3-50 shows estimated and projected home availability and values in 5-year increments (Walker 1994). From 2000 to 2020, home values are projected to double while the number of available homes increases by 35 percent.

Table 3-50
Housing Availability and Median Home Value

	Forecast					
	1995	**2000**	**2005**	**2010**	**2015**	**2020**
Median Home Value[a]	$123,016	$144,023	$168,557	$199,576	$236,271	$279,875
Total Housing Units[b]	90,008	98,632	107,274	117,778	124,716	133,113

[a]1995 estimate based on average of first three quarters of 1994 for Central Utah (Walker 1994). Forecasts based on 1995 estimate adjusted for inflation using deflator projections provided in The Electric Utility Cost Service Forecast and Analysis, Winter/Spring 1994 (WEFA 1994).
[b]From Table 11.9 in Statistical Abstract of Utah 1993 (BEBR 1993). Forecast based on change in population projections in Table 3-52 and assumes a vacancy rate of 5 percent.

3.12.6 Impact Analysis

3.12.6.1 Methodology

3.12.6.1.1 Assumptions. Peak employment for the Proposed Action would occur from August 1999 through June 2000 when construction of the Sixth Water connection to Tanner Ridge Tunnel, Tanner Ridge Tunnel and Spanish Fork River Outlet from Diamond Fork Pipeline would require 50 workers. Peak employment for the No Action Alternative would occur during October, November and December 2001 when construction would require 90 workers (see Chapter 1, Section 1.7.1, Tables 1-25 and 1-26). Peak construction employment was compared to the baseline employment year 2000, which coincides with baseline population and employment projections from the Utah Office of Planning and Budget.

Based on past history and current projects in southern Utah County, it is assumed that construction workers would commute from communities in Salt Lake, Utah and Juab counties and that the CUWCD would use its own employees for operation and maintenance.

3.12.6.1.2 Impact Topic Analysis Methods. The methodology used to assess project impacts related to socioeconomics consisted of 1) determining the impact area of influence, 2) identifying the socioeconomic issues that are likely to be affected by the project, 3) developing base-line data on each of these issues and 4) quantifying how the Proposed Action and the No Action Alternative would affect each issue.

3.12.6.2 Significance Criteria

Table 3-51 shows socioeconomic impacts that would be considered significant as a result of construction and operation of the Proposed Action or No Action Alternative. These criteria are based on the authors professional judgment and involvement in other projects subject to the provisions of the National Environmental Policy Act.

Table 3-51
Significance Criteria for Socioeconomic Impacts

Area/Impact Topic	Significance Criteria
Employment	A change greater than 10 percent in construction employment
Personal Income	A change greater than 10 percent in personal income to the construction labor sector
Population	A change greater than 10 percent in population
Public Services and Related Fiscal Impacts	A change greater than 10 percent in tax revenue collected and level or quality of public services
Housing	A change greater than 10 percent in demand for housing
Social Environment	1) If the project would force a major change in lifestyle for some or all persons in any of the social groups identified in the local area 2) If the project would severely conflict with the attitudes, beliefs and values of a large percentage of those residing in, or with interest in, the local area 3) If the project would severely disrupt the degree of cooperation between segments of the community

3.12.6.3 Potential Impacts Eliminated From Further Analysis

The following issues were eliminated from further analysis.

- Potential short- and long-term effects of the Proposed Action or No Action Alternative on employment. Based on work force assumptions, no change or shift in regional baseline population is expected as a result of project construction. Any construction employment impacts would be short-term. Regional employment impacts are further described in this section, but no further analysis will be undertaken to estimate local area employment impacts.
- Potential population changes in the area or population shifts among counties as a result of construction and operation of the Proposed Action or No Action Alternative.
  Local and regional workers would commute to job sites over a 3½-year period but would not induce growth in the local or regional area. Growth-inducing impacts, therefore, are not addressed in any further detail. The Utah Department of Workforce Services (1999) reports that, since October 1998, overall construction employment has leveled off from previous steep climbs. Current and pending projects have stabilized the construction industry labor stream at a sustainable level.
- Increases in the demand for temporary housing, such as hotels and other short-term residences, or any change in demand for long-term housing in the local area as a result of project construction. No population shifts or changes are expected.
- Declines in the quality or level of public services as a result of the project construction (also because no population shifts or changes are expected).

3.12.6.4 Proposed Action

3.12.6.4.1 Impacts During Construction.

3.12.6.4.1.1 Direct Employment. Table 3-52 shows the estimated direct impact on employment during construction of the Proposed Action. These estimates were made by comparing projected employment figures with baseline figures and calculating the average percentage increase. Employment associated with construction of the Proposed Action would be greatest in the year 2000.

During the peak construction period, the Proposed Action would employ 30 people on the Sixth Water Connection to Tanner Ridge Tunnel and Tanner Ridge Tunnel and 20 people on the Spanish Fork Outlet from Diamond Fork Pipeline. Total construction employment of 50 employees would be less than 1 percent of total baseline construction employment. This is not considered a significant impact because it falls below the 10 percent significance.

3.12.6.4.1.2 Indirect Employment. Indirect employment as a result of total construction employment was estimated using an indirect multiplier from the Bureau of Economic and Business Research at the University of Utah. Total direct and indirect employment resulting from the Proposed Action would be 180 jobs in the peak year, which is less than 1 percent of all baseline employment in the area. This is not considered a significant impact because it falls below the 10 percent significance criteria.

Table 3-52
Peak Year Regional Employment Impacts
During Construction of Proposed Action

		Proposed Action	
	Baseline Employment	**Jobs**	**Increase over Baseline**
Total Regional Area Construction Employment	40,535	50	<1%
Other (Indirect) Employment	764,103	130	<1%
Total Direct and Indirect Employment	804,638	180	<1%

3.12.6.4.1.3 Employment Income. Table 3-53 shows estimated personal income associated with the Proposed Action. Impacts were calculated by comparing projected income figures with baseline figures and calculating the average percentage increase.

Table 3-53
Peak Year Personal Income Impacts
During Construction of Proposed Action

		Proposed Action		
	Average Annual Wage[a]	Jobs[b]	Income[c]	Increase over Baseline[d]
Construction	$ 28,095	50	$ 1,404,750	<1%
Other (Indirect)	$ 26,062	130	$ 3,388,060	<1%
Total	--	180	$ 4,792,810	<1%

[a]From Table 3-48.
[b]From Table 3-52.
[c]Product of values shown in Jobs and Average Annual Wage columns.
[d]Baseline income found in Table 3-48.

Total peak year personal income during construction of the Proposed Action is estimated at $1,404,750, which is less than 1 percent of baseline construction income and not a significant impact.

3.12.6.4.1.4 Indirect Income. Total indirect income from the Proposed Action would be $3,388,060 in the peak year. Direct and indirect income would total $4,792,810 and represent an increase of less than 1 percent over the total baseline income of $25,476,500,000 therefore not a significant impact.

3.12.6.4.1.5 Social Impacts. Construction of the Proposed Action would not cause major lifestyle changes to any of the groups identified, but instead would contribute to maintaining lifestyles in the area. No serious conflicts with attitudes, beliefs and values of most local citizens are expected due to conscious decisions to reduce water use, implementation of secondary water systems, and installation of water-saving devices. It is anticipated that construction and operation of the Proposed Action would not seriously disrupt cooperation among segments of the community. Therefore, no significant adverse social or lifestyle impacts are expected.

3.12.6.4.2 Impacts During Operation. Maintenance and operation of the Proposed Action would not impact employment or income because CUWCD would use its current employees.

Table 3-54 shows the impact of the estimated increased angler-use days per year due to improved aquatic habitat (see Chapter 3, Section 3.10, Recreational Resources, for a description of angler-use estimates in the impact area of influence).

Table 3-54
2005 Fiscal Impacts of Angler-Use Resulting From the Proposed Action

	Baseline	Proposed Action
Total Angler-Use Days per Year	4,926	33,286
Total Annual Fiscal Impact	$ 133,347	$901,052
Percentage Increase from Baseline	Not Applicable	676%
Notes: The estimated expenditure per angler day is $27.07 (URMC 1997) The increase in angler days per year are only for Sixth Water and Diamond Fork creeks.		

Although there may be significant increases in angler-use over the baseline, the overall impact on the economy would be negligible. For the Proposed Action, angler-use would increase by 676 percent over baseline, resulting in an annual impact of $901,052. This is less than 1 percent of baseline income for the local area, which falls below the 10 percent significance criterion.

3.12.6.4.3 Impact Summary. Although direct and indirect employment would rise along with income, the increase would fall below the 10 percent significance criterion. Recreation use would increase, which could increase income. However it would also fall below the 10 percent significance criterion.

3.12.6.5 No Action Alternative

3.12.6.5.1 Impacts During Construction.

3.12.6.5.1.1 Direct Employment. Table 3-55 shows estimated direct employment during construction of the No Action Alternative. These estimates were made by comparing projected employment figures with baseline figures and calculating the average percentage increase. Employment associated with construction of the No Action Alternative would be greatest in the year 2001.

During the peak construction period, the No Action Alternative would employ 90 people on the Three Forks Dam and Reservoir, Diamond Fork pipeline extension, and Spanish Fork River Outlet. However, total construction employment would be less than 1 percent of total baseline, which falls below the significance criterion of 10 percent.

Table 3-55
Peak Year Regional Area Employment Impacts
During Construction of No Action Alternative

		No Action Alternative	
	Baseline Employment	**Jobs**	**Increase over Baseline**
Total Regional Area Construction Employment	40,535	90	<1%
Other (Indirect) Employment	764,103	195	<1%
Total Direct and Indirect Employment	804,638	285	<1%

Source: Baseline estimates from Table 3-48.

*3.12.6.5.1.2 **Indirect Employment.*** Indirect employment as a result of total construction employment was estimated using an indirect multiplier from the Bureau of Economic and Business Research at the University of Utah. Direct and indirect employment from the No Action Alternative would total 285 jobs in the peak year. This is less than 1 percent of all baseline employment in the area, which falls below the 10 percent significance criterion.

*3.12.6.5.1.3 **Employment Income.*** Table 3-56 shows estimated personal income associated with the No Action Alternative. Impacts were calculated by comparing projected income figures with baseline totals and calculating the average percentage increase.

Total peak year construction personal income for the No Action Alternative is estimated at $2,528,550, which is less than 1 percent of baseline construction income and therefore not a significant impact.

Table 3-56
Peak Year Personal Income Impacts
During Construction of No Action Alternative

		No Action Alternative		
	Average Annual Wage[a]	**Jobs[b]**	**Income[c]**	**Increase over Baseline[d]**
Construction	$ 28,095	90	$ 2,528,550	<1%
Other (Indirect)	$ 26,062	195	$ 5,082,090	<1%
Total	--	285	$ 7,610,640	<1%

[a]From Table 3-48.
[b]From Table 3-55.
[c]Product of values shown in Jobs and Average Annual Wage columns.
[d]Baseline income found in Table 3-48.

*3.12.6.5.1.4 **Indirect Income.*** Total direct and indirect income for the No Action Alternative would be $7,610,640 in the peak year. This is an increase of less than 1 percent over the total baseline income of $25,476,500,000, whi falls below the 10 percent significance criterion.

*3.12.6.5.1.5 **Social Impacts.*** Same as for the Proposed Action.

3.12.6.5.2 Impacts During Operation. Maintenance and operation of the Proposed Action would not impact employment or income because CUWCD would use its current employees.

Table 3-57 shows the impact of increased angler-use days per year due to improved aquatic habitat (see Chapter 3, Section 3.10, Recreational Resources, for a description of predicted angler-use in the impact area of influence).

Table 3-57
2005 Fiscal Impacts of Angler-Use Resulting From the No Action Alternative

	Baseline	No Action Alternative
Total Angler-Use Days per Year	4,926	29,663
Total Annual Fiscal Impact	$ 133,347	$802,977
Percentage Increase from Baseline	Not Applicable	602%

<u>Notes</u>:

The estimated expenditure per angler day is $27.07 (URMC 1997)
The increase in angler days per year are only for Sixth Water and Diamond Fork creeks.

Although there may be significant increases in angler-use over the baseline the overall impact on the economy would be negligible. For the No Action Alternative, angler-use would increase by 602 percent resulting in an annual impact of $802,977. However, this is less than 1 percent of baseline income for the local area, which falls below the 10 percent significance criterion.

3.12.6.5.3 Impact Summary. The increases in employment and income during construction would not be significant since it would be less than 10 percent. The same holds true during operations. Although the angler-days per year use would increase, the increase in income would be less than the 10 percent significance criteria.

3.13 Cultural Resources

3.13.1 Introduction

This section describes recorded cultural and paleontological resources and the potential impacts on these resources from construction, operation and maintenance of the Proposed Action and No Action Alternative. Cultural resources include all historic and prehistoric remains associated with human occupation of an area. Paleontological resources are fossilized remains of plants and animals from former geologic periods. Intensive archaeological or paleontological ground surveys have not yet been conducted over the entire area of impact. Areas that would be affected by modifications to the Spanish Fork River diversions have not yet been examined to determine historical and prehistoric significance, but would be prior to construction (see Sections 3.13.6.4 and 3.13.6.5 below).

3.13.2 Issues Eliminated From Further Analysis

None.

3.13.3 Issues Addressed in the Impact Analysis

No issues or concerns were raised during the scoping process.

3.13.4 Description of Impact Area of Influence

The impact area of influence for cultural and paleontological resources includes any area that would be directly or indirectly disturbed by construction activities as described in Chapter 1.

3.13.5 Affected Environment (Baseline Conditions)

No known cultural or paleontological resources would be affected by the Proposed Action or No Action Alternative.

No archaeological sites were identified during several archaeological surveys in the project area, particularly along Diamond Fork Canyon and the Sixth Water Creek drainage. Previous inventories include (BYU 1998):

- Cultural resource survey of Sixth Water Power Plant Access Road (84-BE-1147w) (Wiens 1984b)

- Cultural Survey of the Sixth Water road alignment, Utah County (86-BE-1147w) (Wiens 1986)

- Diamond Stream Project UN-89-0095 (89-FS-0366f) (Loosle 1989)

- Cultural Resources Survey of the Fifth Water alternative, Diamond Fork Power System, Utah County (81-MB-0956) (Merrill and Nielson 1981)

- A Cultural Resource Survey of Drill Hole and Test Trench Sites for Fifth Water Power System (84-BE-1146w) (Wiens 1984a)

No archaeological sites, historic properties or isolated artifacts were found during a recent survey (BYU 1998) of 31 drill hole locations along the proposed tunnel and pipeline routes. All drill locations were examined in a low-level helicopter reconnaissance; 20 sites were examined in detail on the ground; and the area between the drill sites was walked and examined.

3.13.6 Impact Analysis

3.13.6.1 Methodology

Previous reports were reviewed to determine the possible occurrence of cultural resources in the impact area of influence.

3.13.6.2 Significance Criteria

For this evaluation, impacts on cultural resources are considered significant if the resource is eligible for inclusion in the National Register of Historical Properties (NRHP) or has already been listed. Ultimately, significance (or eligibility) would be determined by the lead federal agency in consultation with the State Historic Preservation Office (SHPO) and the Keeper of the NRHP. The lead federal agency, in consultation with the SHPO and the Advisory Council on Historic Preservation (ACHP) determines any impacts and treatment planning related to these resources. If the eligibility of a site is not determined, it is assumed for the purpose of this analysis that the site is eligible. Impacts to cultural resources are considered significant if either of the following were to occur:

- Disturbance or alteration of site surface and/or features; excavation, burial or inundation of any cultural resource that is listed in or is eligible for nomination to the NRHP or the Utah Register

- Alteration of surrounding topographic or cultural features that adversely affects the feeling, setting or association of a significant site

3.13.6.3 Potential Impacts Eliminated From Further Analysis

None.

3.13.6.4 Proposed Action

3.13.6.4.1 Impacts During Construction. No impacts are expected because the site densities in the area are low. . The SOPs (Chapter 1, Section 1.7.8.8) require that all disturbed areas receive a detailed Class III Cultural Inventory before construction and appropriate steps taken if significant sites are found. Each Spanish Fork River diversion to be modified would also be examined to determine historical significance.

3.13.6.4.2 Impacts During Operation. None.

3.13.6.4.3 Impact Summary. No impacts are expected to occur.

3.13.6.5 No Action Alternative

Same as for the Proposed Action.

3.14 Visual Resources

3.14.1 Introduction

This section addresses potential impacts on visual resources that would result from construction and operation of the Proposed Action and No Action Alternative. The analysis focuses on potential impacts on visual quality objectives under Forest Service guidelines.

3.14.2 Issues Eliminated From Further Analysis

None.

3.14.3 Issues Addressed in the Impact Analysis

The only issue is the potential adverse impacts on the visual quality of the area.

3.14.4 Description of Impact Area of Influence

The impact area of influence includes the Diamond Fork drainage and Red Hollow area in the Uinta National Forest.

3.14.5 Affected Environment (Baseline Conditions)

Areas in Diamond Fork Canyon and its tributary canyons that would be affected by construction and operation of the Proposed Action and the No Action alternative are shown on Maps 1-1 (Chapter 1, Section 1.3.1), 1-4 (Chapter 1, Section 1.5.1), and A-1 (see map pocket). Visual impacts associated with the No Action Alternative would be limited to Diamond Fork canyon in the vicinity of Three Forks, downstream to Red Ledges, and the area around the Spanish Fork River Outlet from Diamond Fork Pipeline at the mouth of Diamond Fork Creek. The Proposed Action would be constructed entirely on Uinta National Forest land except for the Spanish Fork River Outlet near the mouth of Diamond Fork Creek, which would be constructed on Utah Department of Transportation land.

Most of the public access in the Uinta National Forest upstream of the Monks Hollow-Three Forks area is along the narrow, curving creek bottoms, where trees may limit the visibility of construction on the canyon sidehills. Despite this restriction, the rugged natural terrain of Sixth Water Creek and Diamond Fork Creek are popular scenic attractions for the motoring and hiking public.

Areas that would be impacted by construction and operation of projects within National Forest boundaries are rated according to visual quality objectives under Forest Service guidelines (Forest Service 1975). These objectives are intended to limit visual impacts and retain the natural forest setting to the extent possible through restoration after construction.

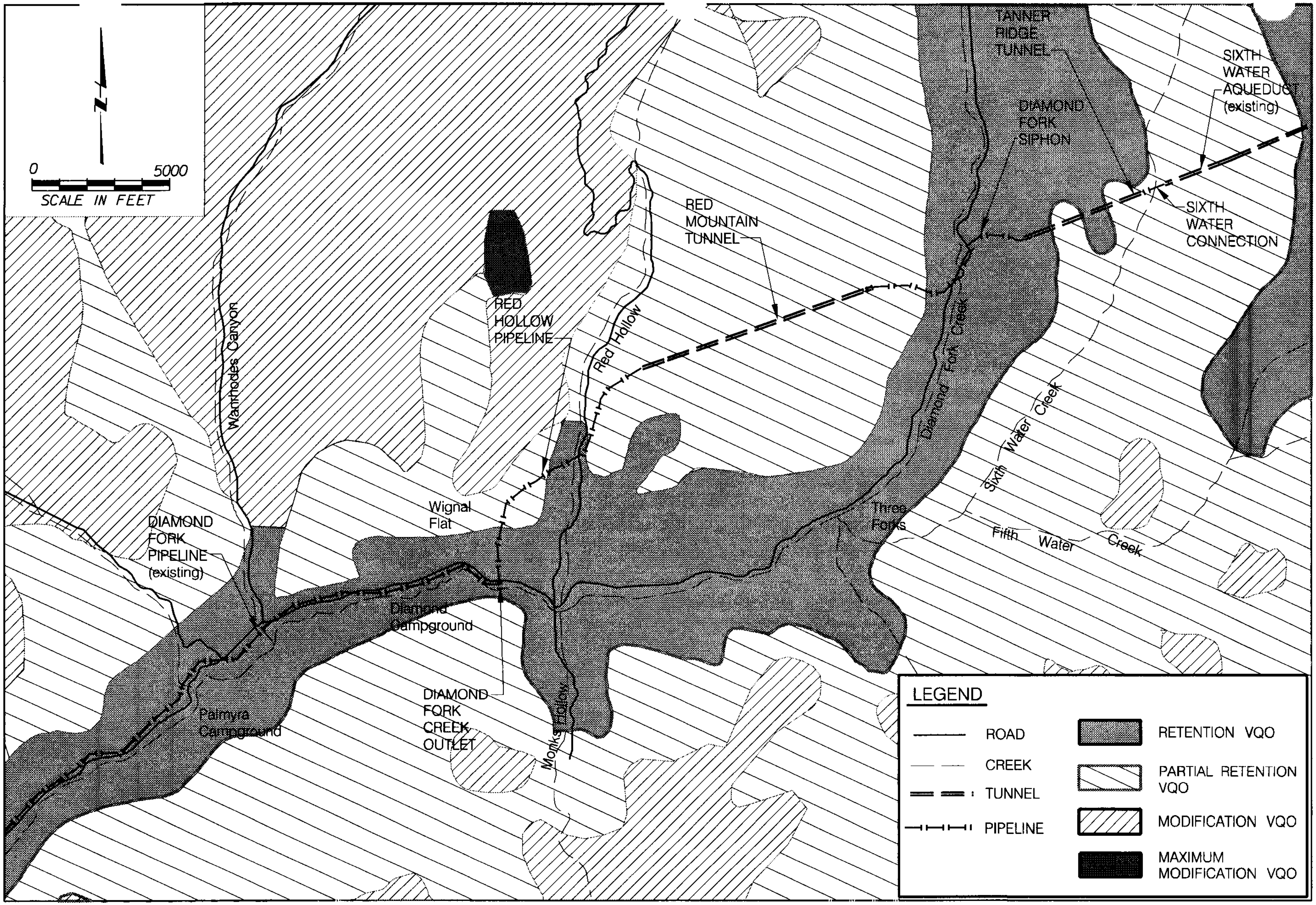
Visual quality objective designations in the Diamond Fork area include "Retention", "Partial Retention", "Modification", and "Maximum Modification". Two of these ratings – "Retention" and "Partial Retention" – apply to this project. In a retention area, restoration of visual qualities must be completed immediately after completion of construction. Restored areas may *only* repeat form, line, color and texture that are frequently found in the surrounding landscape. Changes in size, amount, intensity, direction and pattern should not be evident. In a partial retention area, visual impact must be limited to one year. Restoration efforts (as described above) may be evident, but must not dominate the surrounding landscape.

Within these ratings the Forest Service specifies the Visual Absorption Capability (VAC) of an area, which ranks the likelihood that an area would be seen by the public. The VAC categories that apply to this project are "Seldom Seen," "Moderate," "High" and "Low." The high VAC rating includes areas viewed primarily from the middle-ground to the background distance zone. These areas have a moderately high capacity for modifications and can absorb greater visual impact than areas seen at the foreground and middle-ground distances. A moderate rating includes areas that are viewed primarily at the middle-ground distance zone with a moderate capacity to absorb modifications to the characteristic landscape. The low rating means the area has a low capacity to absorb modifications to the characteristic landscape. Areas in a low VAC designation usually have slopes steeper than 40% and can be seen from ¼ to 1 mile away. Seldom seen means an area cannot be seen from primary or secondary viewing areas such as highways or other roadways and can tolerate higher levels of visual impact.

Table 3-58 shows the visual quality objective and VAC rankings of areas that lie within the Uinta National Forest (see Map 3-3):

Table 3-58
Visual Quality Objective Ratings for Affected Uinta National Forest Areas

Corridor Area	Retention Rating	Proposed Action And No Action Alternative Features In Corridor	Vac Ranking Of Affected Area
Sixth Water Creek	Partial Retention	Sixth Water Connection to Tanner Ridge Tunnel, Tanner Ridge Tunnel Inlet	Seldom Seen
Diamond Fork Creek/Road	Retention	Tanner Ridge Tunnel Outlet, Diamond Fork Siphon, Red Mountain Tunnel Inlet, East and West Temporary Access Roads, Red Hollow Pipeline, Diamond Fork Flow Control Facility, Diamond Fork Creek Outlet, Diamond Fork Pipeline Extension, Three Forks Dam and Reservoir, Spanish Fork River Outlet from Diamond Fork Pipeline	Moderate to High
Red Hollow (upper portion)	Partial Retention	Red Mountain Tunnel Outlet, Red Hollow Pipeline Permanent Access Road, Temporary Access Road	Seldom Seen, Low, High
Red Hollow (lower portion)	Retention	Red Hollow Pipeline and connection to Diamond Fork Pipeline	Moderate to High
Red Mountain	Partial Retention	Diamond Fork Siphon, Red Mountain Tunnel Inlet	Low



Map 3-3
Forest Service Visual Quality Objectives

3.14.5.1 Proposed Action

Construction areas vary in accessibility and visibility to the public. Most areas are viewed at the foreground and middle-ground distance zones. Following are descriptions of the viewsheds (from upstream to downstream) in the Uinta National Forest that would be affected by the Proposed Action:

Sixth Water Connection to Tanner Ridge Tunnel and Tanner Ridge Tunnel Inlet. The most upstream features that would be constructed are the Sixth Water Connection and the Tanner Ridge Tunnel inlet portal (see Map A-1, Inset 2). In this area Sixth Water Creek occupies a narrow, "V"-shaped canyon bordered by steep slopes vegetated with shrubs and trees, interspersed with massive rock outcroppings. This area is accessible to the public only by a pack trail 4.2 miles upstream on Sixth Water Creek, or by nonmotorized travel along the Sixth Water Aqueduct maintenance road from Sheep Creek-Rays Valley Road.

Tanner Ridge Tunnel Outlet, Diamond Fork Siphon, Red Mountain Tunnel Inlet and East and West Temporary Access Roads (see Map A-1, insets 3 and 4). The public uses the Diamond Fork Creek bottom in this area for sightseeing, picnicking and fishing. It is accessible by upper Diamond Fork road, either from Spanish Fork Canyon or from the Right Fork of Hobble Creek road, which enters the canyon upstream. The tree-lined creek bottom is somewhat wider than the creek bottom along the first 3 miles of Diamond Fork Creek above Red Hollow. The sidehills, while extremely steep in places, are generally vegetated with brush and scrub oak without cliffs or massive rock outcrops. Man-made features are limited to the narrow (mostly one-lane) paved road along Diamond Fork Creek.

Red Mountain Tunnel Outlet, Red Hollow Pipeline, Flow Control Facility, Diamond Fork Creek Outlet, East Permanent Access Road, West Temporary Access Road (see Map A-1, inset 4). Red Hollow is an extremely narrow "V"-shaped gorge for its first 0.75 mile, then the bottom of the hollow widens gradually to form an open valley floor that once contained a ranch. Red Hollow is relatively isolated, with access provided by a narrow dirt road that is open for public access for the first 0.75 mile, after which it is blocked by a locked gate to restrict motorized public access. At Monks Hollow, Diamond Fork Canyon has a relatively wide canyon bottom bordered by scenic rock bluffs and steeply rising slopes with scattered shrubs and trees.

Spanish Fork River Outlet from Diamond Fork Pipeline (see Map A-1, inset 5). This area contains an open-water pond created by the Highway 6 embankment and an abandoned farm house upstream of the pond. The landscape is gently sloping in a relatively narrow valley floor, with Diamond Fork Creek flowing on the southern edge of the valley. Vegetation is dominated by pasture grasses and wetland plant species. The construction area is visible to people traveling along Diamond Fork Road and Highway 6. It is less visible from Highway 6 because the highway is much higher than the pond, obscuring much of the area from view.

3.14.5.2 No Action Alternative

Three Forks Dam and Reservoir. This major feature of the No Action Alternative would be constructed in the Three Forks Area (see Chapter 1, Section 1.5.1, Map 1-4). This area is heavily used by recreationists. The landscape is characterized as steep, rugged terrain with rock outcroppings and vegetation dominated by shrubs and evergreen trees. Most scenery is viewed at the foreground distance zone since sight distances are relatively short.

Diamond Fork Pipeline Extension. The pipeline would be constructed along Diamond Fork Road from the end of the existing Diamond Fork Pipeline near Red Hollow to the Three Forks area. The landscape consists mainly of steeply rising slopes with scattered shrubs and trees. Most scenery is viewed at the foreground distance zone since sight distances are relatively short.

Spanish Fork River Outlet From Diamond Fork Pipeline. Same as for the Proposed Action.

3.14.6 Impact Analysis

3.14.6.1 Methodology

Potential impacts on visual resources were compared to the Forest Service visual quality objectives to determine if a significant adverse impact would result from implementation of the Proposed Action or No Action Alternative.

3.14.6.2 Significance Criteria

Any violation of visual quality objectives for Preservation, Retention, Partial Retention, or Modification of Forest Service lands is considered significant. Violations would include the following:

- Direct, permanent changes to the existing character of the landscape
- Changes to a visual resource that would require more than 1 year to restore to its original character for areas designated as Partial Retention
- Changes to the visual resource that cannot be rectified immediately following completion of construction for areas that are designated as Retention
- Permanent changes to visual contrast related to spatial characteristics, visual scale, landform, texture, line and color that are not subordinate to the characteristic landscape

3.14.6.3 Potential Impacts Eliminated From Further Analysis

Potential impacts caused by modification of the diversion structures along the Spanish Fork River were eliminated from further analysis. The modifications are minor, mostly on private land, and are not visible from any major road or highway. These areas are already disturbed, and additional modifications would not alter the scenic characteristics of the areas.

3.14.6.4 Proposed Action

3.14.6.4.1 Impacts During Construction. Impacts are identified below by viewshed, proceeding from upstream to downstream.

Sixth Water Connection to Tanner Ridge Tunnel and Tanner Ridge Tunnel Inlet. The Sixth Water Connection and the inlet to Tanner Ridge Tunnel next to Sixth Water Creek would be the furthest upstream features constructed under the Proposed Action. Construction activity and the remaining structural evidence of the tunnel would be visible to very few people. Impacts on visual resources in this area would not be significant because the area is not viewed from any highways or roadways, and the site is accessible only to hikers. All of the area disturbed by construction of the tunnel inlet would be restored under the SOPs, except for approximately 0.5 acre above the inlet that would be inaccessible (see Chapter 3, Section 3.8). The concrete inlet structure in Sixth Water Creek would be a permanent change in form, color and texture, but would not change the overall character of the surrounding landscape.

Construction staging area 1 (see Map A-1) would be visible to the public using the Sheep Creek-Rays Valley Road The disturbed and staging areas would not be a significant impact because they would not exceed 5 acres and would occur in an area already disturbed by previous construction. The staging area would be restored under the SOPs following construction.

Tanner Ridge Tunnel Outlet, Diamond Fork Siphon, Red Mountain Tunnel Inlet, and East and West Temporary Access Roads. Public access to upper Diamond Fork Canyon between Red Ledges to just north of Diamond Fork Siphon (see Map A-1) would be closed during the 3 1/2 year construction period. Construction disturbance would be visible to construction workers in this area. However, no significant visual impacts would occur because the disturbance to Diamond Fork Canyon would not be visible to the public during construction.

For several years following construction, disturbance in the form of bare earth and newly placed rock would be obvious. In the long-term, the creek bottom would regain its visual attractiveness after restorations of the creek and adjacent areas blend with the surrounding vegetation. However, the temporary disturbance would be considered significant because it occurs in an area designated Retention, and revegetation would not be complete for several years.

Red Mountain Tunnel Outlet, Red Hollow Pipeline, Flow Control Facility, Diamond Fork Creek Outlet, East Permanent Access Road, West Temporary Access Road. Red Hollow would be affected by construction of Red Mountain Tunnel and Red Hollow Pipeline. Red Hollow is accessible only by a dirt road. Construction of a new access road would be required to the outlet of the Red Mountain Tunnel (from which the tunnel would be constructed). The road to Red Mountain Tunnel Outlet would become a permanent access road for operation and maintenance. A temporary access road would be constructed to provide access to Red Hollow Pipeline west of Red Hollow Road. These roads are described in Chapter 1, Section 1.3.6. Currently, only the first 0.75 miles of the dirt road into Red Hollow is open to motorized access; the rest is restricted to foot and horseback travel by the Forest Service for wildlife management reasons. During construction, the public would be excluded from all of Red Hollow. The construction disturbance would be short-term, continuing until the pipe trench of the Red Hollow Pipeline is revegetated. After construction and revegetation is completed, visitors would (from Diamond Fork Road) encounter a detectable but not visually degraded construction zone. Impacts would not be significant.

The Red Hollow Pipeline would end at the Diamond Fork flow control facility, a connection to the end of the existing Diamond Fork Pipeline, and the Diamond Fork Creek Outlet downstream of Red Hollow (see Map A-1, Inset 4). The Diamond Fork flow control facility would be designed to blend with the existing landscape. A portion of the structure would be constructed into the mountain so only the entrance and a small portion of the structure would be visible. Nonreflective materials would be used for doors and ventilation equipment. Significant visual impacts would result from construction of the Diamond Fork flow control facility, but its intrusiveness would be minimized to the extent possible by the measures described. At Monks Hollow and for about 1 mile downstream, Diamond Fork Canyon has a relatively wide bottom bordered by steeply rising slopes with a light cover of grasses, shrubs and trees. Short-term impacts from construction of the Diamond Fork Creek Outlet and the connection to the existing Diamond Fork Pipeline would include color and texture changes that would be restored under SOPs after construction.

Spanish Fork River Outlet From Diamond Fork Pipeline. Construction at the outlet and construction staging area 5 (see Map A-1, inset 5) would be visible from Diamond Fork Road and Highway 6. This would cause a significant short-term impact since they would be visible for several miles to the public using the Diamond Fork Road.

3.14.6.4.2 Impacts During Operation. Significant long-term impacts on visual resources would result during interim operation of the Proposed Action. These impacts include permanent concrete and rock structures and one permanent access road. Impacts would include changes in form, color and texture that are not subordinate to the characteristic landscape. Reduction of streamflow in Sixth Water Creek below Sixth Water Aqueduct and Diamond Fork Creek below Three Forks would result in a long-term improvement in visual quality because of revegetated streambanks, reductions in turbidity and reductions in sediment transport.

3.14.6.4.3 Impact Summary. Significant short-term visual impacts would occur in the Spanish Fork River Outlet area during construction. Significant impacts on visual resources would result from construction of project features in the areas of the Red Mountain Tunnel Outlet and permanent access road, and the Red Hollow Pipeline and Diamond Fork Siphon areas.

3.14.6.5 No Action Alternative

3.14.6.5.1 Impacts During Construction. Impacts are identified below by viewshed, proceeding from upstream to downstream.

Three Forks Dam and Reservoir. No significant impacts on visual resources would occur during construction because the area would be closed to the public. Public access along Diamond Fork Road would be closed from Red Ledges to just past Three Forks Reservoir for the 3-year construction period.

Diamond Fork Pipeline Extension. Same as for Three Forks Dam and Reservoir.

Spanish Fork River Outlet From Diamond Fork Pipeline. Same as for the Proposed Action.

3.14.6.5.2 Impacts During Operation. Significant long-term impacts on visual resources would result during operation of the No Action Alternative. Impacts would be caused by 0.9 miles of new access road, the 6.9-acre spoil material area along Diamond Fork Road, and permanent concrete and rock structures along the Diamond Fork Pipeline Extension. Significant impacts would also be caused by Three Forks Dam and Reservoir, including changes in form, color and texture that are not subordinate to the characteristic landscape. These changes would be viewed by a large number of recreation users. Increased streamflow in Sixth Water Creek below Sixth Water Aqueduct would decrease the visual quality because of more streambank erosion, higher turbidity, and greater sediment transport into Three Forks Reservoir.

3.14.6.5.3 Impact Summary. Significant short-term visual impacts would occur in the Spanish Fork River Outlet area during construction. Significant long-term impacts would result from construction and operation of the No Action Alternative. The visual landscape character in the Three Forks area would be permanently changed by the dam and reservoir.

3.15 Transportation

3.15.1 Introduction

This section addresses potential impacts on transportation systems from construction, operation and maintenance of the Proposed Action and No Action Alternative.

3.15.2 Issues Eliminated From Further Analysis

None.

3.15.3 Issues Addressed in the Impact Analysis

The following issues are addressed in the impact analysis:

- Potential disruption of traffic flow resulting from construction activities
- Potential traffic increases as a result of construction, operation and maintenance of the Proposed Action and No Action Alternative.

3.15.4 Description of Impact Area of Influence

The impact area of influence for transportation systems consists of roads that would be used during construction, operation and maintenance of the Proposed Action and No Action Alternative. Additional impacts would occur during construction on roads that are crossed by pipelines.

3.15.5 Affected Environment (Baseline Conditions)

The affected environment includes major and minor roads that would be used during construction, operation and maintenance of the Proposed Action and No Action Alternative.

Except for major roads such as I-15 and Highway 6, the affected transportation network is generally unimproved because of the rural nature of the area. Local roadways typically consist of paved, secondary one- and two-lane roads. Two paved roads, Diamond Fork Road and Sheep Creek-Rays Valley Road, provide access to the Diamond Fork drainage area and enter the Uinta National Forest from Highway 6. The Diamond Fork road is a paved, arterial road. This road receives heavy public use. The Diamond Fork road would be the primary route of access during construction. The lower portion of this road is a recently reconstructed, double-lane, paved road. The upper portion of this road is also paved and varies in width from one fairly narrow lane to about one and a half lanes in spots. Other major local roads that may be affected are the Right Fork of Hobble Creek Road, which provides access from the City of Springville to Springville Crossing and the Springville Crossing-Rays Valley Road. A number of dirt and gravel roads in the area are used primarily for recreation, timber, grazing and administrative access to Uinta National Forest. The lower portion of Diamond Fork Road also provides access to private lands.

Major roads that would be used during construction of the Diamond Fork System include I-15 and Highway 6. Table 3-59 shows recent Average Annual Daily Traffic (AADT) counts for intersections along stretches of these roads in the impact area of influence. These intersections would be used to access Proposed Action and No Action Alternative features. AADT counts are not available for the Diamond Fork Road or Sheep Creek-Rays Valley Road.

Table 3-59
Average Annual Daily Traffic Counts at Intersections Within the Diamond Fork System Impact Area of Influence (Base Year 1996)

Location	Base Year (1996) Average Annual Daily Traffic
I-15 at Spanish Fork	42,625
Highway 6 at east Spanish Fork	13,005
Highway 6 at SR 198	6,000
Highway 6 at Moark Junction	8,285
Highway 6 at Rays Valley Road	5,765*
Highway 6 at Diamond Fork Canyon Road	5,765*
Highway 6 at SR 89 at Thistle	5,765

Source: Jager 1998
*It was assumed that the AADT is similar to Highway 6 at SR89 at Thistle.

3.15.6 Impact Analysis

3.15.6.1 Methodology

3.15.6.1.1 Assumptions. Traffic resulting from construction workers commuting to and from job sites was assumed to be between 20 and 30 people per day for each segment. As discussed in Section 3.12, Socioeconomics, construction workers are expected to come from Utah, Juab and Salt Lake counties. The assumed travel route for Salt Lake County workers would be generally south on I-15 to specific construction segments. For this analysis, 30 workers per day (or 60 trips) were assumed in order to assess the impacts on traffic at major intersections.

3.15.6.1.2 Impact Analysis Methods. Average Annual Daily Traffic (AADT) counts from 1996 were used by the Utah Department of Transportation (UDOT) to project AADTs for 2020. The future year AADTs were developed based on projections for population, number of households and employment (Jager 1998). Table 3-60 shows the 2020 AADTs for the impact area of influence.

Table 3-60 Average Annual Daily Traffic Counts at Intersections Within the Diamond Fork System Impact Area of Influence (2020)	
Location	2020 Average Annual Daily Traffic
I-15 at Spanish Fork	121,100
Highway 6 at east Spanish Fork	41,300
Highway 6 at SR 198	19,000
Highway 6 at Moark Junction	26,300
Highway 6 at Rays Valley Road	18,300*
Highway 6 at Diamond Fork Canyon Road	18,300*
Highway 6 at SR 89 at Thistle	18,300

The maximum number of daily trips required for each segment to deliver equipment and materials was estimated based on preliminary construction plans. This number was added to the estimate of traffic resulting from construction workers commuting to and from the job site to determine the maximum number of daily trips for each alternative. The maximum number of trips would be 416 for the Proposed Action and 150 for the No Action Alternative.

A quantitative analysis was used to determine if AADTs at any intersection would be increased 10% or more by construction traffic. The AADTs for the peak construction year were calculated using 1996 and 2020 AADTs provided by UDOT (Tables 3-59 and 3-60). For example, for the Proposed Action the AADT for I-15 at Spanish Fork would be equal to:

(Base Year AADT) + (Peak Construction Year – Base Year) x (Future Year AADT – Base Year AADT) / (Future Year – Base Year) = Peak Construction Year AADT

where:
Base Year = 1996
Future Year = 2020
Peak Construction Year = 2000
Base Year AADT = 42,625
Future Year AADT = 121,100

42,625 + (2000 – 1996) x (121,100 – 42,625) ÷ (2020 – 1996) = 55,704 vehicles/day

The percentage increase in AADT due to construction traffic was calculated by dividing the maximum number of construction trips by the AADT for the peak construction year. For example, the percentage increase in AADT for I-15 at Spanish Fork for the Proposed Action would be:

$(416 \div 55{,}704) \times 100 = 0.7\%$

where:
416 = maximum number of daily construction trips
55,704 = AADT for the peak construction year at the appropriate intersection

3.15.6.2 Significance Criteria

The following transportation impacts would be considered significant if construction, operation or maintenance activities associated with the Proposed Action or No Action Alternative would result in one or more of the following:

- An increase in AADT of 10 percent or more for selected major roadways
- Vehicular travel delays of more than 15 minutes
- Rerouting of emergency response vehicles
- Rerouting of normal traffic patterns
- Accelerated roadway deterioration and increased maintenance costs, or upgrading of roadways or capital expenditures required to mitigate vehicle flow or safety deficiencies that are beyond the plans or fiscal capabilities of the agency maintaining the road

These criteria are based on discussions with traffic engineers from the UDOT and Utah County, review of common traffic practices, and professional judgment.

3.15.6.3 Potential Impacts Eliminated From Further Analysis

Potential physical impacts to roads from heavy equipment and other construction-related traffic were eliminated from further analysis. As stated in the SOPs for Transportation Networks, Chapter 1, Section 1.7.8.11, any road damaged by project construction activities would be restored to a condition better than or equal to its preconstruction condition. In addition, snow removal SOPs listed in this section would be followed, and therefore snow removal operations are not expected to have any significant impacts. Traffic impacts resulting from modification of the diversion structures on the Spanish Fork River were also eliminated from further analysis because traffic would be minimal.

3.15.6.4 Proposed Action

3.15.6.4.1 Impacts During Construction. Construction-related traffic would be associated with worker commuter traffic and delivery of equipment, pipe and other construction materials to the job site. Table 3-61 shows the expected construction traffic route for each feature of the Proposed Action.

Table 3-61
Planned Construction Traffic Route by Proposed Action Feature

Feature	Transportation Route to Segment
Sixth Water Connection	I-15 to Highway 6; Highway 6 to Sheep Creek-Rays Valley Road; Sheep Creek-Rays Valley Road to Sixth Water Aqueduct maintenance road.
Tanner Ridge Tunnel	I-15 to Highway 6; Highway 6 to Diamond Fork Road; Diamond Fork Road to east temporary access road near the Diamond Fork Bridge.
Diamond Fork Siphon	I-15 to Highway 6; Highway 6 to Diamond Fork Road; Diamond Fork Road to east and west temporary access roads near the Diamond Fork Bridge.
Red Mountain Tunnel	I-15 to Highway 6; Highway 6 to Diamond Fork Road; Diamond Fork Road to Red Hollow Road; Red Hollow Road to east permanent access road.
Red Hollow Pipeline	I-15 to Highway 6; Highway 6 to Diamond Fork Road; Diamond Fork Road to Red Hollow Road; Red Hollow Road to east permanent access road and west temporary access road and construction corridor to the west of Red Hollow Road.
Diamond Fork Creek Outlet	I-15 to Highway 6; Highway 6 to Diamond Fork Road.
Spanish Fork River Outlet	I-15 to Highway 6; Highway 6 to Diamond Fork Road.

The year 2000, when both Tanner Ridge and Red Mountain Tunnels would be under construction simultaneously, would be considered the peak construction year for the Proposed Action. Table 3-62 summarizes construction-related traffic by percentage increase for major intersections.

Table 3-62
Summary of AADT Increases Resulting From Construction Traffic for the Proposed Action

Location	Base Year (1996) AADT	Peak Construction Year (2000) AADT	Maximum No. of Construction-Related Trips	% Increase
I-15 at Spanish Fork	42,625	55,704	416	0.7%
Highway 6 at east Spanish Fork	13,005	17,721	416	2.3%
Highway 6 at SR 198	6,000	8,167	416	5.1%
Highway 6 at Moark Junction	8,285	11,288	416	3.7%
Highway 6 and SR 89 at Thistle	5,765	7,854	416	5.3%

As indicated in Table 3-62, increases to AADT resulting from construction trips on I-15 and Highway 6 would be less than 10 percent, which is not considered a significant impact. Traffic counts are not available for Diamond Fork Road, but 416 construction trips would most likely increase AADTs more than 10 percent on this road. Therefore, a significant impact to Diamond Fork Road would occur from increased AADTs.

Pipeline construction across all roads would be by the open-trench method as explained in Chapter 1, Section 1.3.5 and shown on Figures 1-2 and 1-3. Diamond Fork Road would be closed to public access at the crossings of Diamond Fork Siphon and Diamond Fork Creek Outlet (see Map A-1), therefore only the crossing of Diamond Fork Road by the construction of the Spanish Fork River Outlet could impact traffic. Open-trench construction in roadways would involve closing one lane at a time and temporary road detours to shoulders or other roads; covering open trenches in roadways with steel plating; and scheduling some construction activities during off-peak traffic hours. These procedures would result in temporary delays of less than 15 minutes on Diamond Fork Road. Blasting should not be necessary, but if it is, local traffic is not expected to be delayed more than 15 minutes because of the limited area that would be affected. Traffic delays greater than 15 minutes would not be expected during construction of the Proposed Action, therefore no significant delay impacts would occur.

Rerouting of emergency response vehicles would not be necessary because access would be available along Diamond Fork Road, including the segment closed to the public as necessary during construction and would not result in any significant impacts.

Construction equipment traffic on Diamond Fork Road during constructions is expected to be heavy. As a public safety measure, the Diamond Fork Road between Red Ledges and Diamond Fork Siphon would be closed to public use during the 3½ year construction period. Public access between Hobble Creek Road and the Wasatch Front and Spanish Fork Canyon would be available via the Right Fork of Hobble Creek Road and the Sheep Creek – Rays Valley Road. The hiking trails normally accessed via the Diamond Fork Road to Three Forks would also be accessed off the Sheep Creek – Rays Valley Road. Alternatively, they could be accessed from the Diamond Fork Road by hiking from Red Ledges to Three Forks. Rerouting of normal traffic patterns would be a significant adverse impact.

Closure of Diamond Fork Road could cause increased traffic on the Right Fork of Hobble Creek Road, Sheep Creek – Rays Valley Road and Springville Crossing – Rays Valley Road. It is expected that only Sheep Creek – Rays Valley Road could experience increased AADTs of 10 percent or more. This would be a significant adverse impact.

3.15.6.4.2 Impacts During Operation. Minimal maintenance is required for a pressurized water pipeline built to current standards. Visits to the Diamond Fork flow control facility (downstream of Monks Hollow) could potentially be made once a day, involving one vehicle traveling along Diamond Fork Road. Traffic generated by maintenance and operation of the Proposed Action would not significantly impact transportation resources and would not be expected to accelerate roadway deterioration or increase road maintenance costs.

3.15.6.4.3 Impact Summary. The only significant impacts occurring as a result of the Proposed Action would be a significant but unquantifiable increase in AADTs on Diamond Fork Road from Highway 6 to Red Ledges and on Sheep Creek – Rays Valley Road, and closure of Diamond Fork Road during construction. This closure would require rerouting traffic to provide access to the upper portion of Diamond Fork Canyon.

3.15.6.5 No Action Alternative

3.15.6.5.1 Impacts During Construction. Construction-related traffic for the No Action Alternative would consist of worker commuter traffic and delivery of equipment, pipe, concrete and other construction materials to the job site. The expected construction traffic route for all of the No Action Alternative features would be I-15 to Highway 6 to Diamond Fork Road.

Table 3-63 summarizes construction-related traffic by percentage increase for major intersections. Peak construction years for the No Action Alternative would be during 2001 and 2002. Using AADTs from 2001 provides the worst-case scenario for percentage increases in AADT.

Table 3-63
Summary of Construction-Related Traffic Impacts Resulting From the No Action Alternative

Location	Base Year (1996) AADT	Peak Construction Year (2001) AADT	Maximum No. of Construction-Related Trips	% Increase
I-15 at Spanish Fork	42,625	58,974	150	0.3%
Highway 6 at east Spanish Fork	13,005	18,900	150	0.8%
Highway 6 at SR 198	6,000	8,708	150	1.7%
Highway 6 at Moark Junction	8,285	12,038	150	1.2%
Highway 6 and SR 89 at Thistle	5,765	8,376	150	1.8%

As indicated in Table 3-63, increases to AADT resulting from construction trips on I-15 and Highway 6 would be less than 10 percent, which is not considered a significant impact. Traffic counts are not available for Diamond

Fork Road, but 150 construction trips would possibly increase AADTs more than 10 percent on this road, which would be a significant impact to Diamond Fork Road.

The only road to be crossed with pipeline construction under the No Action Alternative would be the Diamond Fork Road at the Spanish Fork River Outlet. Traffic delays would be the same as described for the Proposed Action and would not be significant.

Rerouting of emergency vehicles would not be necessary. As in the Proposed Action, emergency access would be available along Diamond Fork Road and would not result in any significant impacts.

Construction activities associated with the No Action Alternative would result in the closure of Diamond Fork Road between Red Ledges and Three Forks during the 3-year construction period. The relocated Diamond Fork Road would not be opened until construction of the dam and reservoir was completed. Public access between Hobble Creek Road and the Wasatch Front and Spanish Fork Canyon would be available via the Right Fork of Hobble Creek Road and the Sheep Creek – Rays Valley Road. The hiking trails normally accessed via the Diamond Fork Road to Three Forks would also be accessed off the Sheep Creek – Rays Valley Road. Alternatively, they could be accessed from the Diamond Fork Road by hiking from Red Ledges to Three Forks. Rerouting of normal traffic patterns would be a significant adverse impact.

Closure of Diamond Fork Road could cause increased traffic on the Right Fork of Hobble Creek Road, Sheep Creek – Rays Valley Road and Springville Crossing – Rays Valley Road. It is expected that only Sheep Creek – Rays Valley Road could experience increased AADTs of 10 percent or more. This would be a significant adverse impact.

3.15.6.5.2 Impacts During Operation. Very little traffic would be generated by operations and maintenance of t' Diamond Fork Pipeline and Three Forks Dam and Reservoir. Therefore, no significant impact on transportation resources would result from operation and maintenance of the No Action Alternative.

3.15.6.5.3 Impact Summary. The only significant impacts of the No Action Alternative would be a significant but unquantifiable increase in AADTs on Diamond Fork Road from Highway 6 to Red Ledges and on Sheep Creek – Rays Valley Road, and the closure of Diamond Fork Road during construction. This closure would require rerouting traffic to provide access to the upper portion of Diamond Fork Canyon.

3.16 Air Quality

3.16.1 Introduction

This section addresses potential impacts on air quality as a result of the construction and operation of the Proposed Action and No Action Alternative. The analysis focuses on potential short- and long-term impacts and the ability to meet established air quality standards.

3.16.2 Issues Eliminated From Further Analysis

None.

3.16.3 Issues Addressed in the Impact Analysis

No issues regarding air quality were raised in the SFN public scoping process or in any comments made on the SFN Draft EIS.

The air quality impact analysis focuses on the following issues:

- Whether fugitive dust and gaseous emissions generated during construction of the Proposed Action and No Action Alternative would cause a temporary exceedance of ambient air quality standards or interfere with Utah County's ability to meet the PM_{10} standard.

- Whether long-term operation and maintenance of the Proposed Action or No Action Alternative would result in any direct or indirect long-term air quality impacts.

3.16.4 Description of Impact Area of Influence

The general air quality impact area of influence is located within Utah County. The impacts of construction activities on air quality would be localized and limited to areas where construction would occur.

3.16.5 Affected Environment (Baseline Conditions)

The affected environment for the Proposed Action and No Action Alternative air quality analysis includes both climate and the existing ambient air quality in the impact area of influence. Although sources of data to directly characterize climate and air quality parameters of influence are limited, available data is adequate to generalize existing baseline conditions. Available ambient air quality data has been acquired from the Utah Department of Environmental Quality Division of Air Quality for the North Provo station, which is expected to have significantly poorer air quality than areas near Proposed Action and No Action Alternative features. Therefore, use of this data results in a conservative (i.e., worst-case) estimate of existing air quality within the impact area of influence.

3.16.5.1 Climate

Climate represents the long-term average weather patterns of a given area. Weather affects air quality through its impact on the dispersion of pollutants emitted into the atmosphere. In some cases, weather conditions can also affect the amount of pollutants emitted, such as fugitive dust particles blown airborne from exposed soils. The most nportant meteorological parameters affecting air quality are wind speed and direction, which determine where pollutants are transported and the rate of dilution in the atmosphere. Temperature and precipitation also affect air quality through their effects on emissions, pollutant transport, atmospheric removal mechanisms and atmospheric chemistry.

Utah County has a semiarid continental climate, with four well-defined seasons. Climate and meteorological conditions are influenced by the altitude of the area (4,200 to 7,800 feet above sea level) and the presence of the Wasatch Mountains, which rise to elevations of nearly 12,000 feet. Summers are typically hot and dry, with temperatures above 100°F occurring several days per year. Winters are cold, but generally not severe. The average annual snowfall is 60 to 70 inches, with greater snowfall occurring at higher elevations.

Precipitation is generally light in the summer and early fall. Maximum precipitation occurs during the spring, when storms originating over the Pacific Ocean reach the area more frequently than in other seasons. Summer precipitation usually results from thunderstorms, which can produce significant localized rainfall. Typically, 20 to 40 thunderstorms per year occur in the Diamond Fork impact area of influence.

Table 3-64 summarizes general climate parameters along the Wasatch Front based on 30 years of historical meteorological data collection at Salt Lake City, approximately 60 miles north of the impact area of influence. Seasonal variations in temperature and precipitation in the impact area of influence are similar to those in Salt Lake City. It can be assumed that precipitation levels are somewhat higher and temperatures lower in the Diamond Fork drainage because of elevation differences.

The Utah Department of Environmental Quality Division of Air Quality collects wind speed and direction data at many of its ambient air quality monitoring locations. Data from the North Provo station, which is closest to the impact area of influence, indicates that the predominant wind direction is from the north to northeast and wind speeds are generally light (i.e., less than 8 miles per hour). This is particularly true in Spanish Fork and Diamond Fork Canyons where mountains affect wind patterns and "canyon winds" are common in the morning.

3.16.5.2 Ambient Air Quality

Ambient air quality is characterized by the atmospheric concentrations of "criteria pollutants": nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), particulate matter (PM_{10}), and lead (Pb). NAAQS for these pollutants are intended to protect public health, with a margin of safety. For purposes of air quality management, geographic areas of the country are classified as "attainment" or "nonattainment" with NAAQS. Table 3-65 shows the attainment classifications for Utah County, which is designated as a nonattainment area for two pollutants: CO and PM_{10}. The PM_{10} nonattainment area includes the entire county, while the CO nonattainment area is limited to the cities of Provo and Orem.

The Federal Clean Air Act requires each state to prepare and submit to the EPA a State Implementation Plan for attainment and maintenance of NAAQS. The PM_{10} plan for Utah County was approved by the EPA on July 22, 1994, and shows an attainment date of December 31, 1994 (McNeil 1994). The CO plan was submitted to the EPA on July 13, 1994.

Table 3-64
Climatic Parameters

Month	Temperature (F)		Precipitation (inches)		Mean Number of Days		Wind	
	Daily Maximum	Daily Minimum	Total Precipitation	Snowfall	Precipitation > 0.01 inch	Snow, Ice Pellets >1.0 inch	Mean Wind Speed (mph)	Prevailing Direction
January	37.4	18.5	1.27	13.5	10	4	7.7	SSE
February	45.4	23.3	1.19	9.7	9	3	8.2	SE
March	50.8	28.3	1.63	10.0	10	3	8.2	SSE
April	61.8	36.6	2.12	5.9	10	2	9.3	SE
May	72.4	44.2	1.49	0.9	8	0	9.4	SE
June	81.3	51.6	1.30	Trace	5	0	9.4	SSE
July	92.6	60.5	0.70	0.0	4	0	9.4	SSE
August	90.8	58.7	0.93	0.0	8	0	9.6	SSE
September	80.3	49.3	0.68	0.1	5	0	9.1	SE
October	66.4	38.4	1.16	1.0	6	0	8.5	SE
November	50.0	28.1	1.31	6.4	7	1	7.8	SSE
December	39.0	21.5	1.39	11.7	6	4	7.8	SSE
Annual	63.6	38.2	15.17	59.2	88	18	8.8	SSE

Source: National Oceanic and Atmospheric Administration

Table 3-65
Air Quality Attainment Status of Utah County

Pollutant	Status
Nitrogen Dioxide (NO_2)	Attainment
Sulfur Dioxide (SO_2)	Attainment
Ozone (O_3)	Attainment
Carbon Monoxide (CO)	Nonattainment (Provo and Orem only)
Particulate Matter (PM_{10})	Nonattainment
Lead (Pb)	Attainment

Ambient air quality is monitored by the Division of Air Quality at locations throughout the state. The monitoring station closest to Diamond Fork is located in northern Provo. Data from this monitoring station in North Provo, which is closest to Diamond Fork, has been used as a conservative estimate of existing air quality in the impact area of influence. The actual ambient air quality in the Diamond Fork area of Utah County is probably much better than at the North Provo station because of the lower population and lack of significant major emission sources.

Table 3-66 shows measured ambient data from North Provo. Since SO_2 is not measured at this station, the SO_2 concentrations from Salt Lake City are included in this table. Violations of the 24-hour PM_{10} standard shown in the table occurred from 1991 to 1993. These standard violations have consistently occurred during the winter months due to a combination of very stable meteorological conditions and increases in residential wood combustion and other emission sources. The peak 24-hour PM_{10} concentrations from 1990 to 1993 exceeded the federal standard during January and February. PM_{10} concentrations were at a minimum between April and October.

Table 3-66
Ambient Air Quality in Utah County

Station	Pollutant	Averaging Time	Highest Measured Concentrations			National Ambient Air Quality Standard
			1991	1992	1993	
North Provo	NO_2	Annual	0.023 ppm	0.019 ppm	0.025 ppm	0.05 ppm
		1 Hour	0.14 ppm (0.14 ppm)	0.093 ppm (0.066 ppm)	0.112 ppm (0.111 ppm)	
Salt Lake City	SO_2	Annual	0.007 ppm	0.007 ppm	0.006 ppm	0.03 ppm
		24 Hour	0.04 ppm (0.04 ppm)	0.089 ppm (0.073 ppm)	0.040 ppm (0.035 ppm)	0.14 ppm
		3 Hour	0.12 ppm (0.11 ppm)	0.392 ppm (0.333 ppm)	0.080 ppm (0.079 ppm)	0.5 ppm
North Provo	O_3	1 Hour	0.09 ppm (0.08 ppm)	0.096 ppm (0.089 ppm)	0.089 ppm (0.084 ppm)	0.12 ppm
North Provo	CO	8 Hour	9 ppm (7 ppm)	8 ppm (8 ppm)	6 ppm (6 ppm)	9 ppm
		1 Hour	13 ppm (11 ppm)	13 ppm (12 ppm)	9 ppm (9 ppm)	36 ppm
North Provo	PM_{10}	Annual	37 $\mu g/m^3$	33 $\mu g/m^3$	33 $\mu g/m^3$	50 $\mu g/m^3$
		24 Hour	234 $\mu g/m^3$ (182 $\mu g/m^3$)	227 $\mu g/m^3$ (173 $\mu g/m^3$)	194 $\mu g/m^3$ (178 $\mu g/m^3$)	150 $\mu g/m^3$

Notes:

Values in parentheses represent second highest concentration measured during the year.
Values in bold are measured concentrations that equal or exceed standards.

The 8-hour standard for CO was equaled only once in the 3-year period (in 1991) and this has not occurred since (see Table 3-68). Although the Provo/Orem area is still designated nonattainment, it is likely that the area has actually been meeting the CO standards since 1992.

3.16.6 Impact Analysis

3.16.6.1 Methodology

Because the Proposed Action and No Action Alternative would not result in any long-term emissions of airborne pollutants, this impact analysis focuses on the temporary effects of construction activities on air quality in the impact area of influence. Emissions from construction are associated with two primary sources:

- Exhaust from heavy equipment operation
- Construction dust produced during site preparation, excavation, pipe installation, backfill activities and site restoration

Impacts were assessed by estimating the magnitude of construction emissions for a typical construction spread and comparing them with air quality standards.

3.16.6.1.1 Assumptions. It was assumed that emissions from construction activities for the Proposed Action and No Action Alternative could be represented by emissions calculated from a typical construction operation.

Modeling (described in Section 3.16.6.1.2) assumes actions would be taken to minimize short-term construction dust and long-term wind erosion. These actions would be implemented as SOPs or best management practices and would be specified in individual construction contracts prepared by the CUWCD. Section 1.7.8, Standard Operating Procedures, identifies specific steps that would be taken to minimize activities that generate dust and mitigate emissions. Revegetation, as described in the SOPs, would stabilize disturbed soil, which would prevent long-term impacts from wind erosion and minimize soil and water erosion.

3.16.6.1.2 Impact Topic Analysis Methods. Typical PM_{10} emissions associated with a construction operation were estimated using emission factors from the Fourth Edition of AP42, EPA's Compilation of Air Pollutant Emission Factors (EPA 1985).

Chapter 1, Table 1-23, summarizes the types of equipment and monthly emissions for a typical construction operation. Emission factors for equipment exhaust were based on an EPA study of non-road vehicle and engine emissions (EPA 1991).

The short-term impacts of emissions from a typical construction operation were assessed by applying the EPA's Fugitive Dust Model (FDM) to the emission estimates. The FDM produces estimates of ambient impacts of PM_{10} emissions, taking into account the settling and deposition of particles of various size categories (Winges 1992). The FDM model was run for a series of meteorological conditions (i.e., wind speeds and stability classes) using a worst-case condition of wind blowing directly across the construction operation at a 90° angle. A typical summertime peak, 24-hour background concentration of 75 micrograms per cubic meter ($\mu g/m^3$) was used and included both construction dust and equipment exhaust PM_{10} emissions.

3.16.6.2 Significance Criteria

Significant air quality impacts occur when emissions from a project prevent attainment or maintenance of the EPA's NAAQS as described in Section 3.16.5.2. For the Proposed Action or No Action Alternative, an air quality impact would be considered significant if one of the following were to occur:

- Construction activities result in a short- or long-term violation of any ambient air quality standard
- Activities or emissions caused by growth induced by the Proposed Action or No Action Alternative interfere with any local air quality management planning efforts to attain and maintain standards

3.16.6.3 Potential Impacts Eliminated From Further Analysis

Long-term operational impacts were not considered since there are no permanent emission sources associated with operating the pipeline.

3.16.6.4 Proposed Action

3.16.6.4.1 Impacts During Construction. The impact analysis focuses on construction activities in the Diamond Fork Canyon area, where the most significant dust and gaseous emissions would occur. Minimal, short term construction activities at the diversion structures along the Spanish Fork River would not result in any significant air quality impacts.

The most intensive emission-producing construction activities would occur during trenching and other excavation, when fugitive dust and vehicle exhaust emissions would be emitted. Fugitive dust would be emitted from several sources, including construction of temporary access roads, clearing of pipeline right-of-way, trenching, backfilling, travel over unpaved surfaces, and grading. In some areas, blasting would also cause suspension of construction dust. The location of these emissions would change as segments of the pipeline were completed and construction moved to other locations. It is expected that no more than 600 feet of open trench would exist at any one time. Activities such as clearing of the pipeline right-of-way may occur a considerable distance in advance of the trench excavation and would contribute to the overall impacts from construction dust. However, emissions from construction would not occur for any appreciable period of time at any one location. Applying the SOPs as described in Chapter 1, Section 1.7 would reduce dust emissions to insignificant levels.

Table 3-67 shows construction dust PM_{10} emissions from a typical construction operation. Approximately 222 lb/day of construction dust PM_{10} emissions would be produced, mainly from vehicle and equipment travel over unpaved roads or direct disturbance of the soil by excavation, grading and compacting. Application of standard dust suppression techniques (e.g., soil stabilization or watering of trench stockpiles) would reduce daily PM_{10} emissions from 222 lb/day to 150 lb/day.

Table 3-67 Construction Dust PM_{10} Emissions From a Typical Construction Spread			
Emission Source or Activity	**Activity Factor**	**Emission Factor**	**Emission Rate (lb/day)**
Wind erosion-temporary stockpiles	0.826 acre	6.3 lb/acre/day	5.21
Excavation	8 dozer-hours/day	3.16 lb/hour	25.28
Unpaved roads	44 miles	1.677 lb/mile	73.79
Compacting	10 hours/day	3.16 lb/hour	31.60
Grading	5 miles	11.48 lb/mile	57.40
Backfill (dozer)	8 dozer-hours/day	3.16 lb/hour	25.28
Wind erosion	2 acres	1.7 lb/acre/day	3.40
Total Fugitive Dust			221.96

Assumptions:

- Typical construction spread includes excavation sufficient for 600 feet of pipeline per day.
- Stockpile is 216,000 cubic feet of trench material to a depth of 6 feet.
- Compacting and backfill emission factors are assumed to be similar to those for excavation.
- Silt content = 15 percent, 88 days per year of rain > 0.01 inch, winds > 12 mph for 1.33 percent of year.

Construction equipment exhaust would include emissions of CO, NO_x, SO_2, reactive organic gases, and PM_{10}. Table 3-68 shows the total daily emissions from both equipment exhaust and construction dust for a typical construction operation.

Table 3-68
Summary of Total Daily Construction Emissions

Emission Source Category	Daily Emissions (lb/day)				
	CO	Reactive Organic Gases	NO_x	SO_2	PM_{10}
Equipment Exhaust	101	24	225	21	19
Construction Dust	0	0	0	0	222
Total	101	24	225	21	241

The results of the FDM model run for PM_{10} for a typical construction operation show that the federal 24-hour PM_{10} standard may be exceeded to a distance of about 660 feet from construction activities. While this could be characterized as temporary and localized, estimated exceedances in the federal 24-hour PM_{10} standard are considered significant based on the significance criteria and results of the FDM model.

The emission of PM_{10} in and near Utah County may impact efforts to meet the PM_{10} standard. As indicated earlier. Utah County is a nonattainment area and is implementing a plan to bring the area into attainment. It is very unlike that Proposed Action construction emissions would have any significant effect on these efforts because PM_{10} levels would be reduced to near background levels at distances of less than 1 mile from construction sites. The North Provo monitoring station is located more than 15 miles from areas where construction would take place. The monitored PM_{10} violations in Utah County are located in areas that are considerably more populated than those near the Proposed Action. Therefore, the impact of construction emissions on areas where the PM_{10} standard is currently exceeded would not be significant. This conclusion is strengthened by the fact that the PM_{10} standard is currently exceeded in Utah County only during January and February when construction activities are expected to be minimal because of weather.

Table 3-69 shows results of FDM modeling of gaseous equipment exhaust emissions for a typical construction operation. Results indicate that gaseous exhaust emissions would produce a peak impact that is a very small fraction of the health-based standard and would not produce a significant impact. The magnitude of peak CO impacts would be 1 percent or less of the ambient standard and would be located many miles from the CO nonattainment area in Provo and Orem. Annual impact estimates cannot be made since the location of emissions would constantly change; thus the location of impact would not be constant. Estimates were not made for NO_2, because no short-term ambient air quality standard exists.

Table 3-69
Gaseous Equipment Exhaust Emissions

Pollutant	Averaging Time	Peak Impact ($\mu g/m^3$)	Ambient Standard ($\mu g/m^3$)
CO	1 hours	244	40,000
	8 hours	122	10,000
SO_2	3 hours	46	1,300
	24 hours	16	365

3.16.6.4.2 Impacts During Operation. None.

3.16.6.4.3 Impact Summary. Construction of the Proposed Action could cause temporary, localized exceedance of the PM_{10} standard.

3.16.6.5 No Action Alternative

3.16.6.5.1 Impacts During Construction. Same as the Proposed Action for pipeline construction. In addition, construction of Three Forks Dam would result in a localized increase in air emissions from construction equipment and activities in the Diamond Fork Drainage. PM_{10} standards would likely be exceeded due to construction of the dam.

3.16.6.5.2 Impacts During Operation. None.

3.16.6.5.3 Impact Summary. Same as for the Proposed Action.

3.17 Mineral and Energy Resources

3.17.1 Introduction

This section addresses the potential impacts on mineral and energy resources that could occur from construction and operation of the Proposed Action and No Action Alternative.

3.17.2 Issues Eliminated From Further Analysis

The following issues were eliminated from further analysis:

- Energy resources of coal and oil shale would not be affected by the Proposed Action or No Action Alternative because these resources do not occur in marketable quantities near any of the proposed facilities described in Chapter 1 (UDNR, 1983a). Some exploratory oil and gas wells have been drilled in the general area in the past, however no producing wells have been developed in the Diamond Fork Drainage. Potential for oil and gas in the drainage is low to moderate. (Forest Service 1997b). Neither the Proposed Action or the No Action Alternative would prohibit energy resource exploration other than as needed to protect the project features.

- Operation of the Dream Mine would not be affected by the Proposed Action and No Action Alternative because the mine is inactive and is located outside the impact area of influence.

- Development of nonmetallic mineral resources, including gypsum, anyhydride, clays, phosphates, and sand and gravel would not be affected by the Proposed Action or No Action Alternative because these minerals do not occur in marketable quantities (Although a "favorable" band for phosphates (UDNR, 1983b) would be crossed by the Diamond Fork Siphon and the Red Hollow Pipeline under the Proposed Action and the Upper Diamond Fork Pipeline under the No Action Alternative, there is no evidence of phosphates along the alignments of these features based on boreholes [Monley 1999]).

- Operation of the sand pit east of the intersection of Diamond Fork Road and Highway 6 would not be affected by the Proposed Action and No Action Alternative because it is outside of the impact area of influence and traffic delays on Diamond Fork Road during construction of the Spanish Fork River Outlet would be less than 15 minutes (see Section 3.17.6.3).

- Potential development of mineral and energy resources would not be affected by modifications to the diversion structures on the Spanish Fork River under the Proposed Action or No Action Alternative.

- Transportation routes to active mines would not be affected. Any traffic delays caused by construction are expected to be less than 15 minutes (see Section 3.15, Transportation).

3.17.3 Issues Addressed in the Impact Analysis

No issues were raised during the SFN scoping process. However, the following issue is addressed in this section. Impacts to mineral resources were eliminated form further analysis (see Section 3.17.2).

- Potential adverse impacts on energy production of the two Strawberry Valley Project (SVP) hydroelectric power plants on the Spanish Fork River

3.17.4 Description of Impact Area of Influence

The impact area of influence includes any mineral and energy resources within 300 feet of Proposed Action and No Action Alternative features.

3.17.5 Affected Environment (Baseline Conditions)

3.17.5.1 Energy Resources

Two hydroelectric power plants are located in the impact area of influence. The upper and lower SVP plants are owned and operated by the Strawberry Water Users Association (SWUA). The upper plant has a capacity of 3,500 kilowatts and the lower plant has a capacity of 370 kilowatts.

The water that passes through the power plants is diverted from the Spanish Fork River at the Spanish Fork Diversion Dam. The water is conveyed to the plants in the 3.3-mile-long Strawberry Power Canal, which has a capacity of 500 cfs. The terminus of the power canal serves as a forebay for the upper Strawberry power plant and as the headworks for the High Line Canal. The flow of water also is divided here, with up to 240 cfs released into the High Line Canal to meet irrigation demands and the balance released to flow through a steel penstock to the upper Strawberry power plant. During the nonirrigation season, all flows in the Strawberry Power Canal are released through the upper plant.

The flow divides again from the tailrace of the upper plant, where up to 130 cfs is released into a canal that serves the Salem and Spanish Fork South Irrigation Companies. The remainder flows through the lower plant to the Spanish Fork River. During the nonirrigation season, all flows passing through the upper power plant also pass through the lower plant.

3.17.6 Impact Analysis

3.17.6.1 Methodology

Project impacts on energy and mineral resources were determined by a detailed review of known energy and mineral resources (Monley 1999, UDNR 1983a, UDNR 1983b) in the impact area of influence. Construction and operation plans for the Proposed Action and No Action Alternative features were then compared to the known resources to determine any potential conflicts.

3.17.6.2 Significance Criteria

Impacts on mineral and energy resources were considered significant if the construction, operation or maintenance of the Proposed Action or No Action Alternative would prevent or disrupt development of mineral or energy resources.

3.17.6.3 Potential Impacts Eliminated From Further Analysis

The following potential impacts were eliminated from further review:

- Based on the construction procedures described in Chapter 1 and the impact analysis in Section 3.15, Transportation, any construction activities involving crossings of local or minor roadways would involve closing one lane at a time and temporary delays less than 15 minutes. These closures and delays are not likely to impact the sand and gravel mining operation.

- Based on the stream flow analysis (Chapter 3, Section 3.2.6.4.2.1) the flow available to the SVP power plants would not be affected by construction or operation of features under the Proposed Action or No Action Alternative. Modification of the Spanish Fork Diversion Dam would also not affect the flow available to the power plants. Therefore no impact on energy production would be expected.

3.17.6.4 Proposed Action

No significant impacts on mineral or energy resources are expected from the Proposed Action (see Section 3.17.6.2 above).

3.17.6.5 No Action Alternative

An unquantified amount of the supplemental irrigation water may flow through the Power Canal SVP powerplants, which may increase power production from these plants. It is unlikely that the increase would result in a significant impact. No other significant impacts on mineral or energy resources are expected from the No Action Alternative (see Section 3.17.6.2 above). Construction of the dam and reservoir would not inundate any viable mineral resources.

3.18 Land Use Plans and Conflicts

3.18.1 Introduction

This section identifies conflicts between the Proposed Action and No Action Alternative project features and existing land use plans. Since all the features would be constructed on land administrated by the U.S. Forest Service, only plans developed by the Forest Service were examined. This analysis focused on identifying construction and operational aspects of the Diamond Fork System that would be in conflict with existing land use plans.

3.18.2 Issues Eliminated From Further Analysis

None.

3.18.3 Issues Addressed in the Impact Analysis

The issue is whether or not any of the proposed features would conflict with existing land use plans.

3.18.4 Description of Impact Area of Influence

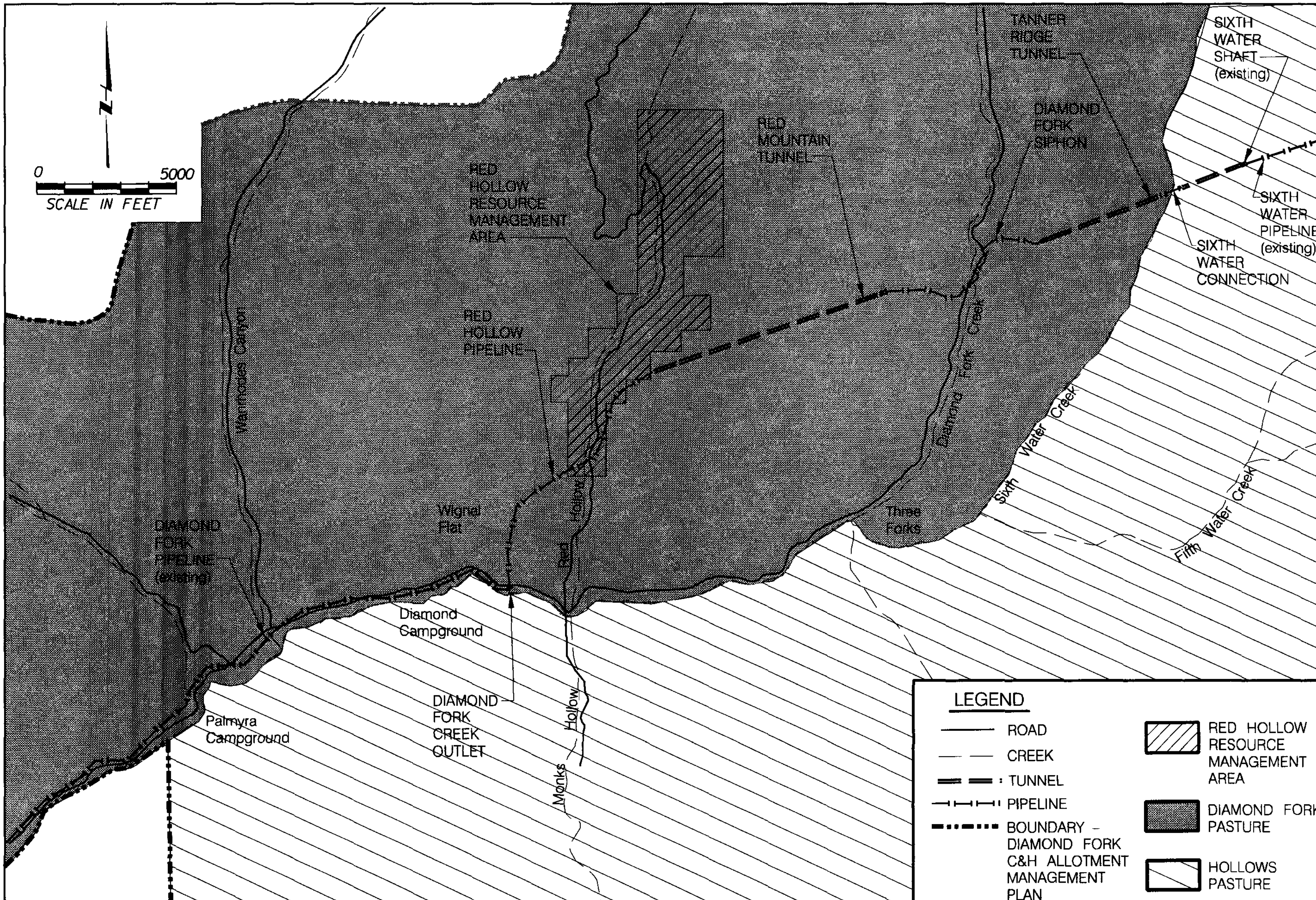
The impact area of influence consists of Forest Service managed lands in the Diamond Fork drainage.

3.18.5 Affected Environment

Three plans in the impact area of influence were considered as land use plans for this analysis. These plans are: 1. Land and Resource Management Plan for the Uinta National Forest, Undated (Forest Service Undated); 2. Allotment Management Plan for Diamond Fork C&H Allotment, Spanish Fork Ranger District, Uinta National Forest, 1995 (Forest Service 1995); and 3. Red Hollow Resource Management Plan for the Diamond Properties, Bonneville Unit Wildlife Mitigation Lands, Central Utah Project, Uinta National Forest, 1989 (Forest Service 1989).

The Land and Resource Management Plan provides management direction for the entire Uinta National Forest. Pages 3-197 through 3-207 of the plan cover the Spanish Fork Management Area No. 4 which contains the Diamond Fork drainage area (Forest Service Undated). This plan identifies a number of management prescriptions for each resource area, too numerous to list here.

The Diamond Fork C&H Allotment Management Plan covers an area in the Diamond Fork and Sheep Creek drainage (see Map 3-4 Key Management Plans). The allotment is managed under a three pasture (Diamond Fork, Waters, and Hollows), rest-rotation grazing system (Forest Service 1995). The Diamond Fork and Hollows pastures would be affected by construction of the proposed Diamond Fork System features. Table 3-70 shows the seasons of use for these two pastures.



Map 3-4

Key Management Plans

Table 3-70
Diamond Fork C&H Allotment Seasons of Use

Unit	1999	2000	2001	2002	2003
Diamond Fork	Late	Rest	Early	Late	Rest
Hollows	Rest	Early	Late	Rest	Early

Notes:

Source: Forest Service 1995

The early and late periods refer to the time of year and are dependent on vegetative conditions and seed ripe. Rest means no use in that pasture for that particular year.

The plan identifies a number of existing and planned range improvements. It also identifies mitigation measures based on the then proposed construction of the Monks Hollow Dam and reservoir feature of the Diamond Fork System.

The Red Hollow Resource Management Plan directs management of natural resources on the Diamond wildlife mitigation lands in Red Hollow, a tributary of Diamond Fork (see Map 3-4). The area was purchased by the Bureau of Reclamation as mitigation for the impact of construction of the Diamond Fork Power System, including the then proposed Monks Hollow Dam and reservoir. The area was transferred to the Forest Service by Public Law 105-326, October 30, 1998.

The goal of the management plan is to optimize habitat for wildlife through several objectives and management prescriptions. One objective that could be affected by the Proposed Action is to eliminate road access and rehabilitate roadbeds. A management prescription of limiting public access to foot or horseback may also be affected.

The Forest Service recently adopted an interim rule suspending road construction and reconstruction in roadless areas (see Section 3.10.2.1).

3.18.6 Impact Analysis

This section discusses the conflicts with existing land use plans associated with the construction and operation of the Proposed Action and No Action Alternative.

3.18.6.1 Methodology

The methodology used for this analysis was a detailed review of each plan, its objectives and management prescriptions. Features, construction and operation plans for the Proposed Action and No Action Alternative were then compared to the management plans to determine any conflicts.

3.18.6.2 Significance Criteria

Impacts on any type of land use or management plan would be considered significant if construction or operation of project features would require amending the management plan or would cause a conflict with a land use plan objective or management prescription.

3.18.6.3 Potential Impacts Eliminated From Further Analysis

None.

3.18.6.4 Proposed Action

3.18.6.4.1 Impacts During Construction. After a thorough review of the objectives and management prescriptions it was determined that the Land and Resource Management Plan (Forest Service Undated) would not be affected or require modification.

As discussed in Section 3.9 construction and operation would not necessitate a change in grazing systems, season of use, or kind or number of livestock and therefore no changes to the Diamond Fork C&H Allotment Management Plan would be required.

Construction of the Proposed Action would not conflict with management objectives identified in the Red Hollow Resource Management Plan. However, the Proposed Action would develop a permanent road in the Red Hollow Area (see Section 1.3.6, Chapter 1). This action conflicts with the management prescription to eliminate road access and rehabilitate road beds in the Red Hollow Management Plan, which would require a revision of the plan, a significant impact. However, it does not conflict with the management prescription of limiting public access to foot or horseback since the access road would be gated at its current location and only authorized use for maintenance and operation purposes would be permitted. This use is expected to be very infrequent, especially in the critical winter months, once construction is completed.

The proposed roads associated with the Proposed Action would not be in conflict with the Forest Service interim road construction suspension rule. The roads are not subject to suspension under the Forest Service's Interim Transportation Policy. The Red Mountain Tunnel inlet and outlet portal and Tanner Ridge outlet portal access roads are directly needed for completion of the Diamond Fork System which is authorized by statute (CUPCA). In addition, most of the Red Mountain tunnel inlet portal access road and a short section of the Tanner Ridge tunnel outlet portal access road lies on lands withdrawn by the USBR for purposes of the Diamond Fork Project and therefore, is subject to this valid existing right. Furthermore, the Red Mountain Tunnel outlet portal road does not lie more than 0.25 miles beyond an existing classified road. (Forest Service 1999b).

3.18.6.4.2 Impacts During Operation. None.

3.18.6.4.3 Impact Summary. The Proposed Action would significantly impact the Red Hollow Resource Management Plan, requiring a plan revision.

3.18.6.5 No Action Alternative

3.18.6.5.1 Impacts During Construction. Closing the Three Forks area and eliminating stock trail access from the Diamond Fork Road under the No Action Alternative (see Chapter 1, Section 1.7.1.2) would have significant impact on livestock operations (see Section 3.9) in the Diamond Fork and Hollows Pastures. The changes required in management could cause the permittees cost to increase reducing their ability to raise cattle. If they are unable to absorb the increased cost the allotment management plan would need to be revised.

3.18.6.5.2 Impacts During Operation. None.

3.18.6.5.3 Impact Summary. The No Action alternative would significantly impact the Diamond Fork C&H Allotment Management Plan, which would have to be revised.

3.19 Indian Trust Assets and Environmental Justice

3.19.1 Indian Trust Assets

Under the Proposed Action and the No Action Alternative, water from the Ute Indian Tribe of the Uintah and Ouray Indian Reservation would be diverted from the Uinta Basin as a result of the Indian Deferral Agreement signed in 1965 by the Ute Tribe, USBR, Bureau of Indian Affairs, and CUWCD. The deferral of water use was mutually considered until the year 2005, at which time, if suitable projects were not developed, an equitable adjustment would be made in accordance with Tribal water rights to permit the immediate Indian use of the water so reserved.

However, in 1992, CUPCA recognized unresolved Tribal claims arising out of the Deferral Agreement and legislated equitable adjustments for the Tribe with the intention to 1) quantify the Tribe's reserved water rights, 2) allow increased beneficial use of such water, and 3) put the Tribe in the same economic position it would have enjoyed had the features contemplated by the Deferral Agreement been constructed. Resolution of these claims are on track and should be completed by the year 2005.

These issues have been adequately addressed in previous agreements and environmental documents. There are no additional Indian Trust Assets which will be affected relating to the proposed action which have not already been addressed in previous environmental documents (BIA 1999).

3.19.2 Environmental Justice

On February 11, 1994, the President of the United States issued Executive Order 12898 on Environmental Justice in Minority Populations and Low Income Populations (DOI 1994). The policy required the analysis and evaluation of impacts of any proposed project, action, or decision on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risks of those decisions.

Socioeconomic data analyzed for Utah County indicates that peoples of Hispanic origin and other minority races constitute 5.5 percent of Utah County. Data indicating the number of minority representatives located specifically in southern Utah County is not available. Regarding low-income populations (i.e., families whose annual income is less than $9,999), 9.4 percent of families in Utah County fall into this group (BEBR 1993). During the SFN scoping and planning process, no issues were identified that would impact only low-income or minority groups. The benefits (see Chapter 3, Section 3.12) derived from the Diamond Fork System would accrue to the entire population in the Diamond Fork System impact area of influence. No disproportionate negative impact to Hispanic or low-income communities is expected.

3.20 Mitigation and Monitoring

3.20.1 Introduction

This section describes proposed practical and feasible mitigation measures, as well as monitoring procedures, for significant impacts caused by the Proposed Action and No Action Alternative. This section only includes resources that had significant impacts and for which feasible and practical means were available to mitigate those impacts.

3.20.2 Water Quality

3.20.2.1 Proposed Action

3.20.2.1.1 Mitigation. Some flooding mitigation may be necessary under the Proposed Action because of the potential for freezing conditions above the Spanish Fork Diversion Dam. Although the potential for freezing is not different compared to baseline, the higher volumes of flow during frozen conditions could lead to greater flooding. The necessary mitigation will depend on climate and duration of freezing conditions. Strawberry Reservoir releases will be adjusted to minimize impacts of freezing conditions by minimizing or ceasing flows when freezing conditions persist and increasing releases during free-flowing conditions to adjust for potential reductions.

3.20.2.1.2 Monitoring. The water quality monitoring program committed to in the 1990 Final Supplement (USBR 1990) and the DOI 1995 Diamond Fork Pipeline ROD will be continued. The CUWCD has been collecting water quality and temperature data since July 1996. The Mitigation Commission and CUWCD will evaluate monitoring results to date in 1999, and they will coordinate with the FWS and others to determine the need for future monitoring. The Mitigation Commission will be responsible for continuing this program after completion of the Proposed Action.

3.20.2.2 No Action Alternative

3.20.2.2.1 Mitigation. Same as for the Proposed Action.

3.20.2.2.2 Monitoring. Same as for the Proposed Action.

3.20.3 Wetland Resources

3.20.3.1 Proposed Action

3.20.3.1.1 Mitigation. Wetland mitigation will be necessary to mitigate significant impacts on wetland resources from construction of Sixth Water Connection to Tanner Ridge Tunnel and Diamond Fork Creek Outlet. Construction of Sixth Water Connection to Tanner Ridge Tunnel would permanently remove 0.02 acre of creek bed/riverine type wetlands. Construction of Diamond Fork Creek Outlet would permanently remove 0.02 acre of riparian shrubs from riparian forest type wetlands. These significant impacts will be mitigated by the federal government's acquisition of three private properties containing wetland and riparian community types in the Diamond Fork Creek drainage. The Mitigation Commission acquired the Childs property through the U.S. Bureau of Reclamation (USBR); the U.S. Forest Service (USFS) made a land exchange for the Redford property; and the USBR acquired the Diamond property for the federal government in anticipation of mitigating impacts of the Monks Hollow Dam and Reservoir, which were never constructed. The Childs property contains about 35.6 acres of riparian and wetland habitat; the Redford property contains about 64.4 acres; and the Diamond property about 9.7 acres, for a total of about 109.7 acres of federally controlled property. The USFS now manages the riparian, wetland and other resources on these lands. Much of the riparian and wetland habitat on these lands has been subsequently protected from livestock grazing, farming, dispersed recreational camping and other activities that historically damaged riparian and wetland resources. The 0.04 acre of significant wetland impacts that would occur under the Proposed Action will be mitigated in-kind and on-site in the impact area of influence by the federal government's acquisition and protection of these wetland and riparian resources.

3.20.3.1.2 Monitoring. The USFS and Mitigation Commission have monitored wetland and riparian resources using numerous indicator variables for Sixth Water Creek above Sixth Water Aqueduct and Diamond Fork Creek from Red Hollow to Spanish Fork River since 1998. This initial recovery and evaluation system (IRES) monitoring resulted from recommendations in studies on these reaches conducted by Trihey & Associates (1997a and 1997b). The IRES monitoring underway includes stream temperature and streamflow; additional IRES monitoring that needs to continue includes channel morphology, sediment transport capacity, streambank erosion and responses of riparian vegetation to various levels of flows, in anticipation of interim operation of the Diamond Fork System. The IRES monitoring will be continued through 2003.

The CUWCD will monitor construction impacts on wetland and riparian areas throughout the construction period. These impacts will be documented in annual construction monitoring reports and made available for public review at the CUWCD office in Orem.

Following completion of construction activities, the Mitigation Commission will have the responsibility for monitoring changes in wetland and riparian areas resulting from interim operation of the Proposed Action.

The joint-lead agencies will plan for a long-term riparian vegetation monitoring program to determine the effects on species composition, riparian corridor width, and vegetation density from flow modifications within the impact area of influence.

The joint-lead agencies will continue to coordinate with the FWS regarding results of the monitoring program and recommendations to mitigate any documented impacts.

The joint-lead agencies will continue to be active partners with the FWS, U.S. Forest Service, Utah Division of Wildlife Resources, and others to plan and implement restoration of Sixth Water and Diamond Fork creeks, and to the extent possible, Spanish Fork River. The CUWCD commits to working with the agencies to utilize facilities and modify operations and water management to the extent possible to contribute to successful wetland and riparian restoration.

3.20.3.2 No Action Alternative

3.20.3.2.1 Mitigation. Wetland mitigation will be necessary to mitigate significant impacts on wetland resources from construction of Three Forks Dam and operation of Three Forks Reservoir. Construction of Three Forks Dam would permanently remove 0.5 acre of creek bed/riverine type wetlands. Operation of Three Forks Reservoir would permanently remove and inundate 9.1 acres of riparian shrub and riparian forest type wetlands. The mitigation proposed for these significant impacts would be the same as for the Proposed Action.

3.20.3.2.2 Monitoring. Same as for the Proposed Action.

3.20.4 Wildlife Resources

3.20.4.1 Proposed Action

3.20.4.1.1 Mitigation. No additional wildlife habitat mitigation is required beyond what has already been accomplished under the Diamond Fork system mitigation plan.

The following analysis is based on information in the Terrestrial Wildlife and Vegetation Impact analysis and Mitigation Recommendations for alternatives A, B and C (1989-Option 2), Diamond Fork System, Supplement to November 1987 and February 1989 Team Reports for the Modified Diamond Fork Power System Plan), December 1989, Prepared by Interagency Wildlife Mitigation Team. The FWS revised the distribution of terrestrial mitigation credits in their February 21, 1997 memorandum.

The Diamond Fork System plan prepared by the mitigation team was the recommended plan described in the Final Supplement to the Final Environmental Impact Statement (USBR 1990). The plan included Syar Tunnel, Sixth Water Aqueduct system, Monks Hollow dam and reservoir, several powerplants and associated switchyards and substations, Diamond Fork Pipeline, and new recreation sites. Permanent habitat losses for this plan totaled 438 acres, and temporary losses were estimated at 132 acres. Based on the Habitat Evaluation Procedure (HEP), the net mitigation requirement for the recommended plan was 4,103 acres. Of the two options considered (inside and outside the impact area of influence), the team chose the outside mitigation option. Based on this recommendation, the federal government purchased lands to mitigate habitat impacts that were predicted but never occurred from the 1990 proposed Diamond Fork System. A total of 3,782 acres (3,309 HEP units) were acquired to offset anticipated impacts documented in the 1990 FS-FEIS.

The majority of the predicted habitat impact (359 acres) involved the Monks Hollow dam and reservoir, powerplants, switchyards and substations, and new recreation sites. This habitat impact has been avoided under the revised Diamond Fork System as described in Chapter 1 of this FS-FEIS. The total estimated permanent wildlife habitat loss under the current Proposed Action is only 3.8 acres, and the temporary impact is only 53.3 acres. These impacts are far less than those predicted for the 1990 Diamond Fork System features which have been eliminated from consideration.

The Red Hollow management area is one area acquired under the mitigation plan. This area alone contains about 152 acres of critical winter range for moose and 64 acres for mule deer. This acreage by itself exceeds the impact of the Proposed Action.

3.20.4.1.2 Monitoring. CUWCD will conduct a survey to determine if black bear exist in the impact area of influence. Any black bear found will be radio tagged and monitored to determine what effect, if any, project construction is having on their habits.

The joint-lead agencies will closely coordinate with the Utah Division of Wildlife Resources regarding pre-construction surveys for black bear and dens within the project area. In addition, UDWR will be closely involved with monitoring of any black bear during project construction. If black bear are found during pre-construction surveys or during construction, monitoring should continue for a minimum of five years following construction completion to determine potential long-term effects of construction or operation disturbances on black bear. Any black bear sightings should be reported to the Utah Division of Wildlife Resources.

Pre-construction surveys will be conducted to determine the presence of migratory bird nests along construction corridors. To the extent feasible, project-related activities that may disturb identified nest sites should be scheduled to avoid the active nesting and brooding periods.

3.20.4.2 No Action Alternative

3.20.4.2.1 Mitigation. No additional wildlife habitat mitigation will be required. The permanent loss of 30.1 acres of habitat is less than would have occurred if Monks Hollow dam and reservoir had been built (see Section 3.20.4.1).

Six wildlife ramps will be built, one on each side of the three arms of Three Forks Reservoir to offer an escape route for trapped animals. The ramps will be cut into the side slopes of the reservoir and be operable between the minimum and maximum pool levels.

3.20.4.2.2 Monitoring. None.

3.20.5 Aquatic Resources

3.20.5.1 Proposed Action

3.20.5.1.1 Mitigation. As determined by monitoring, flow manipulation could be used to create/maintain backwater, cutoff pools, and other habitat for leatherside chub.

3.20.5.1.2 Monitoring. See water quality monitoring requirements.

The Mitigation Commission will conduct annual monitoring of Diamond Fork Creek channel and trout-spawning gravels to determine if additional May flows are periodically needed to maintain the channel and clean the gravels of deposited fines.

The Mitigation Commission will conduct monitoring in compliance with the Diamond Fork 1990 FS-FEIS.

An interagency team consisting of representatives from the joint-lead agencies, U.S. Forest Service, FWS, and Utah Division of Wildlife Resources will be organized to determine flow needs within Sixth Water and Diamond Fork creeks and Spanish Fork River to benefit aquatic, terrestrial and riparian resources.

Water quality monitoring will continue downstream of Strawberry Tunnel, Sixth Water Aqueduct and Diamond Fork Creek Outlet to determine potential dissolved oxygen concentration impacts and how far downstream low dissolved oxygen levels are found.

If low dissolved oxygen levels are found downstream from tunnel outlets, baffles or oxygen aerators should be installed to bring dissolved oxygen concentrations up to levels that are not detrimental to fish and other aquatic resources.

3.20.5.2 No Action Alternative

3.20.5.2.1 Mitigation. None.

3.20.5.2.2 Monitoring. Same as for the Proposed Action.

3.20.6 Special Status Species

3.20.6.1 Proposed Action

3.20.6.1.1 Conservation Measures.

For Ute ladies'-tresses:

Many years of monitoring, research and presentations to academic societies have already been committed to increase the knowledge of this species. It is proposed that this contribution to the UTL body of information be recognized as conservation measures already performed for this species.

Monitoring will be continued during the construction period prior to project operation to establish a credible baseline.

Data collection following project implementation will include measurements of actual stream elevations relative to colony locations. This will allow FWS to verify the model and its results. If there are significant discrepancies, the model should be modified and additionally, a new impact assessment completed. Additionally, the joint-lead agencies will perform aerial mapping at a resolution sufficient to record stream channel geomorphology, vegetation community and orchid colony locations in several-year intervals to help better understand changes and evaluate their significance in relation to restoration and conservation goals.

Changes in vegetative communities in occupied or potentially suitable orchid habitat will be measured along Diamond Fork Creek and Spanish Fork Canyon.

The natural variation in Ute ladies'-tresses demography, population vigor, and habitat will be characterized under baseline conditions.

The natural variation in Ute ladies'-tresses demography, population vigor, and habitat will be characterized following implementation of proposed operation flows.

The Three Forks colony will be monitored to better understand the process of loss of viability and eventual extirpation of colonies. Monitoring will focus on the rate of loss, identifying which parameters are best to measure to determine if loss is occurring, etc.

Conservation measures in addition to altering flows and rescue/transplant will be considered, such as vegetation manipulation, providing supplemental water to colonies, and mechanical reconfiguration of portions of the stream channel or floodplain surfaces, if monitoring data show streamflow hydrology is adversely affecting the Ute ladies'-tresses population.

If pollination is determined to be a limiting factor to long-term orchid viability and successful colonization of new habitats, the joint-lead agencies will consider actions to enhance pollinator habitat or numbers as appropriate.

A methodology will be developed that would monitor changes in Ute ladies'-tresses habitat quality, and the methodology will be used to establish habitat quality parameters of the population.

Population viability parameters and "red-flag" conditions will be established for the habitat quality parameters.

The accuracy of the predicted effects analysis will be measured.

Timing for performing the most accurate canyon-wide Ute ladies'-tresses counts will be evaluated.

The relationship between river hydrology, depth to soil water, soil moisture, soil characteristics and Ute ladies'-tresses colonies will be correlated.

3.20.6.1.2 Mitigation.

For June sucker:

The joint-lead agencies will identify, acquire, and permanently provide a block of water for flows in lower Provo River through critical habitat, in perpetuity, for June sucker.

- An annual hydrograph that exhibits a defined spring runoff peak and subsequent high quality summer flow is necessary to protect the June sucker and its critical habitat during its annual spawning activities in lower Provo River. In 1994, the Fish and Wildlife Service (FWS) issued a jeopardy Biological Opinion on June sucker for the Provo River Project. A reasonable and prudent alternative called for the Bureau of Reclamation to provide a range of research flows, defined within existing annual hydrologic conditions, to mimic historic conditions for a three year period (1995 – 1997). In 1997, the FWS requested that the hydrograph in the lower Provo River be 50 percent of the water quantity that occurs at the Hailstone gage above Jordanelle Reservoir. The requested flow was difficult to achieve because of a variety of circumstances (natural fluctuations in the upper Provo River, weather changes, water user needs, etc.).

- Section 302(a) of the Central Utah Project Completion Act (CUPCA) requires the Central Utah Water Conservancy District (CUWCD) to acquire, on an expedited basis with funds provided by the Mitigation Commission, 25,000 acre-feet of water rights in the Utah Lake drainage basin for the purposes of maintaining instream flows provided for in Section 303(c)(3) and 303(c)(4) for fish, wildlife, and recreation in the Provo River. Upon acquisition of these water rights, Section 303(c) of CUPCA directs CUWCD to establish or adjust the yield and operating plans for the Bonneville Unit to provide 75 cfs minimum flow year-round in the Provo River from Olmstead Diversion to Utah Lake and 100 cfs from the confluence of Deer Creek and the Provo River to the Olmstead Diversion. In addition, pursuant to Section 207(b)(4) of CUPCA, the CUWCD is making saved water available to the Secretary of the Interior for instream flows in addition to the stream flow requirements established by Section 303(c). The joint-lead agencies agree to utilize these authorities to obtain a permanent block of water. This water would contribute to the goal of providing flows for the June sucker.

- To date 2,200 acre-feet has been permanently acquired on an annual basis. The Department of the Interior (DOI) has accumulated about 20,000 acre-feet in Jordanelle Reservoir, and 5,800 acre-feet annually has been temporarily acquired through 2004 for fishery purposes in lower Provo River. The joint-lead agencies will identify, acquire, and permanently provide a block of water for flows in lower Provo River through critical habitat, in perpetuity, for June sucker.

CUWCD in cooperation with the other Provo River water users, the FWS, and other members of the Provo River Flows Workgroup, will agree on operational scenarios that mimic dry, moderate and wet years. The District, with the support of the joint-lead agencies and Provo River water users, will apply operational scenarios to the annual Provo River operation to benefit June sucker.

- Currently, a new approach has been developed and is being tested to ensure that adequate flows are provided which mimic historical hydrological conditions. Historic runoff patterns in Provo River show considerable variation from year to year in terms of duration, quantity, and peak magnitude over the period of record (1950-1995). In spite of this variation, a few trends are apparent: the duration of runoff is longer, the magnitude of the peak is greater, and the peak occurs later in wetter years. Based on these trends, runoff scenarios to mimic dry, moderate, and wet years were developed. Historic flow data were used to determine runoff duration, peak magnitude and date for the three scenarios. An implementation schedule of daily flows was developed that targets the same flow values through mid-May regardless of anticipated runoff (see Figure 3-3). If conditions indicate that it is a dry year, flows will peak in mid-May at about 550 cfs and begin receding, returning to base flow conditions in early June. If however, in mid-May it appears that there is not enough space in reservoirs to capture the remaining runoff, flows will continue to increase targeting a peak of 750 cfs by late May and then recede to base flow conditions by late June or early July. If in late May it appears the reservoirs cannot capture the remaining runoff, flows will continue to increase targeting 1050 cfs in early June, returning to base flow conditions in late July. After mid-May, however, decisions of whether to continue to increase flows will be made on a frequent basis based on reservoir space, weather, and runoff forecasts. This approach provides reservoir operator

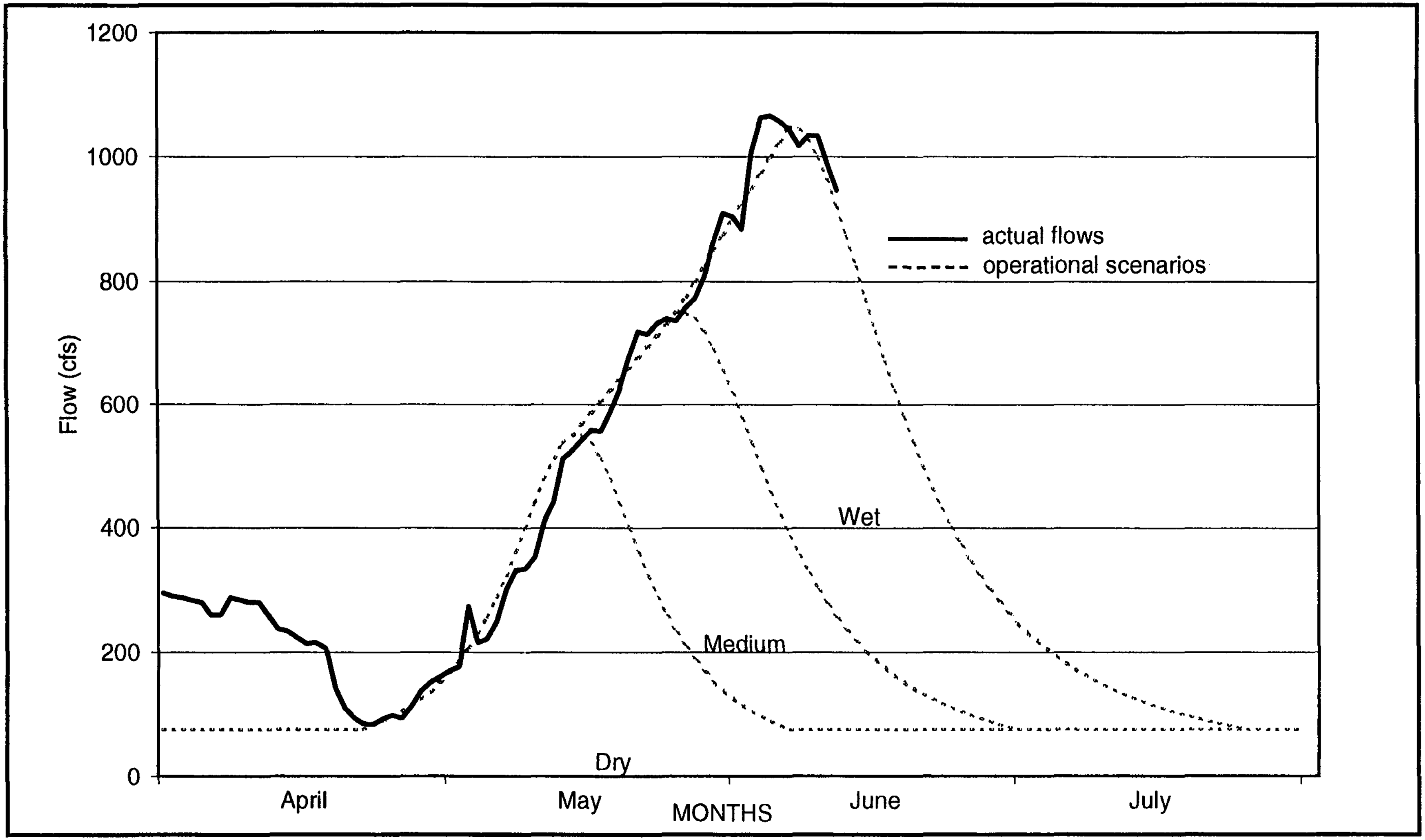


Figure 3-3
Lower Provo River Proposed Operational Scenarios
(dry, moderate, wet year) and Actual Flows
April 1 through June 11, 1999

scenarios for overwinter operations, provides adaptability necessary in a highly variable system and mimics the natural conditions in which June sucker evolved.

- This new approach has been implemented during the 1999 runoff season. The CUWCD has been coordinating with the Provo River Flows Workgroup on flow releases to follow the implementation schedule. To date, water deliveries to the lower Provo River have closely followed those flows identified as targets in the flow approach. The FWS, Provo River Flows Workgroup, and the June Sucker Technical Workgroup will evaluate the biological response of the June sucker to the flow regime and further develop and refine the approach to meet the needs of the June sucker, water users, and reservoir operation. Future implementation, evaluation, and revision of this approach will provide flow requirements needed for the June sucker.

The joint-lead agencies, in cooperation with the State of Utah and FWS, will work toward establishment of a refugium in Red Butte Reservoir for June sucker.

- Red Butte Reservoir is located in the Wasatch-Cache National Forest and currently contains the largest refugia population of June sucker. Monitoring surveys indicate that the population has successfully reproduced in 1995, 1996 and 1998. Current population estimates for the 1995 year-class alone are approximately 4500 fish (Draft Final June Sucker Recovery Plan - 1999). The population was established in 1992 with the stocking of approximately 3,200 fish. In October 1997, the U.S. Army relinquished its interest in Red Butte Dam and associated facilities. Since that time, responsibility for the operation and maintenance of the dam has been shared among several agencies including the U.S. Forest Service and the FWS.

- A Memorandum of Understanding (MOU) was signed (April 1999) by the FWS, U.S. Forest Service, District, DOI, Bureau of Reclamation, and Mitigation Commission to continue the conservation of the endangered June sucker in Red Butte Reservoir. The MOU will remain in effect for a minimum of one year or until repair begins on the facility or operational responsibility has been determined.

- The joint-lead agencies have indicated an interest in taking the lead in establishing a refugium and working out the operational and maintenance responsibility of Red Butte Dam.

The joint lead agencies will participate in the development of a Recovery Implementation Program for June sucker.

- A Memorandum of Understanding was signed by State, Federal and private agencies to develop a Recovery Implementation Program (RIP) for June sucker. The purpose of the RIP would be to achieve recovery of June sucker so that it no longer requires protection under the Endangered Species Act (ESA) and to allow operation of existing water facilities and development of future water resources in the Utah Lake Drainage Basin.

- The June Sucker Recovery Plan (Recovery Plan, currently in draft and anticipated to be finalized by 7/1/99) will serve as the guiding document for development of the RIP. The Recovery Plan is required by Section 4 of ESA and defines actions necessary to recover June sucker. Priority of the Recovery Plan has been given to preserving the genetic integrity of June sucker, developing broodstock and refugia populations, determining and enhancing Provo River instream flows, and restoring habitat in Provo River and Utah Lake. Other critical recovery measures include monitoring the current spawning run in Provo River, establishment of a permanent warm-water native fish hatchery, protection from non-native species impacts, and establishment of a self-sustaining spawning run of June sucker.

- The FWS anticipates that developing and implementing the RIP will take two years. The joint-lead agencies need to take an active role in developing and implementing the RIP. If after two years, the RIP has not been developed and implementation is not making sufficient progress, reinitiation of consultation would be required for federally-approved or licensed projects affecting the June sucker.

Any future development of the Bonneville Unit of CUP will be contingent on the RIP making "sufficient progress" towards recovery of June sucker.

- Additional features of the Bonneville Unit are still contemplated which may require a change in or additional releases of water through the Diamond Fork System. The Service will assess the impacts of future projects that require section 7 consultation and will determine if progress toward recovery has been sufficient for the RIP to serve as a reasonable and prudent alternative. If sufficient progress towards recovery of June sucker has not been achieved by the RIP, specific measures will be identified which must be complete to avoid jeopardy to the species.

- In determining if sufficient progress has been achieved, the FWS considers (a) actions that result in a measurable population response, a measurable improvement in habitat for the fish, legal protection of flows needed for recovery, or reduction in the threat of immediate extinction; (b) status of the fish population; (c) adequacy of flows; and (d) magnitude of the project impact. In addition, the FWS considers support activities (funding, research, information, and education, etc.) of the RIP if they help achieve a measurable population response, a measurable improvement in habitat for the fish, legal protection of lows needed for recovery, or a reduction in the threat of immediate extinction.

- Future decisions about endangered June sucker needs within the Utah Lake Drainage Basin must be based on the best scientific and commercial data available, and will be largely dependent upon RIP progress in achieving the Recovery Plan goals.

For raptors:

Raptor nest surveys will be conducted prior to commencing construction activities.

Preconstruction surveys for Swainson's hawk nests will be performed to ensure compliance with the Migratory Bird Treaty Act.

To the extent possible construction schedules will be modified to start before the golden eagle nesting period or after fledging time.

3.20.6.1.3 Monitoring. The following monitoring is proposed:

For leatherside chub:

- The ultimate effect on leatherside chub of backwater and cutoff pool habitat loss from riparian encroachment, plus increased predation by brown trout, can only be determined through annual monitoring. The Mitigation Commission, in coordination with the USFWS and Utah Division of Wildlife Resources, will conduct annual monitoring of leatherside chub habitat and population. If leatherside chub habitat is significantly reduced, Diamond Fork Creek flows and channel configuration could be managed to maintain necessary habitat. In alternate years, water releases could allow peak flows in May to flood backwater and cutoff pool habitats in Diamond Fork Creek. Side channels that feed these habitats could be cleared and kept open manually if encroachment of riparian vegetation occurs.

For golden eagles:

- In order to reduce the potential for construction impacts on golden eagle nesting in Diamond Fork Canyon, the CUWCD will ensure that qualified biologists are on site during construction to monitor eagle activities. The biologist would have the authority to require temporary shutdown of construction activities that were adversely impacting the nesting eagles. The CUWCD also will monitor the nesting activities of golden eagles for 5 years after completion of the Proposed Action, or whatever will be required in any permits issued by the Utah Division of Wildlife Resources and USFWS.

3.20.6.2 No Action Alternative

3.20.6.2.1 Conservation Measures. Same as for the Proposed Action.

3.20.6.2.2 Mitigation. Same as for the Proposed Action

3.20.6.2.2 Monitoring. Same as for the Proposed Action.

3.20.7 Agriculture

3.20.7.1 Proposed Action

3.20.7.1.1 Mitigation. To mitigate the impact (i.e. increased herding of cattle and increased costs on allotment operations) CUWCD will provide funds to the Forest Service to construct interior pasture fences and a temporary corral to control cattle between the Diamond Fork and Hollows Unit pastures where reduced water flows eliminate a natural barrier between the two units.

3.20.7.1.2 Monitoring. None

3.20.7.2 No Action Alternative

3.20.7.2.1 Mitigation. To mitigate the impact (i.e. increased herding of cattle and increased costs on allotment operations) CUWCD will provide funds to the Forest Service to construct interior pasture fences and a temporary corral to control cattle between the Diamond Fork and Hollows Unit pastures where reduced water flows eliminate a natural barrier between the two units.

To mitigate the impact on allotment operations from having to truck the cattle to the higher pastures, CUWCD will provide funds to the Forest Service to construct new trail access to reconnect existing cattle trails in the Fifth Water and Cottonwood Creeks area with the Diamond Fork Creek area.

3.20.7.2.2 Monitoring. None.

3.20.8 Recreation Resources and Special Status Areas

3.20.8.1 Proposed Action

3.20.8.1.1 Mitigation. To mitigate the temporary impact of the closure of the Diamond Fork Road access to the Three Forks Trailhead, CUWCD will notify the public of the closure and available alternate routes through public notices and information boards erected on the Diamond Fork Road, Right Fork Hobble Creek Road and Rays Valley-Sheep Creek Road. To mitigate for temporary increased use of the Fifth Water trailhead access to the hot springs area, CUWCD will improve and sign the existing parking area.

3.20.8.1.2 Monitoring. None.

3.20.8.2 No Action Alternative

3.20.8.2.1 Mitigation. To mitigate the temporary impact of the closure of the Diamond Fork Road access to the Three Forks Trailhead, CUWCD will notify the public of the closure and available alternate routes through public notices and information boards erected on the Diamond Fork Road, Right Fork of Hobble Creek Road, and Sheep Creek-Rays Valley Road. To mitigate for the temporary increased use of the Fifth Water trailhead access to the hot springs area, CUWCD will improve and sign the existing parking area.

To mitigate the impact of the permanent loss of the Three Forks Trailhead, a new trailhead will be built along Diamond Fork Road below Three Forks Dam. It will include a parking area as well as trails and bridges across Diamond Fork, Cottonwood and Fifth Water creeks to re-establish the trail links that were eliminated with construction of Three Forks Dam and Reservoir under the No Action Alternative.

3.20.8.2.2 Monitoring. None

3.20.9 Public Health and Safety/Noise

3.20.9.1 Proposed Action

3.20.9.1.1 Mitigation. To mitigate hazards associated with emergency flows, warning signs will be posted at Diamond and Palmyra campgrounds, and at the Sixth Water Creek crossing of the Springville Crossing-Rays Valley Road. Emergency flows will be gradually increased from the Strawberry Tunnel. Whenever possible, these flows will be increased during the daytime.

3.20.9.1.2 Monitoring. None

3.20.9.2 No Action Alternative

3.20.9.2.1 Mitigation. To mitigate potential drowning hazards associated with Three Forks Reservoir, marker buoys and float lines will be installed around the spillway intake structures. Also the entire reservoir area will be fenced and signed to exclude public use.

3.20.9.2.2 Monitoring. None

3.20.10 Transportation

3.20.10.1 Proposed Action

3.20.10.1.1 Mitigation. The CUWCD will post and maintain signs and place public notices informing the public of the closure of Diamond Fork Road and available alternate routes.

3.20.10.1.2 Monitoring. None.

3.20.10.2 No Action Alternative

ame as for the Proposed Action.

3.20.11 Cultural Resources

3.20.11.1 Proposed Action

3.20.11.1.1 Mitigation. None beyond the SOPs (see Chapter 1, Section 1..7.8.8).

3.20.11.2 No Action Alternative

3.20.11.2.1 Mitigation. Same as for the Proposed Action.

3.21 Unavoidable Adverse Impacts

3.21.1 Introduction

This section describes unavoidable adverse impacts that would occur after implementing mitigation measures (described in Section 3.20) for the Proposed Action and No Action Alternative. Only those resources that would have unavoidable adverse impacts are shown.

3.21.2 Aquatic Resources

3.21.2.1 Proposed Action

None.

3.21.2.2 No Action Alternative

Approximately 1.95 acres of aquatic resources habitat would be lost to inundation by Three Forks Dam and Reservoir.

3.21.3 Special Status Species

3.21.3.1 Proposed Action

The potential impact on Ute ladies'-tresses and its habitat and on three pairs of nesting golden eagles are considered adverse and unavoidable. All practicable measures would be taken to mitigate for both impacts; however, it is possible that 1) a presently unquantified amount of existing Ute ladies'-tresses habitat would be lost along Diamond Fork Creek and 2) nesting would be interrupted for several years by tunnel and pipeline construction in Red Hollow and at the Diamond Fork Creek Outlet.

3.21.3.2 No Action Alternative

The same as under the Proposed Action, except the nesting of only a pair of golden eagles could be affected by construction of Three Forks Dam and Reservoir. All practicable measures would be taken to mitigate for both impacts;, but it is possible they would still occur.

3.21.4 Soils

3.21.4.1 Proposed Action

Lack of revegetation on six acres and increased erosion along the Spanish Fork River would be an unavoidable adverse impact.

3.21.4.2 No Action Alternative

Lack of revegetation on 29.6 acres, and increased erosion along Sixth Water Creek and the Spanish Fork River would be an unavoidable adverse impact.

3.21.5 Recreation Resources and Special Status Areas

3.21.5.1 Proposed Action

Short-term loss of dispersed camping, fishing, hiking, horseback riding hunting and picnicking opportunities along the closed stretch of Diamond Fork Road and Red Hollow Road (5.3 miles, or 35 percent, of the roads during the 3½-year construction period) would be an unavoidable adverse impact. Specifically, 76 dispersed campsites in the impact area of influence (61 percent) would be temporarily lost during construction.

The solitude of the Red Mountain and Diamond Fork roadless areas would be impacted during the 3½-year construction period. During the life of the project the natural integrity and apparent naturalness of these roadless areas would be impacted by the addition of man-made facilities, which could cause the removal of 4.1 acres and 1.3 acres from the roadless classification.

3.21.5.2 No Action Alternative

Short-term loss of dispersed camping, fishing, hiking, horseback riding, hunting and picnicking opportunities along the closed stretch of the Diamond Fork Road (3.4 miles, or 22 percent, of the road during the 3-year construction period) would be an unavoidable adverse impact. Specifically, 50 dispersed campsites in the impact area of influence (40 percent) would be temporarily lost during construction, and an unknown number would be permanently lost from the 6.9-acre rock disposal area.

The solitude of the Diamond Fork Roadless Area would be impacted the same as under the Proposed Action over the 3-year construction period. During the life of the project the natural integrity and apparent naturalness of this roadless area would be impacted by the addition of man-made facilities, which could cause removal of 15.5 acres from the roadless classification.

3.21.6 Public Health and Safety/Noise

3.21.6.1 Proposed Action

The increase in traffic levels and additional use on roads other than Diamond Fork could result in increased accidents. Any loss of life or serious injury would be an unavoidable adverse impact.

3.21.6.2 No Action Alternative

Same as for the Proposed Action.

3.21.7 Visual Resources

3.21.7.1 Proposed Action

The change in visual characteristics from construction of the Tanner Ridge Tunnel outlet, Red Mountain Tunnel inlet and outlet, the Red Hollow flow control facility, and the disposal of tunnel spoil material, would be an unavoidable adverse impact. The flow control facility is the only feature that would be visible from a roadway.

3.21.7.2 No Action Alternative

The change in visual characteristics resulting from construction of a dam and reservoir at Three Forks, a new access road, and disposal of spoil material would be an unavoidable adverse impact.

3.21.8 Transportation

3.21.8.1 Proposed Action

The only unavoidable adverse impacts on transportation resources would be a possible increase in average annual daily traffic of more than 10 percent on Diamond Fork Road from Highway 6 to Red Ledges and on Sheep Creek-Rays Valley Road, and the rerouting of traffic resulting from the closure of Diamond Fork Road.

3.21.8.2 No Action Alternative

Same as the Proposed Action.

3.21.9 Air Quality

3.21.9.1 Proposed Action

It appears that temporary, extremely localized violations of the federal 24-hour PM_{10} standard could occur during construction. Any unavoidable significant impacts would occur only immediately adjacent to the heaviest construction activity and only for short periods of time.

3.21.9.2 No Action Alternative

Same as for the Proposed Action.

3.21.10 Land Use Plans and Conflicts

3.21.10.1 Proposed Action

The Red Hollow management plans would have to be revised. (an unavoidable but not adverse impact).

3.21.10.2 No Action Alternative

None.

3.22 Cumulative Impacts

3.22.1 Introduction

This section describes the cumulative impacts that may occur as a result of construction and operation of the Proposed Action or No Action Alternative and after any proposed mitigation measures are implemented. Future projects included in the cumulative impact analysis are described in Chapter 1, Section 1.9.3. Only resources that have cumulative impacts are included in this section.

3.22.2 Water Quality

3.22.2.1 Proposed Action

The Diamond Fork Campground modifications, relocation of Springville Crossing–Rays Valley Road, and the Diamond Fork Dispersed Camping Management Plan (along with the Proposed Action are expected to have a positive cumulative impact on water quality by reducing erosion and sedimentation in riparian areas.

3.22.2.2 No Action Alternative

The cumulative impacts would be similar to those under the Proposed Action.

3.22.3 Wetland Resources

3.22.3.1 Proposed Action

Wetlands and riparian vegetation in the region would improve and increase from expansion of the Utah Lake Wetlands Preserve, the Diamond Fork Campground modifications, the Mitigation Commission's Sixth Water and Diamond Fork Creek restoration plans, relocation and improvement of Springville Crossing–Rays Valley Road, and the Diamond Fork Dispersed Camping Management Plan plus the Proposed Action.

The Utah Lake Wetlands Preserve would acquire and manage approximately 22,000 acres of land, some of it wetlands and some converted from wetland to agricultural land. Implementation of the Diamond Fork Campground Modification Plan would result in a net gain of approximately 2.7 acres of riparian vegetation (USFS 1998). The Sixth Water and Diamond Fork creeks restoration plan would result in an unquantified increase in riparian area. Relocation of Springville Crossing-Rays Valley Road would remove the current road from wetland and riparian areas, providing an unquantifiable net gain. Closure of 49 dispersed camping sites and modification of 54 sites would improve wetland and riparian conditions in the area.

3.22.3.2 No Action Alternative

The cumulative impacts would be similar to those that would occur under the Proposed Action.

3.22.4 Wildlife Resources

3.22.4.1 Proposed Action

The net cumulative impact on wildlife resources would be positive from expansion of the Utah Lake Wetlands Preserve, the Diamond Fork Campground modifications, the Mitigation Commission's Sixth Water and Diamond

Fork Creek restoration plan, relocation of Springville Crossing-Rays Valley Road, and the Diamond Fork Dispersed Camping Management Plan.

The Utah Lake Wetlands Preserve would provide an additional approximate 22,000 acres of wildlife habitat. The Diamond Fork campground modifications would provide protected wild turkey roosting habitat at the northeast end of the campground and favorable impacts on neotropical migratory birds with the restoration of approximately 2.7 acres of riparian vegetation in the campground area (USFS 1998). Restoration of Sixth Water and Diamond Fork Creeks, relocation of Springville Crossing-Rays Valley Road, and implementation of the Diamond Fork dispersed camping management plan would result in an unquantified increase in riparian and wetland areas, which would provide additional wildlife habitat.

3.22.4.2 No Action Alternative

Same as for the Proposed Action.

3.22.5 Aquatic Resources

3.22.5.1 Proposed Action

The net cumulative impact on aquatic resources would be positive with the Mitigation Commission's Sixth Water and Diamond Fork Creek restoration plan, the Syar Tunnel Guard Gate and Strawberry Tunnel cross-connection modifications, relocation of Springville Crossing-Rays Valley Road, the Diamond Fork campground modifications, and the Diamond Fork Dispersed Camping Management Plan.

The Proposed Action and the restoration plan would improve aquatic resource conditions in Sixth Water and Diamond Fork creeks. The guard gate and cross-connection modifications would help maintain the required minimum instream flows when the tunnel and pipeline system are shut down for maintenance. The road relocation, campground modifications and dispersed camping management plan would decrease erosion and sedimentation, contributing to an improved aquatic environment. The overall result would be an increase in fish and other aquatic resources.

3.22.5.2 No Action Alternative

Same as for the Proposed Action, except Three Forks Dam and Reservoir would eliminate some stream aquatic resources.

3.22.6 Special Status Species

3.22.6.1 Proposed Action

Some unquantifiable temporary cumulative negative impacts to special status species could occur during the 3½-year construction period of the Proposed Action. The projects that could impact special-status species are the Utah Lake Wetlands Preserve, Diamond Fork Campground modifications, the Mitigation Commission's Sixth Water and Diamond Fork Creek restoration plan, relocation of Springville Crossing-Rays Valley Road, and the Diamond Fork Dispersed Camping Management Plan.

The campground modification project and dispersed camping management plan, which could be underway during the first year of construction of the Proposed Action, could cause cumulative impacts on golden eagle nesting.

The Proposed Action and the Mitigation Commission's restoration plan could cause some negative cumulative impacts on the habitat of Ute ladies'-tresses.

The overall improvement in wetlands (see Section 3.22.3) may be beneficial to some special-status species that depend on wetlands. The overall improvement in riparian habitat (see Section 3.22.3) may be beneficial for two special status species of birds occurring in the impact area of influence, the common yellowthroat and the yellow-breasted chat.

3.22.6.2 No Action Alternative

Same as for the Proposed Action.

3.22.7 Soils

3.22.7.1 Proposed Action

The Diamond Fork Campground modifications, relocation of Springville Crossing-Rays Valley Road, and the Diamond Fork Dispersed Camping Management Plan are expected to have a net positive impact on soils by reducing erosion and soil compaction, especially in riparian areas.

3.22.7.2 No Action Alternative

The cumulative impacts would be the same as under the Proposed Action.
Same as for the Proposed Action.

3.22.8 Recreation

3.22.8.1 Proposed Action

Diamond Fork Campground modifications and the Diamond Fork Dispersed Camping Management Plan would result in fewer campsites in Diamond Fork.

3.22.8.2 No Action Alternative

Same as for the Proposed Action.

3.22.9 Visual Resources

3.22.9.1 Proposed Action

The overall cumulative impact on visual resources likely would be negligible from the Diamond Fork Campground modifications, the Mitigation Commission's Sixth Water and Diamond Fork Creek restoration plan, Diamond Fork Dispersed Camping Management Plan, relocation of Springville Crossing-Rays Valley Road, and Syar Tunnel Guard Gate.

Although overall cumulative impact on visual resources is likely to be negligible, riparian habitat improvements under the campground modification, the dispersed camping management projects and the Mitigation Commission's restoration plan would improve visual resources along Diamond Fork Creek. This could help offset some of the adverse impacts resulting from construction and operation of the Proposed Action and the Syar Tunnel guard gate.

Relocating Springville Crossing-Rays Valley Road and obliterating and reclaiming the existing road would cause significant adverse visual impacts in an area currently designated "retention" by the Forest Service. Relocation of the road potentially could occur at the same time as the Proposed Action.

3.22.9.2 No Action Alternative

Same as for the Proposed Action.

3.22.10 Transportation Resources

3.22.10.1 Proposed Action

An adverse cumulative impact on transportation resources would result if construction of the Springville Crossing-Rays Valley Road were done during construction of the Proposed Action because public access to Springville Crossing and Upper Diamond Fork Road would be limited to the Right Fork of Hobble Creek Road. However, no schedule has yet been determined for this work.

3.22.10.2 No Action Alternative

Same as for the Proposed Action.

3.23 Short-Term Use of Man's Environment Versus Maintenance of Long-Term Productivity

3.23.1 Introduction

This section is provides a broad overview of the effect that construction and implementation of the Proposed Action would have on the long-term productivity of man's environment. This section discusses the tradeoffs (short-term impacts) and benefits (long-term productivity impacts) associated with the Proposed Action. Tradeoffs are adverse impacts that occur during the 3½-year construction period and benefits are positive impacts that occur over the life of the project. All discussions are based on significant impacts remaining after implementation of mitigation measures.

3.23.2 Trade-Offs

- Temporary increase in turbidity
- Temporary disturbance of 2.01 acres of wetlands
- Temporary disturbance of 53.3 acres of critical winter range for deer and elk
- Potential disturbance of golden eagle nesting
- High potential to affect 9.69 habitat acres along Diamond Fork Creek and 2,087 flowering plants along Diamond Fork Creek and Spanish Fork River of Ute ladies'-tresses
- Potential increased predation from brown trout on leatherside chub
- Loss of production on 6 acres of soil permanently removed by facilities
- Increased erosion along the Spanish Fork River
- Temporary loss of use of 76 dispersed camping sites
- Temporary impact on the solitude characteristic of the Red Mountain and Diamond Fork roadless areas
- Possible elimination of area from roadless classification (4.1 acres in Red Mountain Roadless Area and 1.3 acres in Diamond Fork Roadless Area)
- Potential temporary increase in risk of accidents resulting in serious injuries or death
- Reduction in visual quality in areas of project facilities
- Temporary localized exceedance of the PM_{10} standard

3.23.3 Benefits

- Maintenance of Utah Lake water levels in accordance with the state engineer's plan of operation
- Ensures meeting water delivery contracts for municipal and industrial purposes from Jordanelle Reservoir

- Improved flows in Sixth Water and Diamond Fork creeks, and Spanish Fork River
- Reduced turbidity
- Overall reduced suspended and bedload sediment (52,765 tons per year)
- Increased acres, condition and values of wetlands and riparian vegetation
- Improved aquatic habitat conditions
- Increase of 15,949 pounds of trout production
- Decreased erosion along Sixth Water and Diamond Fork creeks
- Increase of 33,286 angler days per year on Sixth Water and Diamond Fork creeks
- Improved fishing opportunities

3.24 Irreversible and Irretrievable Commitment of Resources

3.24.1 Introduction

This section identifies resources that would be irreversibly (cannot be reversed, repealed or annulled) or irretrievably (cannot be retrieved, recovered, restored or recalled) committed to the project after all mitigation measures are applied.

3.24.2 Proposed Action

Use of the following resources would be irreversible and irretrievable:

- Materials used during construction (see Table 1-22, in Section 1.7.4 of Chapter 1)
- An unknown amount of fuel that would be consumed during construction and operation
- Funds used for project construction and operation (approximate construction cost of the Proposed Action is $62 million)

The following resources lost during the 3½-year construction period or the life of the project would be irretrievable:

- The possible loss of nesting habitat for bald and golden eagles
- The loss of 5.8 acres of grazing land for the life of the project
- The loss of fishing, dispersed camping (on 76 sites), and picnicking opportunities during construction
- The loss of 5.4 acres of roadless area for the life of the project
- The temporary loss of 2.01 acres of wetlands during construction

Any loss of life due to traffic accidents resulting from road closures and increased traffic during construction would be irreversible and irretrievable.

3.24.3 No Action Alternative

Use of the following resources would be irreversible and irretrievable:

- Materials used during construction (see Table 1-23, in Section 1.7.4 of Chapter 1)
- An unknown amount of fuel that would be consumed during construction and operation
- Funds used for project construction and operation (approximate construction cost of the No Action Alternative is $56 million)
- The loss of 6.9 acres of soil to a rock spoil area

The following resources lost during the 3-year construction period or the life of the project would be irretrievable:

- The possible loss of nesting habitat for bald and golden eagles
- The loss of 23.2 acres of grazing land for the life of the project
- The loss of fishing, dispersed camping (on 50 sites), and picnicking opportunities during the construction period
- The loss of stream aquatic resources on 1.3 miles of stream for the life of the project
- The loss of stream fishing opportunities on 1.3 miles of stream for the life of the project
- The loss of 29.6 acres of roadless area for the life of the project
- The temporary loss of 9 acres of wetlands during construction

Any loss of life due to traffic accidents resulting from road closures and increased traffic during construction would be irreversible and irretrievable.